

Supplementary Material

***Rhytiphora*: a phylogenetic and morphological study of Australia's largest longhorn beetle genus (Coleoptera: Cerambycidae)**

Lauren G. Ashman^{A,B,*}, *Diana Hartley*^B, *Mengjie Jin*^{B,C}, *David M. Rowell*^A, *Luisa Teasdale*^{B,D},
Adam Słipin'ski^B and *Andreas Zwick*^B

^AResearch School of Biology, Australian National University, Canberra, ACT 2601, Australia

^BAustralian National Insect Collection, CSIRO, Canberra, ACT 2601, Australia

^CState Key Laboratory of Biocontrol, School of Ecology, Sun Yat-Sen University, Guangzhou, 510275, PR China

^DMax Planck Institute for Developmental Biology, D-72076 Tübingen, Germany

*Correspondence to: Email: lauren.g.ashman@gmail.com

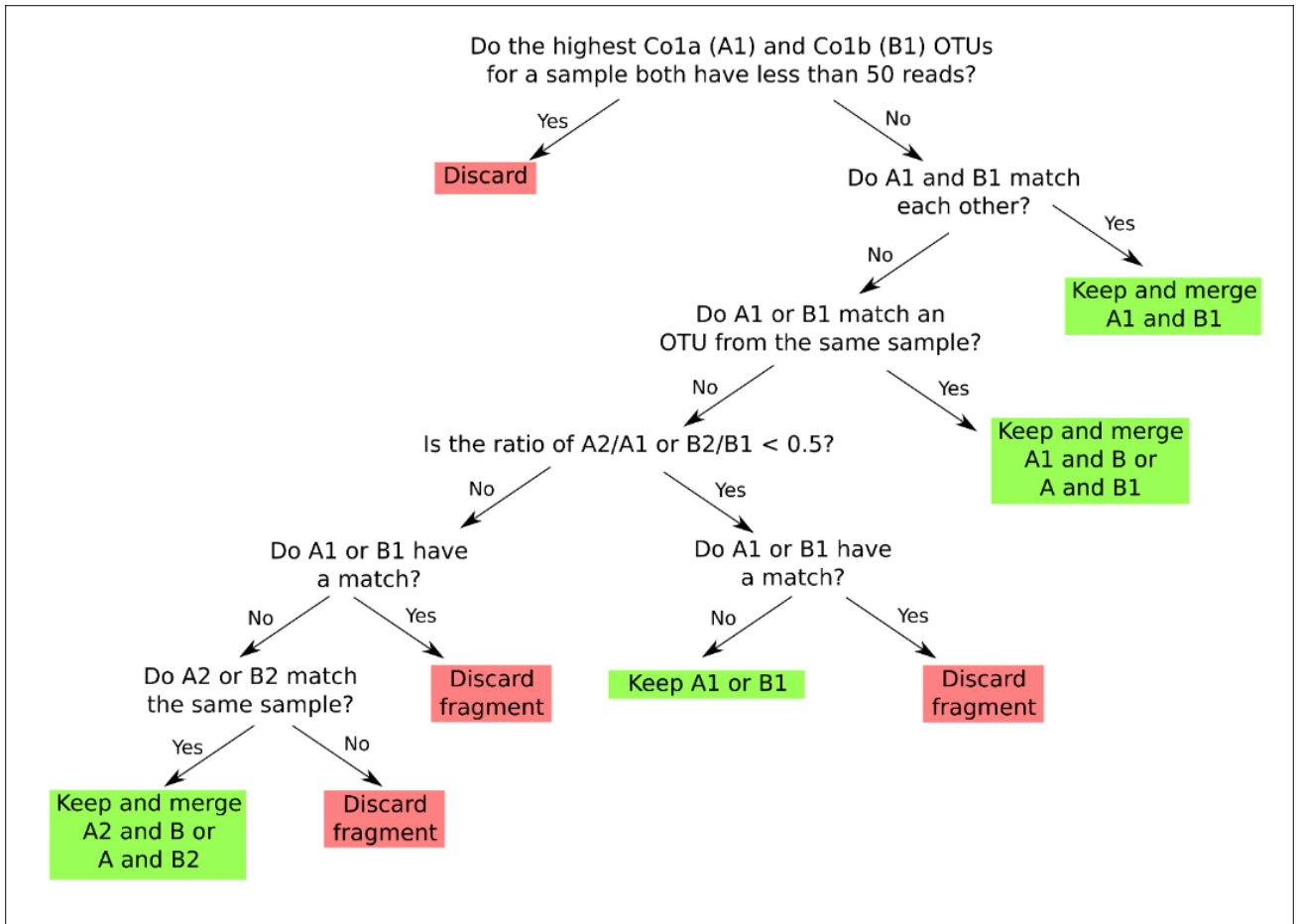


Figure S1. Flowchart of the decision-maker algorithm used to generate the final COI sequences. A1 and B1 refer to the CR and BF fragments of the COI gene that were amplified and analysed separately.

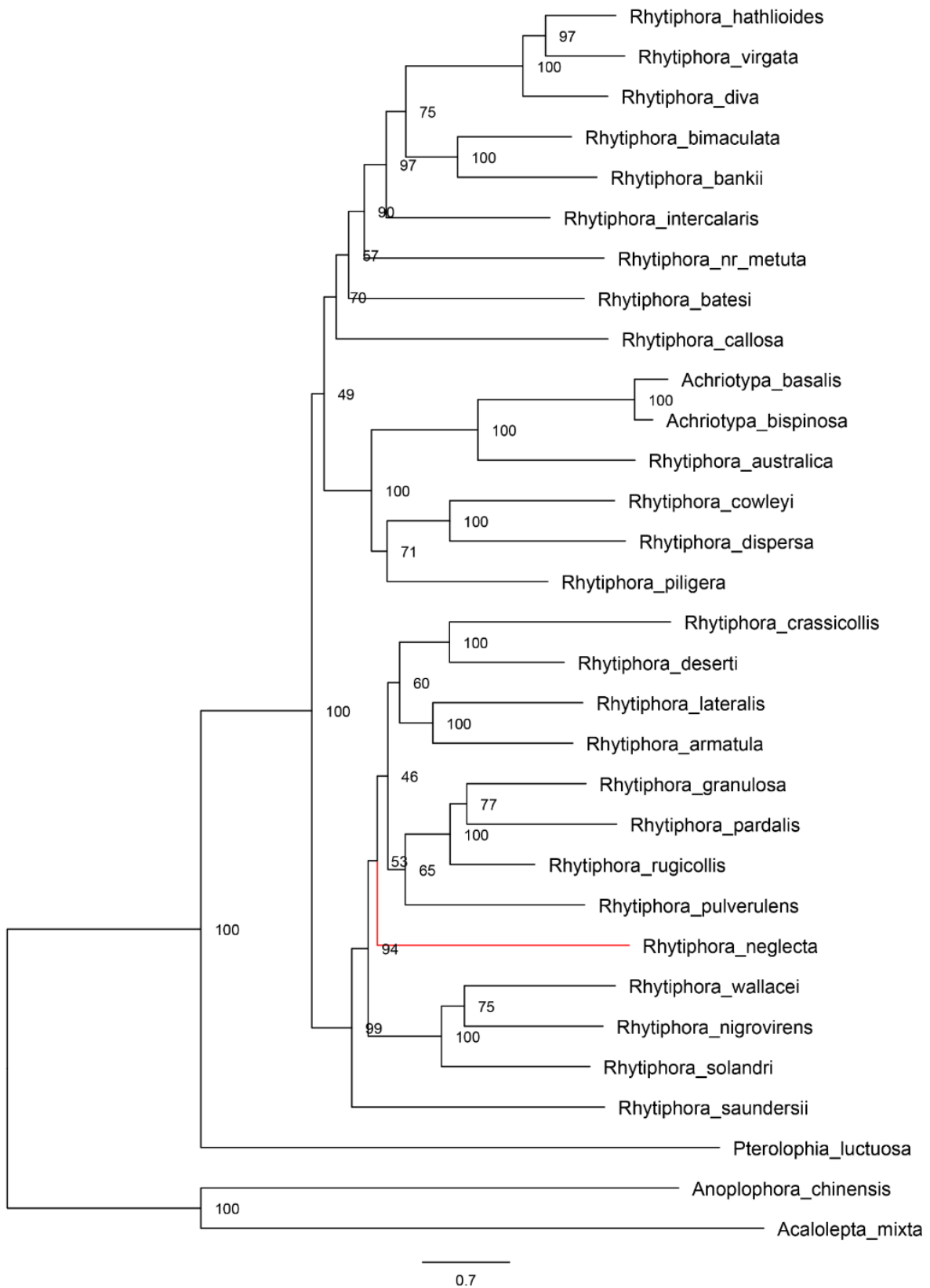


Figure S2. Maximum likelihood phylogeny of *Rhytiphora*: partitioned IQ-TREE analysis of the core nucleotide dataset. Branch supports are bootstrap values and the scale bar is nucleotide sequence change per million years. Rogue taxa are coloured red.

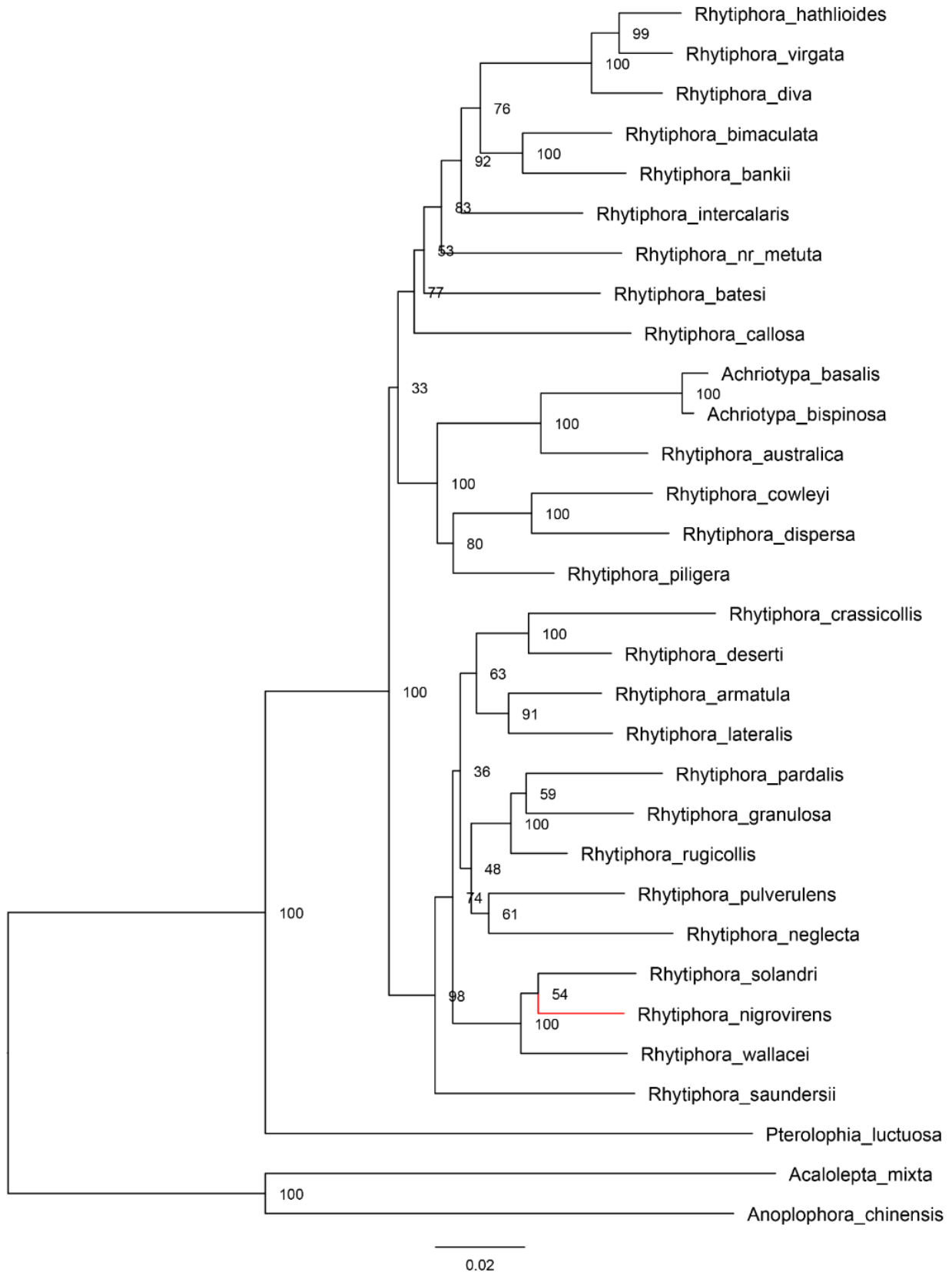


Figure S3. Maximum likelihood phylogeny of *Rhytiphora*: partitioned IQ-TREE analysis of the core degeneracy-recoded nucleotide dataset. Branch supports are bootstrap values and the scale bar is nucleotide sequence change per million years. Rogue taxa are coloured red.

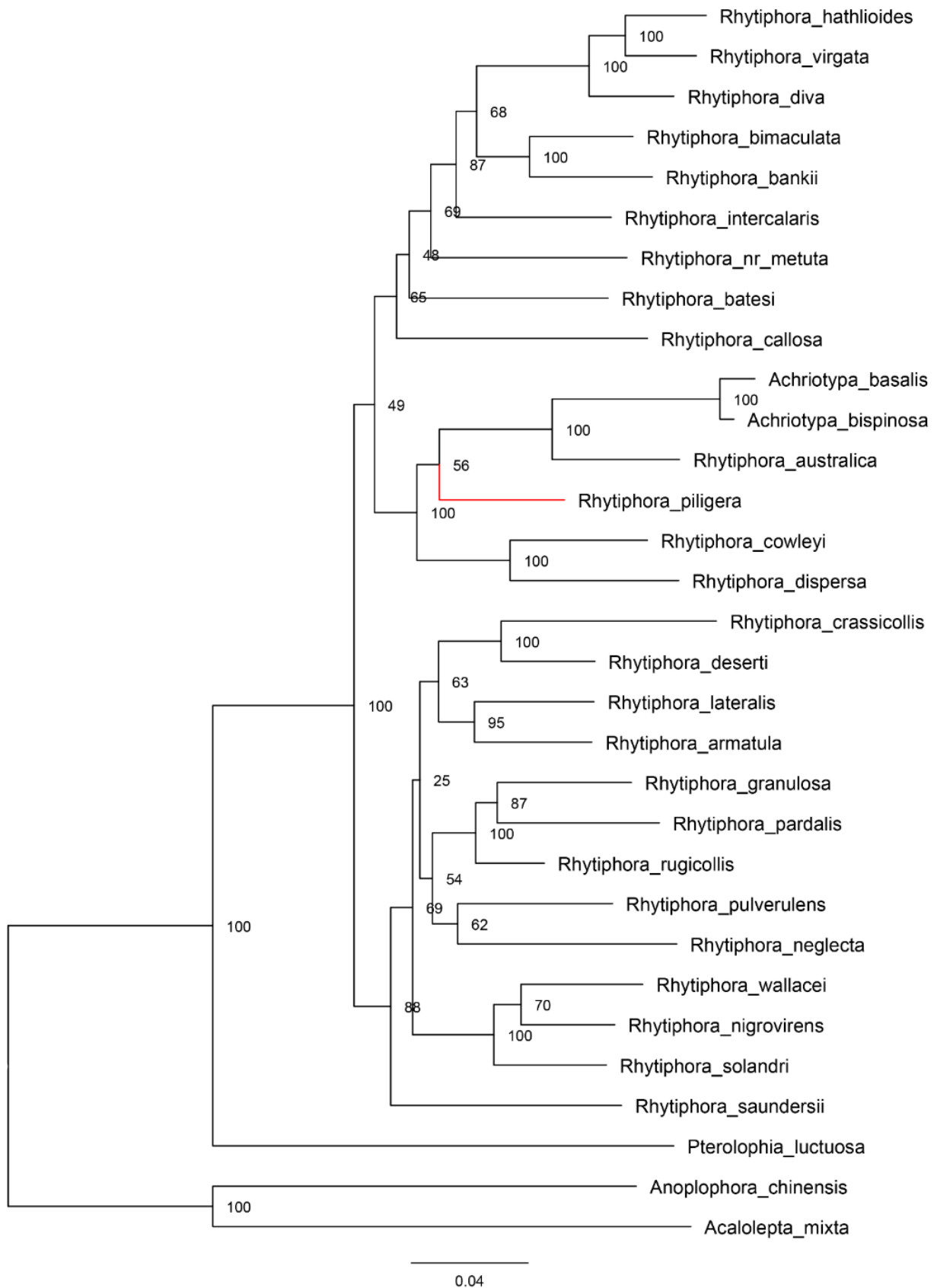


Figure S4. Maximum likelihood phylogeny of *Rhytiphora*: partitioned IQ-TREE analysis of the core amino acid dataset. Branch supports are bootstrap values and the scale bar is sequence change per million years. Rogue taxa are coloured red.

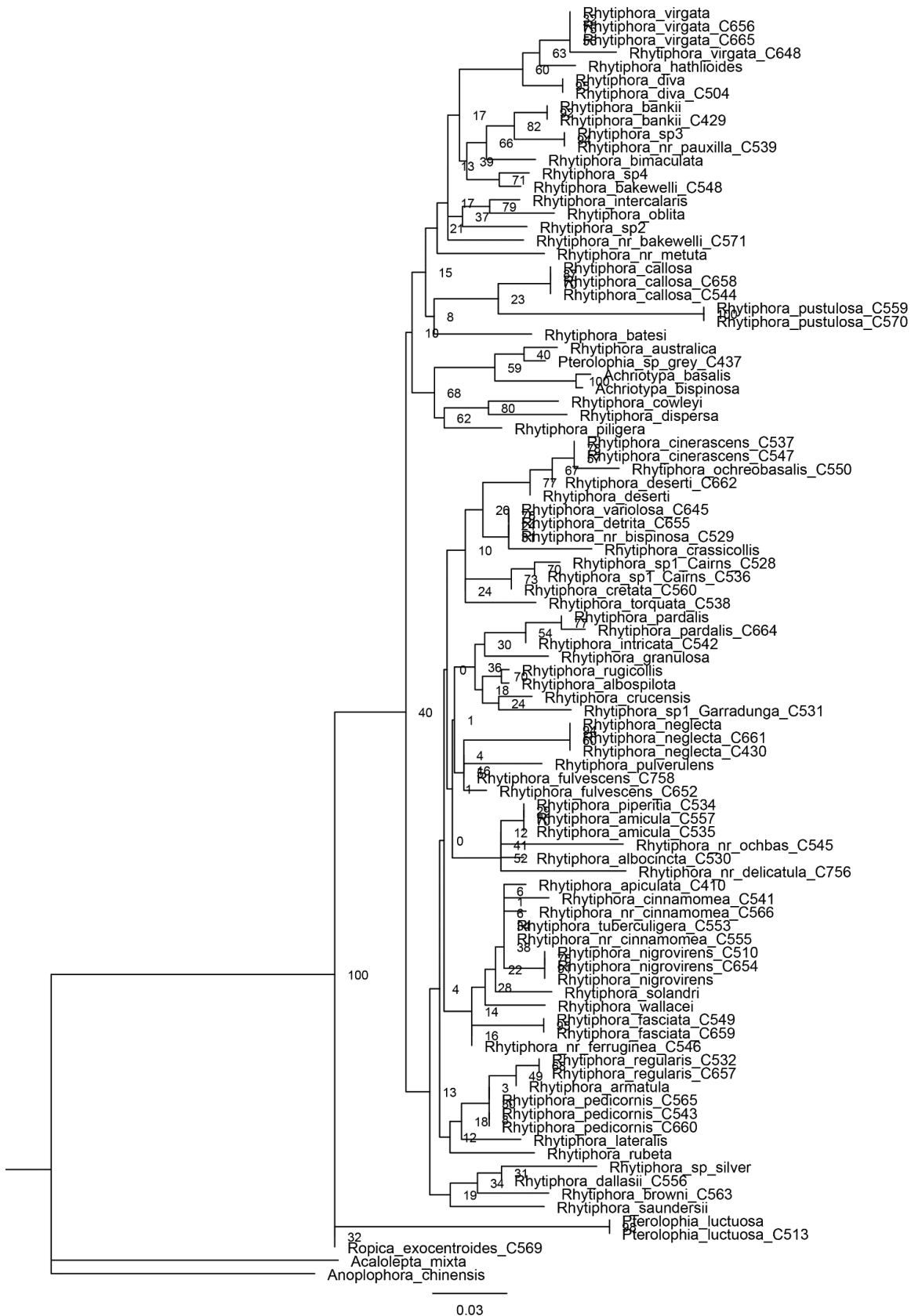


Figure S5. Maximum likelihood phylogeny of *Rhytiphora*: partitioned IQ-TREE analysis of the expanded degeneracy-recoded nucleotide dataset. Branch supports are bootstrap values and the scale bar is nucleotide sequence change per million years.

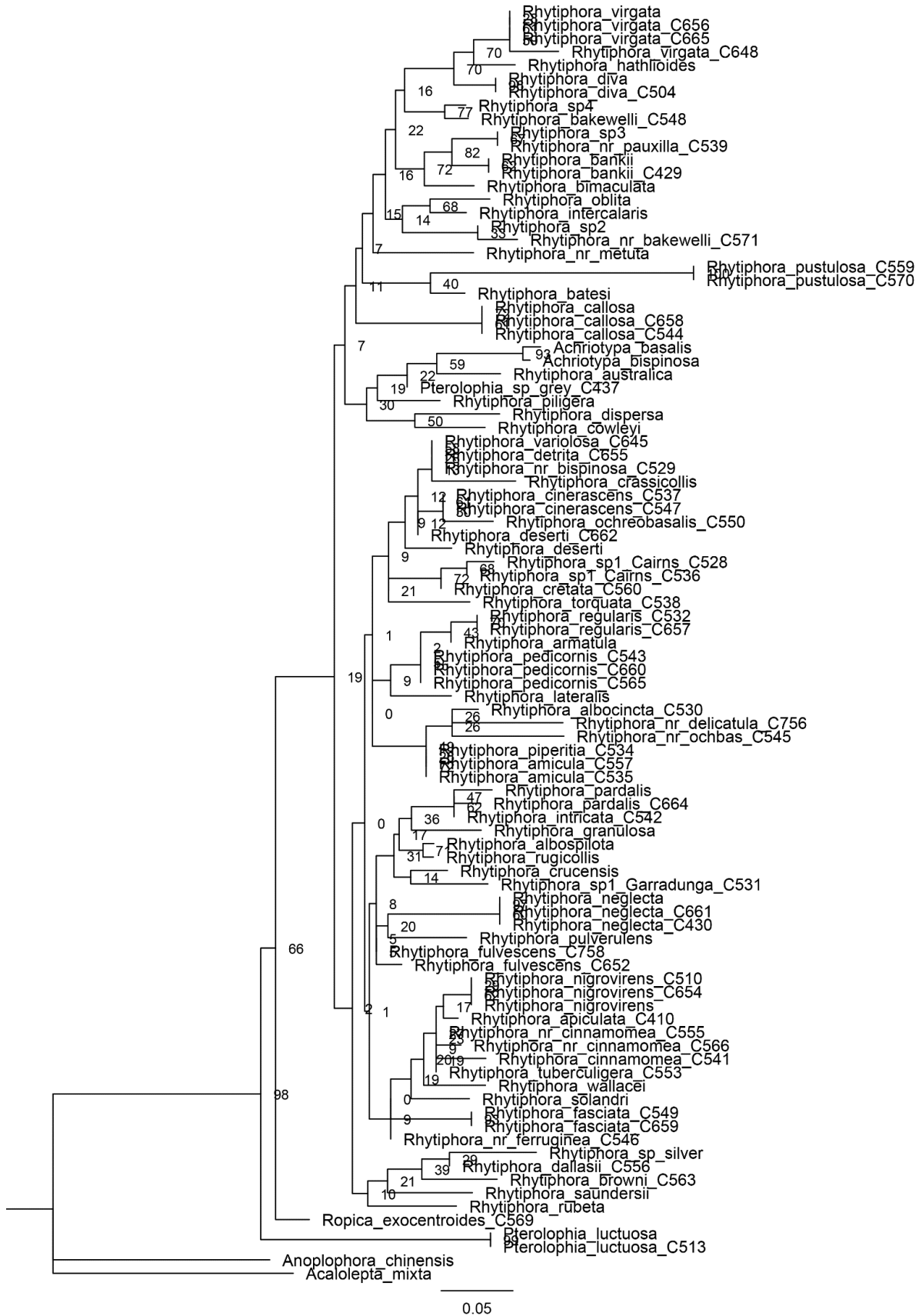


Figure S6. Maximum likelihood phylogeny of *Rhytiphora*: partitioned IQ-TREE analysis of the expanded amino acid dataset. Branch supports are bootstrap values and the scale bar is sequence change per million years.

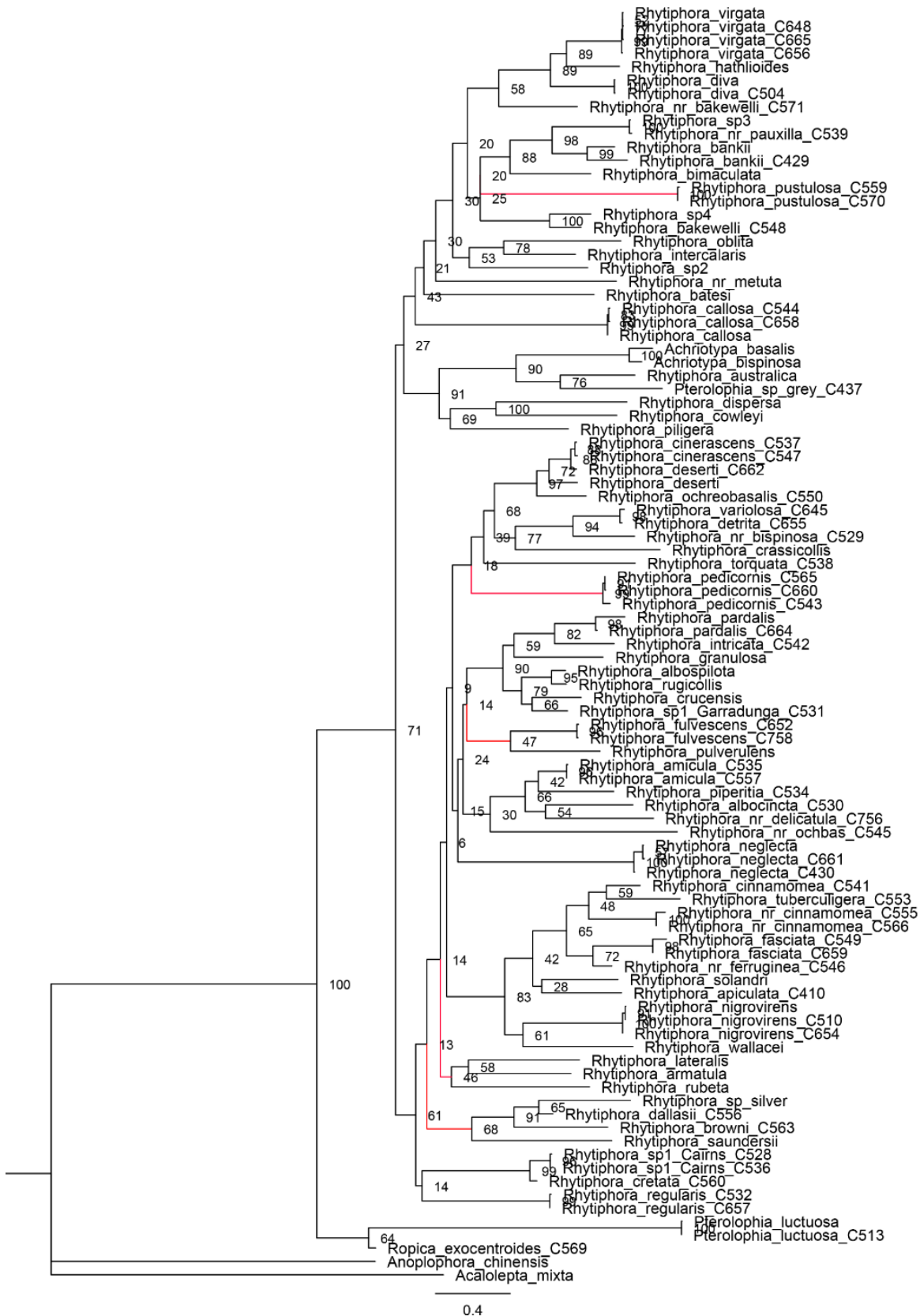


Figure S7. Maximum likelihood phylogeny of *Rhytiphora*: partitioned IQ-TREE analysis of the expanded nucleotide dataset (tree search #149). Branch supports are bootstrap values and the scale bar is nucleotide sequence change per million years. Rogue taxa are coloured red.

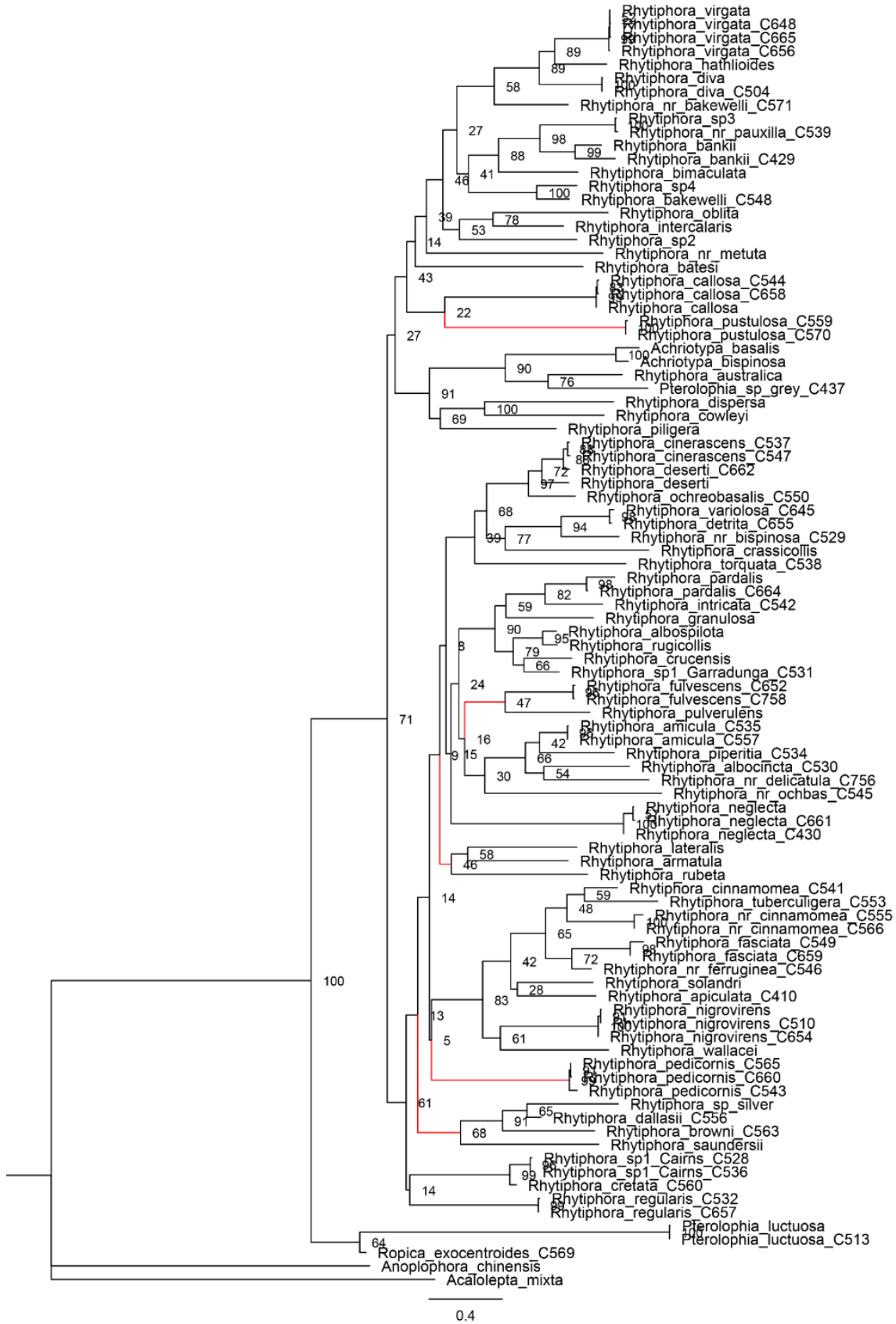


Figure S8. Maximum likelihood phylogeny of *Rhytiphora*: partitioned IQ-TREE analysis of the expanded nucleotide dataset (tree search #201). Branch supports are bootstrap values and the scale bar is nucleotide sequence change per million years. Rogue taxa are coloured red.

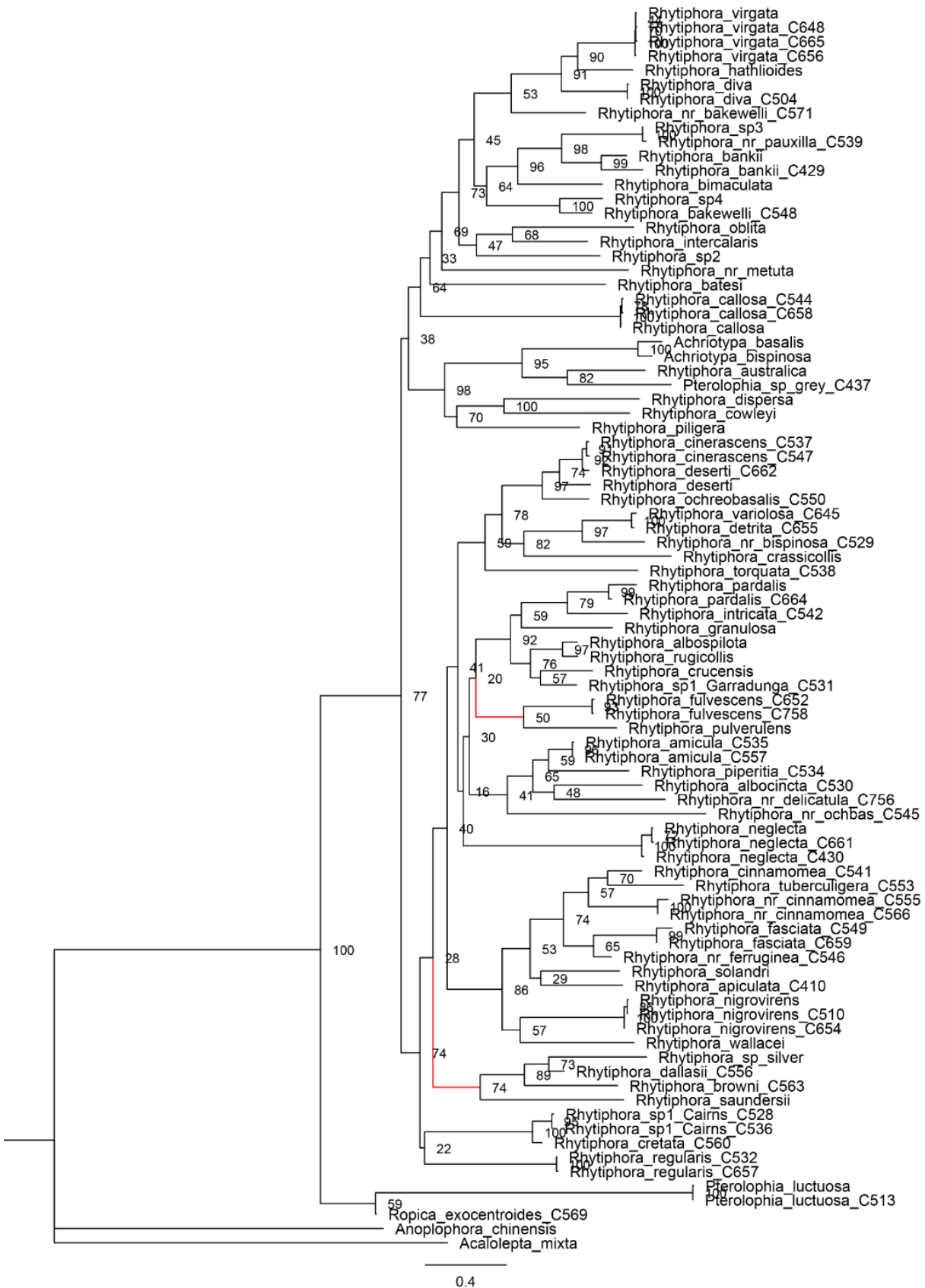


Figure S9. Maximum likelihood phylogeny of *Rhytiphora*: partitioned IQ-TREE analysis of the expanded nucleotide dataset with eight rogue taxa removed. Branch supports are bootstrap values and the scale bar is nucleotide sequence change per million years. Rogue taxa are coloured red.

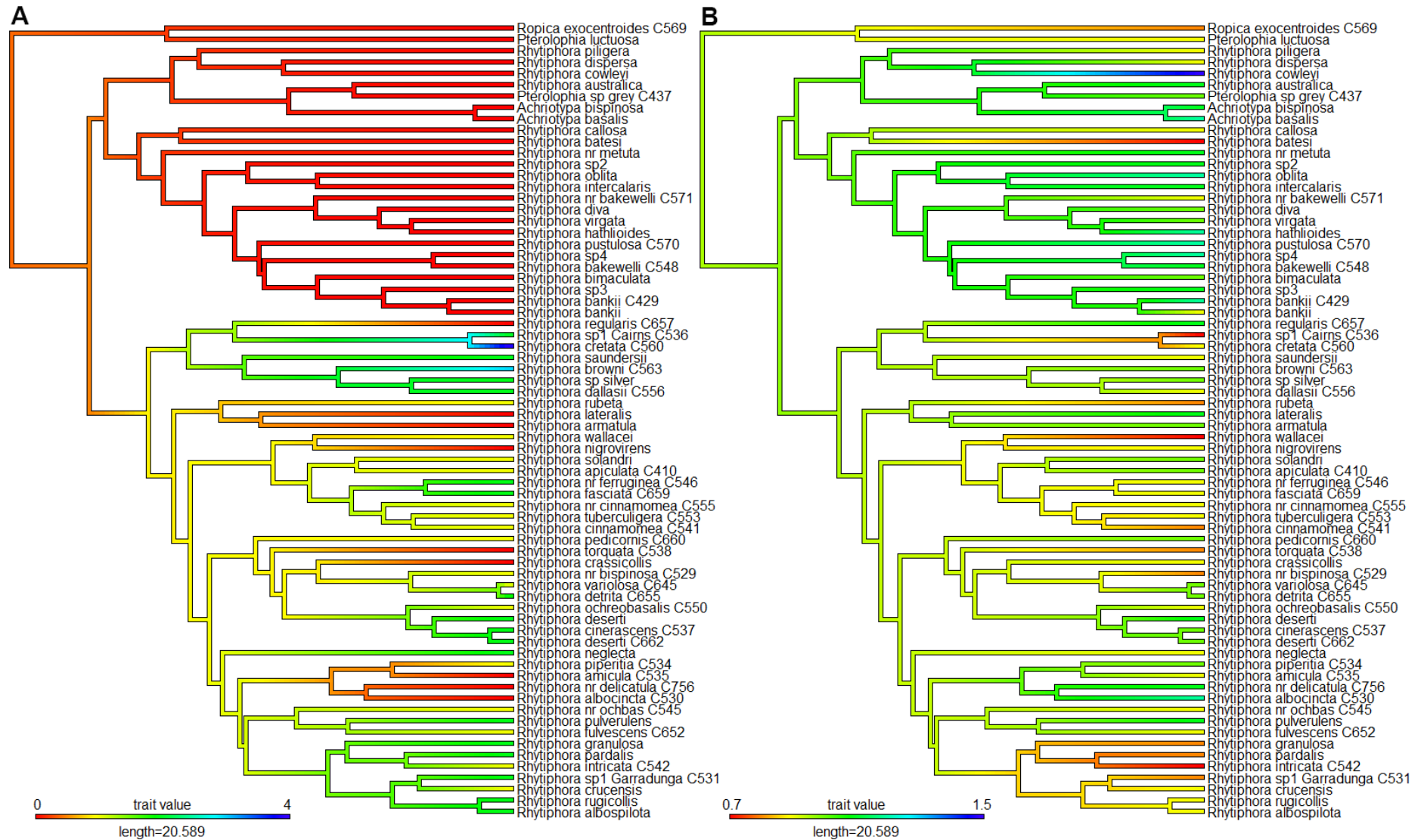


Figure S10. Ancestral morphological trait estimation of *Rhytiphora*: ancestral states reconstructed using APE on the dated BEAST phylogeny. **A:** Analysis of eye row number (ommatidia joining two lobes). **B:** Analysis of eye upper lobe length (maximum length, vertex to frons, divided by antennal socket length).

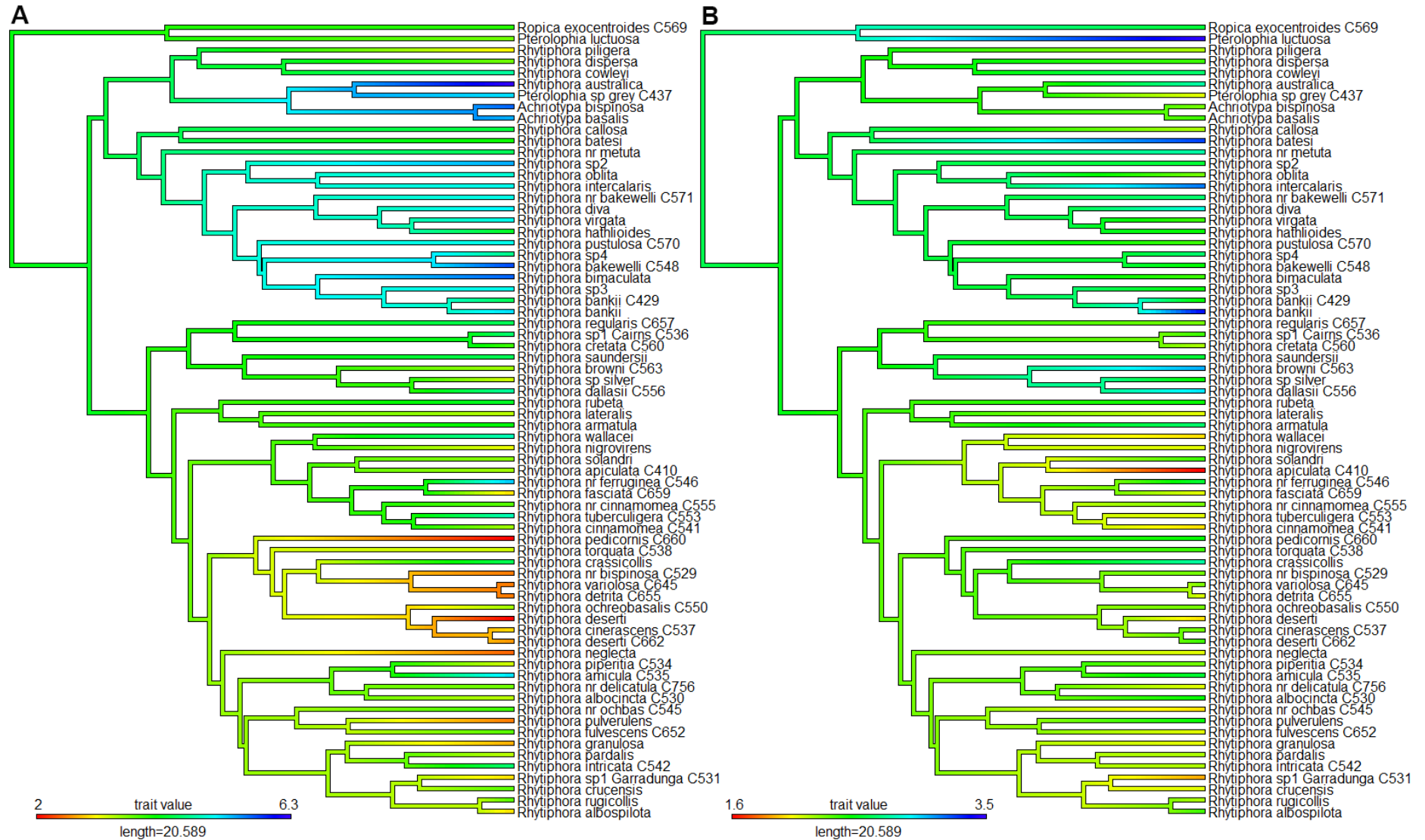


Figure S11. Ancestral morphological trait estimation of *Rhytiphora*: ancestral states reconstructed using APE on the dated BEAST phylogeny. **A:** Analysis of antennal separation (distance between antennal socket inner rims divided by socket width). **B:** Analysis of scape shape (length divided by width).

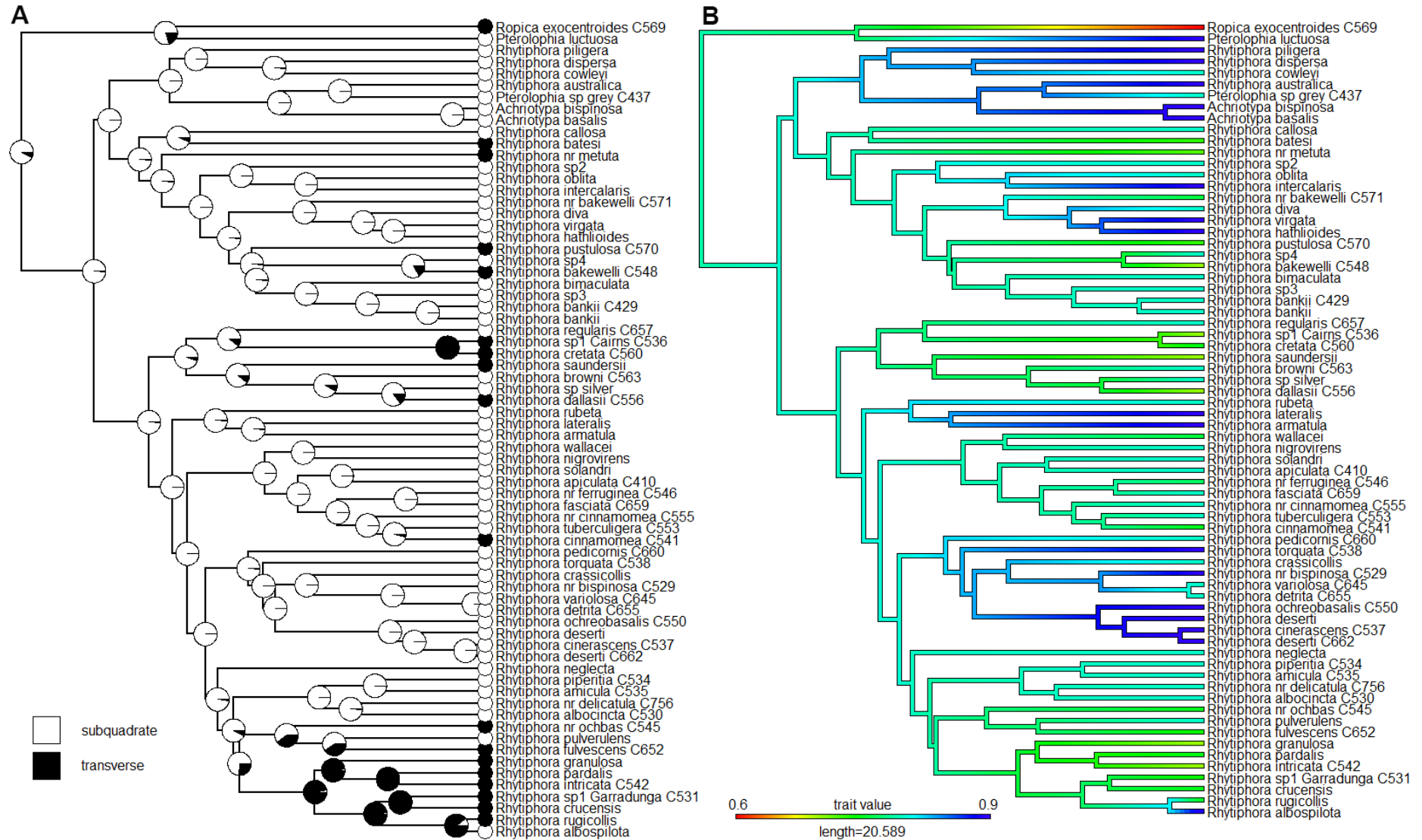


Figure S12. Ancestral morphological trait estimation of *Rhytiphora*: ancestral states reconstructed using APE on the dated BEAST phylogeny. **A:** Analysis of pronotum type, coded as subquadrate (≥ 0.76 length:width) or transverse (≤ 0.75 length:width). **B:** Analysis of pronotum shape (length divided by width).

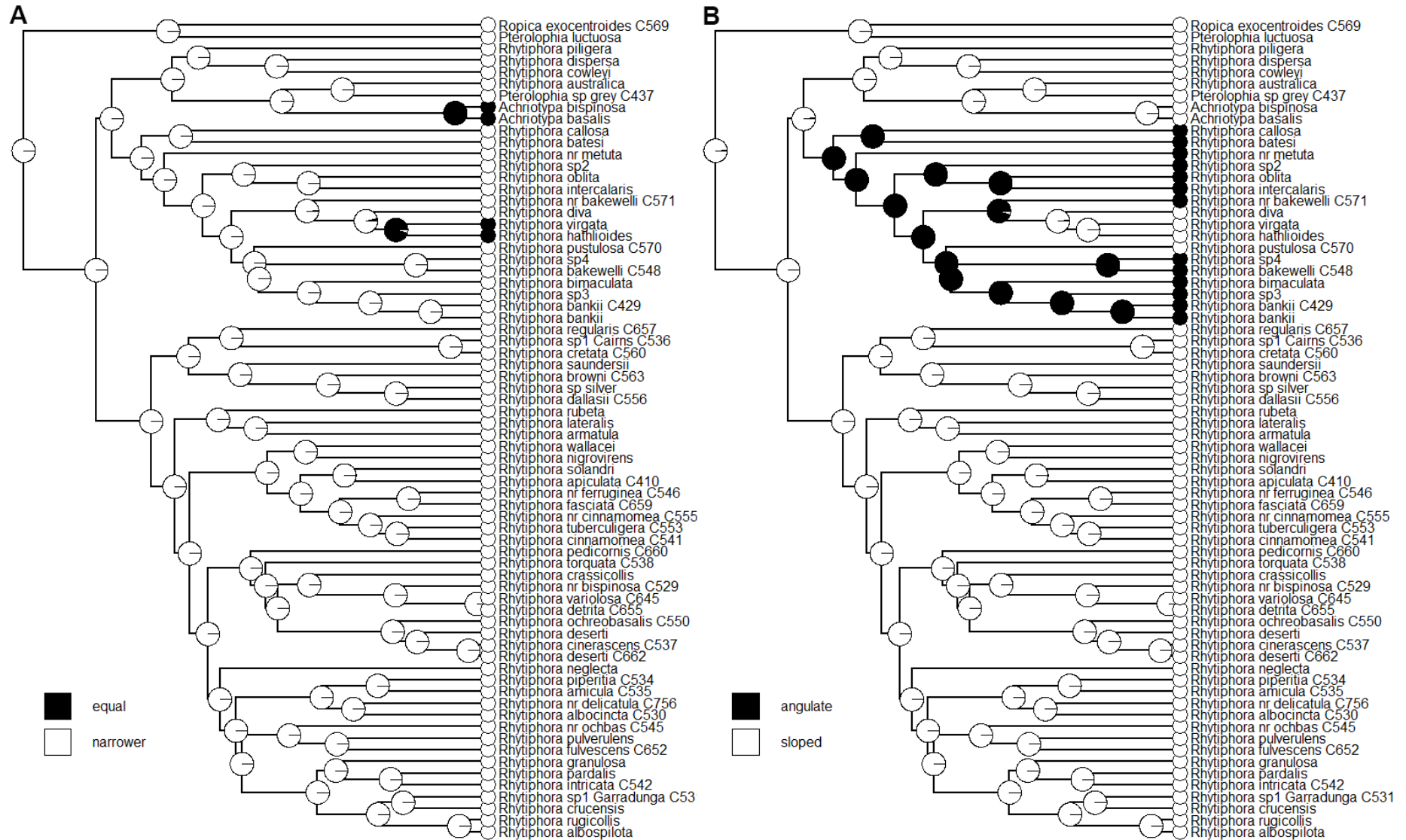


Figure S13. Ancestral morphological trait estimation of *Rhytiphora*: ancestral states reconstructed using APE on the dated BEAST phylogeny. **A:** Analysis of pronotum v. elytra width, coded as equal or narrower (i.e. projecting humeral angles). **B:** Analysis of mesoventrite, coded as angulate (*Prosoplus*) or sloped.

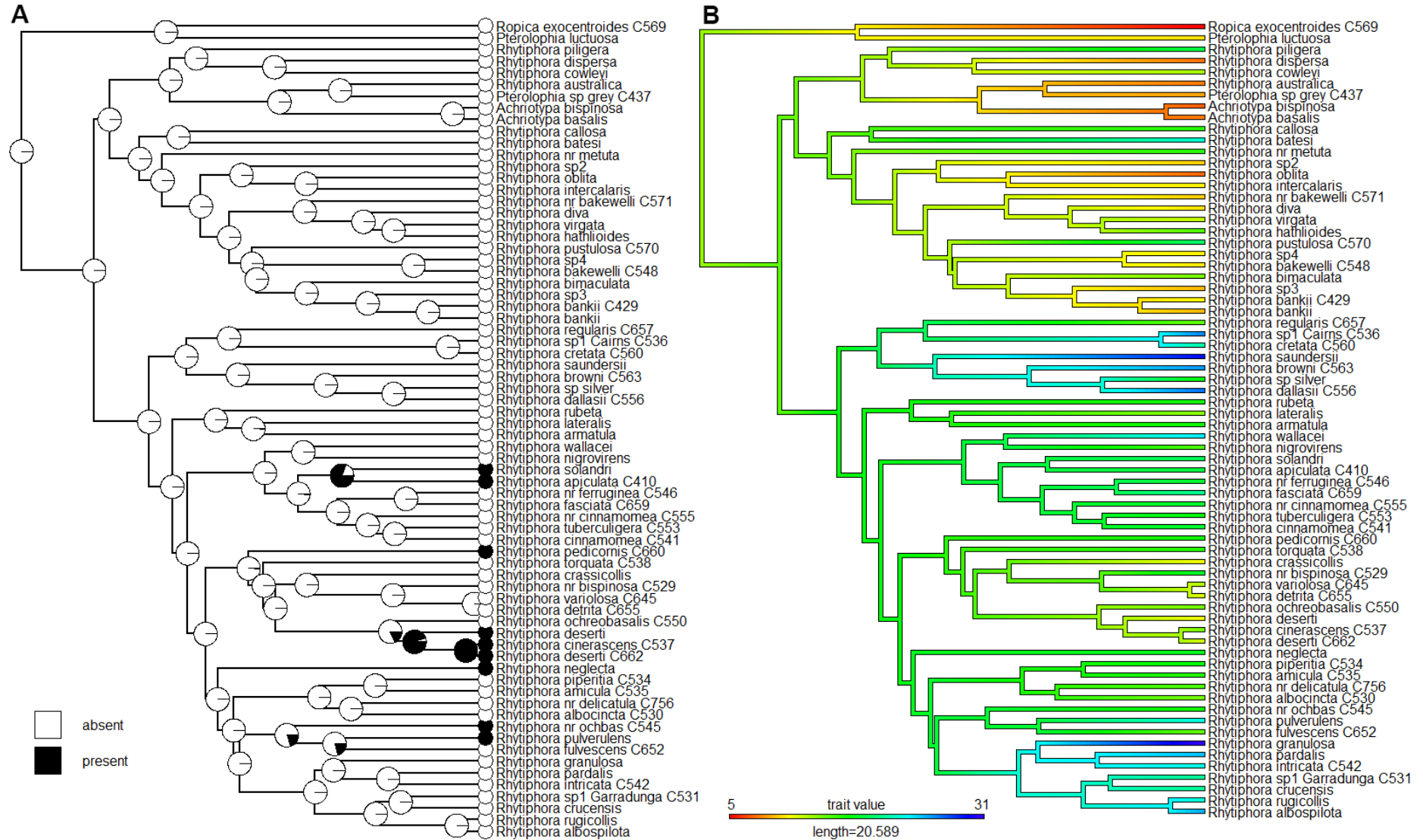


Figure S14. Ancestral morphological trait estimation of *Rhytiphora*: ancestral states reconstructed using APE on the dated BEAST phylogeny. **A:** Analysis of male protibial tubercles, coded as present or absent. **B:** Analysis of mean body size (average of minimum and maximum recorded body size, mm).

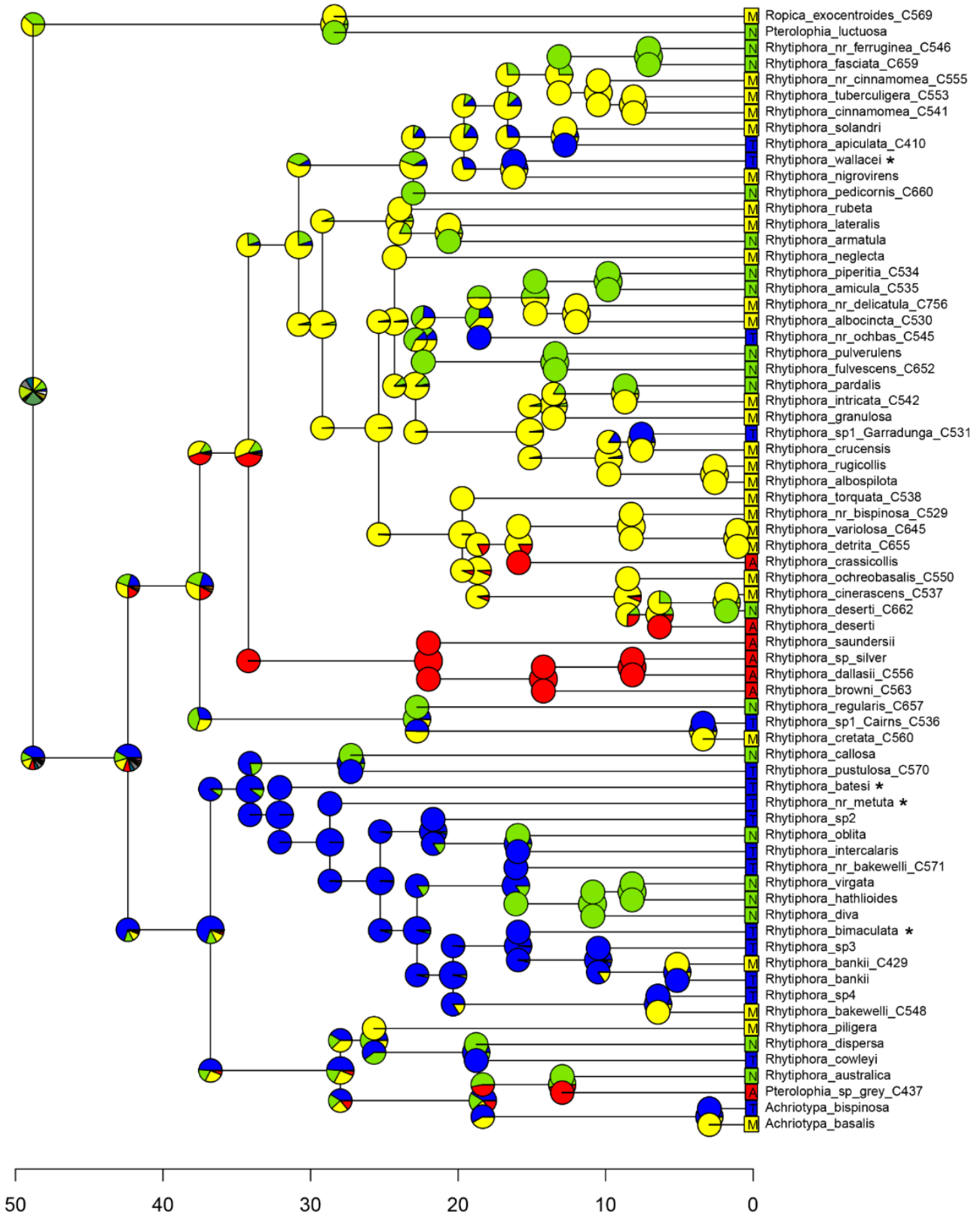


Figure S15. Ancestral geographic range estimation of *Rhytiphora*: ancestral states reconstructed using BioGeoBEARS under the DIVALIKE+J model on the alternate topology. Scale bar is in millions of years (Ma). Biomes are labelled as follows: wet tropics (T) is blue, with New Guinean species indicated by an asterisk (*); monsoonal tropics (N) is green; mesic (M) is yellow; arid zone (A) is red.

Table S1. List of 94 Lamiinae specimens sequenced for phylogenetic analyses.

Accession number	Genus	Species	Locality	Specimen condition	Dataset	Number of genes	Original genus
25-066410	<i>Rhytiphora</i>	<i>apiculata</i>	Qld	Ethanol	Expanded	1	<i>Platyomopsis</i>
25-066429	<i>Rhytiphora</i>	<i>bankii</i>	Qld	Ethanol	Expanded	1	<i>Lamia/Niphona/Prosoplus</i>
25-066430	<i>Rhytiphora</i>	<i>neglecta</i>	Qld	Ethanol	Expanded	1	<i>Symphyletes</i>
25-066437	<i>Pterolophia</i>	'grey sp.'	Qld	Ethanol	Expanded	1	NA
25-066504	<i>Rhytiphora</i>	<i>diva</i>	WA	Ethanol	Expanded	1	<i>Zygrita</i>
25-066510	<i>Rhytiphora</i>	<i>nigrovirens</i>	no label	Ethanol	Expanded	1	<i>Saperda</i>
25-066513	<i>Pterolophia</i>	<i>luctuosa</i>	Qld	Ethanol	Expanded	1	<i>Lychrosia/Mycerinus</i>
25-066528	<i>Rhytiphora</i>	'sp1 from Cairns'	Qld	Ethanol	Expanded	1	NA
25-066529	<i>Rhytiphora</i>	'sp. near <i>bispinosa</i> '	Qld	Ethanol	Expanded	1	NA
25-066530	<i>Rhytiphora</i>	<i>albocincta</i>	Qld	Ethanol	Expanded	1	<i>Rhytiphora/Saperda/Symphyletes</i>
25-066531	<i>Rhytiphora</i>	'sp1 from Garradunga'	Qld	Ethanol	Expanded	1	NA
25-066532	<i>Rhytiphora</i>	<i>regularis</i>	WA	Ethanol	Expanded	1	<i>Platyomopsis</i>
25-066534	<i>Rhytiphora</i>	<i>piperita</i>	WA	Ethanol	Expanded	1	<i>Rhytiphora/Symphyletes</i>
25-066535	<i>Rhytiphora</i>	<i>amicula</i>	WA	Ethanol	Expanded	1	<i>Rhytiphora</i>
25-066536	<i>Rhytiphora</i>	'sp1 from Cairns'	Qld	Ethanol	Expanded	1	NA
25-066537	<i>Rhytiphora</i>	<i>cinerascens</i>	Qld	Ethanol	Expanded	1	<i>Platyomopsis</i>
25-066538	<i>Rhytiphora</i>	<i>torquata</i>	Qld	Ethanol	Expanded	1	<i>Symphyletes</i>
25-066539	<i>Rhytiphora</i>	'sp. near <i>pauzilla</i> '	Qld	Ethanol	Expanded	1	NA
25-066541	<i>Rhytiphora</i>	<i>cinnamomea</i>	Qld	Ethanol	Expanded	1	<i>Symphyletes</i>
25-066542	<i>Rhytiphora</i>	<i>intricata</i>	WA	Ethanol	Expanded	1	<i>Penthea</i>
25-066543	<i>Rhytiphora</i>	<i>pedicornis</i>	Qld	Ethanol	Expanded	1	<i>Lamia/Rhytiphora</i>
25-066544	<i>Rhytiphora</i>	<i>callosa</i>	Qld	Ethanol	Expanded	1	<i>Menyllus/Sysspilotus</i>
25-066545	<i>Rhytiphora</i>	'sp. near <i>ochreobasalis</i> '	Qld	Ethanol	Expanded	1	NA
25-066546	<i>Rhytiphora</i>	'sp. near <i>ferruginea</i> '	Qld	Ethanol	Expanded	1	NA
25-066547	<i>Rhytiphora</i>	<i>cinerascens</i>	Qld	Ethanol	Expanded	1	<i>Platyomopsis</i>
25-066548	<i>Rhytiphora</i>	<i>bakewelli</i>	Qld	Ethanol	Expanded	1	<i>Niphona</i> (moved to <i>Prosoplus</i>)
25-066549	<i>Rhytiphora</i>	<i>fasciata</i>	Qld	Ethanol	Expanded	1	<i>Symphyletes</i>
25-066550	<i>Rhytiphora</i>	<i>ochreobasalis</i>	Qld	Ethanol	Expanded	1	<i>Saperdopsis</i>
25-066553	<i>Rhytiphora</i>	<i>tuberculigera</i>	Qld	Ethanol	Expanded	1	<i>Platyomopsis</i>
25-066555	<i>Rhytiphora</i>	'sp. near <i>cinnamomea</i> '	WA	Ethanol	Expanded	1	NA
25-066556	<i>Rhytiphora</i>	<i>dallasii</i>	WA	Ethanol	Expanded	1	<i>Rhytiphora</i>
25-066557	<i>Rhytiphora</i>	<i>amicula</i>	WA	Ethanol	Expanded	1	<i>Rhytiphora</i>
25-066559	<i>Rhytiphora</i>	<i>pustulosa</i>	Qld	Ethanol	Expanded	1	<i>Rhytiphora/Symphyletes</i>
25-066560	<i>Rhytiphora</i>	<i>cretata</i>	no label	Ethanol	Expanded	1	<i>Rhytiphora</i>
25-066563	<i>Rhytiphora</i>	<i>browni</i>	WA	Ethanol	Expanded	1	<i>Rhytiphora</i>
25-066565	<i>Rhytiphora</i>	<i>pedicornis</i>	NT	Ethanol	Expanded	1	<i>Lamia/Rhytiphora</i>
25-066566	<i>Rhytiphora</i>	'sp. near <i>cinnamomea</i> '	WA	Ethanol	Expanded	1	NA
25-066569	<i>Ropica</i>	<i>exocentroides</i>	Qld	Ethanol	Expanded	1	<i>Ropica</i>
25-066570	<i>Rhytiphora</i>	<i>pustulosa</i>	Qld	Ethanol	Expanded	1	<i>Rhytiphora/Symphyletes</i>
25-066571	<i>Rhytiphora</i>	'sp. near <i>bakewelli</i> '	Qld	Ethanol	Expanded	1	NA
25-066645	<i>Rhytiphora</i>	<i>variolosa</i>	Qld	Ethanol	Expanded	1	<i>Symphyletes</i>
25-066648	<i>Rhytiphora</i>	<i>virgata</i>	Qld	Ethanol	Expanded	1	<i>Hathliodes</i>
25-066652	<i>Rhytiphora</i>	<i>fulvescens</i>	Qld	Ethanol	Expanded	1	<i>Symphyletes</i>
25-066654	<i>Rhytiphora</i>	<i>nigrovirens</i>	Qld	Ethanol	Expanded	1	<i>Saperda</i>
25-066655	<i>Rhytiphora</i>	<i>detrita</i>	WA	Ethanol	Expanded	1	<i>Rhytiphora/Symphyletes</i>
25-066656	<i>Rhytiphora</i>	<i>virgata</i>	Qld	Ethanol	Expanded	1	<i>Hathliodes</i>
25-066657	<i>Rhytiphora</i>	<i>regularis</i>	NT	Ethanol	Expanded	1	<i>Platyomopsis</i>
25-066658	<i>Rhytiphora</i>	<i>callosa</i>	Qld	Ethanol	Expanded	1	<i>Menyllus/Sysspilotus</i>
25-066659	<i>Rhytiphora</i>	<i>fasciata</i>	Qld	Ethanol	Expanded	1	<i>Symphyletes</i>
25-066660	<i>Rhytiphora</i>	<i>pedicornis</i>	WA	Ethanol	Expanded	1	<i>Lamia/Rhytiphora</i>
25-066661	<i>Rhytiphora</i>	<i>neglecta</i>	Qld	Ethanol	Expanded	1	<i>Symphyletes</i>
25-066662	<i>Rhytiphora</i>	<i>deserti</i>	NT	Ethanol	Expanded	1	<i>Symphyletes</i>
25-066664	<i>Rhytiphora</i>	<i>pardalis</i>	Qld	Ethanol	Expanded	1	<i>Lamia/Penthea</i>
25-066665	<i>Rhytiphora</i>	<i>virgata</i>	Qld	Ethanol	Expanded	1	<i>Hathliodes</i>
25-066756	<i>Rhytiphora</i>	'sp. near <i>delicatula</i> '	Qld	Ethanol	Expanded	1	NA
25-066758	<i>Rhytiphora</i>	<i>fulvescens</i>	Qld	Ethanol	Expanded	1	<i>Symphyletes</i>
25-067037	<i>Acalolepta</i>	<i>mixta</i>	NT	Pinned	Core	13	<i>Monohammus</i>
25-067039	<i>Pterolophia</i>	<i>luctuosa</i>	Qld	Pinned	Core	13	<i>Lychrosia/Mycerinus</i>
25-067040	<i>Rhytiphora</i>	<i>bankii</i>	Christmas Is.	Pinned	Core	13	<i>Lamia/Niphona/Prosoplus</i>
25-067041	<i>Rhytiphora</i>	<i>intercalaris</i>	Qld	Pinned	Core	13	<i>Atyporis</i> (moved to <i>Prosoplus</i>)
25-067042	<i>Rhytiphora</i>	<i>cowleyi</i>	Qld	Pinned	Core	13	<i>Cairnsia</i>
25-067043	<i>Rhytiphora</i>	<i>hathlioides</i>	NT	Pinned	Core	13	<i>Xiphotheopsis</i>
25-067044	<i>Rhytiphora</i>	<i>virgata</i>	Qld	Pinned	Core	13	<i>Hathliodes</i>

Accession number	Genus	Species	Locality	Specimen condition	Dataset	Number of genes	Original genus
25-067046	<i>Rhytiphora</i>	<i>dispersa</i>	NT	Pinned	Core	9	<i>Notolophia</i>
25-067047	<i>Rhytiphora</i>	<i>diva</i>	Qld	Pinned	Core	13	<i>Zygria</i>
25-067048	<i>Rhytiphora</i>	<i>crassicollis</i>	NSW	Pinned	Core	13	<i>Penthea</i>
25-067051	<i>Rhytiphora</i>	<i>callosa</i>	Qld	Pinned	Core	13	<i>Menyllus/Sysspilotus</i>
25-067052	<i>Rhytiphora</i>	<i>armatula</i>	Qld	Pinned	Core	13	<i>Symphyletes</i>
25-067053	<i>Rhytiphora</i>	<i>lateralis</i>	Vic.	Pinned	Core	13	<i>Symphyletes</i>
25-067054	<i>Rhytiphora</i>	<i>deserti</i>	NT	Pinned	Core	13	<i>Symphyletes</i>
25-067055	<i>Rhytiphora</i>	<i>piligera</i>	Qld	Pinned	Core	13	<i>Acanthocinus/Symphyletes</i>
25-067057	<i>Rhytiphora</i>	<i>pulverulens</i>	NT	Pinned	Core	13	<i>Lamia/Symphyletes</i>
25-067058	<i>Rhytiphora</i>	<i>neglecta</i>	Qld	Pinned	Core	13	<i>Symphyletes</i>
25-067059	<i>Rhytiphora</i>	<i>solandri</i>	Qld	Pinned	Core	13	<i>Lamia</i>
25-067060	<i>Rhytiphora</i>	<i>nigrovirens</i>	Qld	Pinned	Core	13	<i>Saperda</i>
25-067061	<i>Rhytiphora</i>	<i>pardalis</i>	Qld	Pinned	Core	13	<i>Lamia/Penthea</i>
25-067063	<i>Rhytiphora</i>	<i>saundersii</i>	WA	Pinned	Core	13	<i>Penthea/Rhytiphora</i>
25-067065	<i>Rhytiphora</i>	<i>granulosa</i>	Qld	Pinned	Core	13	<i>Lamia</i>
25-067068	<i>Rhytiphora</i>	<i>rugicollis</i>	NSW	Pinned	Core	13	<i>Lamia/Rhytiphora</i>
25-067098	<i>Rhytiphora</i>	<i>australiana</i>	NT	Pinned	Core	13	<i>Pterolophia</i>
25-068441	<i>Rhytiphora</i>	<i>batesi</i>	PNG	Pinned	Core	12	<i>Eczemotes</i>
25-068448	<i>Rhytiphora</i>	<i>wallacei</i>	PNG	Pinned	Core	13	<i>Symphyletes</i>
25-068452	<i>Rhytiphora</i>	<i>bimaculata</i>	PNG	Pinned	Core	13	<i>Prosoplus</i>
25-068459	<i>Rhytiphora</i>	'sp. near metuta'	PNG	Pinned	Core	13	NA
25-068464	<i>Achriotypa</i>	<i>basalis</i>	NSW	Pinned	Core	9	<i>Achriotypa</i>
25-068466	<i>Achriotypa</i>	<i>bispinosa</i>	Qld	Pinned	Core	12	<i>Pterolophia</i>
25-073783	<i>Rhytiphora</i>	<i>albospilota</i>	Qld	Ethanol	Expanded	9	<i>Rhytiphora</i>
25-073795	<i>Rhytiphora</i>	<i>crucensis</i>	SA	Ethanol	Expanded	6	<i>Rhytiphora</i>
25-073808	<i>Rhytiphora</i>	<i>oblita</i>	Qld	Ethanol	Expanded	9	<i>Niphona</i> (moved to <i>Prosoplus</i>)
25-073815	<i>Rhytiphora</i>	<i>rubeta</i>	NSW	Ethanol	Expanded	9	<i>Rhytiphora</i>
25-073818	<i>Rhytiphora</i>	'silver sp.'	WA	Ethanol	Expanded	8	NA
25-073821	<i>Rhytiphora</i>	'sp2'	Qld	Ethanol	Expanded	4	NA
25-073823	<i>Rhytiphora</i>	'sp3'	Qld	Ethanol	Expanded	4	NA
25-073824	<i>Rhytiphora</i>	'sp4'	Qld	Ethanol	Expanded	6	NA

All specimens are lodged at the Australian National Insect Collection. Locality abbreviations: New South Wales (NSW), Northern Territory (NT), Queensland (Qld), South Australia (SA), Victoria (Vic.), Western Australia (WA); Papua New Guinea (PNG).

Table S2. Primers and indices used for *COI* barcoding.

Standard <i>COI</i> region (2 sets of primers):
III_F1490-t: 5'-CAGGAAACAGCTATGACCTCIACIAAYCAYAARGAYATYGG-3'
III_C_R-t: 5'-TGTA AACGACGGCCAGTGGIGGRTAIACIGTTCAICC-3'
III_B_F-t: 5'-CAGGAAACAGCTATGACCCCIGATATRGCITTYCCICG-3'
III_R2198-t: 5'-TGTA AACGACGGCCAGTTAIACCTTCIGGRTGICCRAARAATCA-3'
M13 linkers for re-amplification:
M13REV: 5'-CAGGAAACAGCTATGACC-3'
M13(-21): 5'- TGTA AACGACGGCCAGT-3'
Forward primers for ligating indices (10 primers):
Bystrykh28_M13REV: 5'-ATAGCGTCCAGGAAACAGCTATGACC-3'
Bystrykh66_M13REV: 5'-GGCTAACTCAGGAAACAGCTATGACC-3'
Bystrykh73_M13REV: 5'-TCCGAGATCAGGAAACAGCTATGACC-3'
Bystrykh76_M13REV: 5'-AGCTAGTCCAGGAAACAGCTATGACC-3'
Bystrykh81_M13REV: 5'-GTCTCAAGCAGGAAACAGCTATGACC-3'
Bystrykh100_M13REV: 5'-GACTGATCCAGGAAACAGCTATGACC-3'
Bystrykh110_M13REV: 5'- ATCGGTCACAGGAAACAGCTATGACC-3'
Bystrykh116_M13REV: 5'- CACGTATGCAGGAAACAGCTATGACC-3'
Bystrykh112_M13REV: 5'-GCCAGTTACAGGAAACAGCTATGACC-3'
Bystrykh241_M13REV: 5'-GCTCTAAGCAGGAAACAGCTATGACC-3'
Reverse primers for ligating indices (10 primers):
Bystrykh122_M13(-21): 5'- TGCACGTATGTAAAACGACGGCCAGT-3'
Bystrykh133_M13(-21): 5'- ATGTACGCTGTAAAACGACGGCCAGT-3'
Bystrykh135_M13(-21): 5'- ACGTGCATTGTAAAACGACGGCCAGT-3'
Bystrykh136_M13(-21): 5'- GAGTTCCATGTAAAACGACGGCCAGT-3'
Bystrykh141_M13(-21): 5'- GTATGCACTGTAAAACGACGGCCAGT-3'
Bystrykh147_M13(-21): 5'- ACTGGCTATGTAAAACGACGGCCAGT-3'
Bystrykh154_M13(-21): 5'- AGCGTCATTGTAAAACGACGGCCAGT-3'
Bystrykh157_M13(-21): 5'- CTAGTCAGTGTAAAACGACGGCCAGT-3'
Bystrykh164_M13(-21): 5'- CATCACAGTGTAAAACGACGGCCAGT-3'
Bystrykh176_M13(-21): 5'- GAACTCTGTGTAAAACGACGGCCAGT-3'

Table S3. Summary of morphological traits and geographic distribution of the Nipponini species.

Species	Body size (class)	Body size (mm, mean)	Eye shape	Eye rows	Eye upper length	Ant. separation	Scape shape	Ant. fringe	Pronotum (class)	Pron. shape	Pron. v. elytra	Mesov. angle	Protib. tubercles	Sex patch	Biome
<i>Achriotypa basalis</i>	small	8	divided	0	1.2	5.4	2.4	sparse	subquadrate	0.9	equal	sloped	absent	absent	MZ
<i>Achriotypa bispinosa</i>	small	7.25	divided	0	1.1	5.7	2.3	sparse	subquadrate	0.9	equal	sloped	absent	absent	T
<i>Pterolophia luctuosa</i>	small	10.5	divided	0	0.9	3.6	3.5	sparse	subquadrate	0.9	narrower	sloped	absent	small	MT
<i>Pterolophia</i> sp. grey C437	small	9	divided	0	1	5.2	2.1	sparse	subquadrate	0.8	narrower	sloped	absent	NA	AZ
<i>Rhytiphora albocincta</i> C530	medium	14.5	divided	0	1.2	3.3	2.5	dense	subquadrate	0.8	narrower	sloped	absent	large	MZ
<i>Rhytiphora albospilota</i>	large	25.5	deep-emarg	2	0.9	2.9	2.4	dense	subquadrate	0.9	narrower	sloped	absent	large	MZ
<i>Rhytiphora amacula</i> C535	medium	16.5	divided	0	0.9	5.2	2.6	dense	subquadrate	0.8	narrower	sloped	absent	large	MT
<i>Rhytiphora apiculata</i> C410	medium	19	deep-emarg	1	1	3.4	1.6	dense	subquadrate	0.8	narrower	sloped	present	small	T
<i>Rhytiphora armatula</i>	medium	17	divided	0	1	4.1	2.7	dense	subquadrate	0.9	narrower	sloped	absent	large	MT
<i>Rhytiphora australica</i>	small	8	divided	0	1.1	6.3	2.8	sparse	subquadrate	0.9	narrower	sloped	absent	small	MT
<i>Rhytiphora bakewelli</i> C548	small	10.75	divided	0	1.1	5.8	2.5	sparse	transverse	0.7	narrower	angulate	absent	small	MZ
<i>Rhytiphora bankii</i>	small	9.5	divided	0	0.9	5.2	3.4	sparse	subquadrate	0.8	narrower	angulate	absent	small	T
<i>Rhytiphora bankii</i> C429	small	11	divided	0	1.2	4.4	2.5	sparse	subquadrate	0.8	narrower	angulate	absent	small	MZ (MT)
<i>Rhytiphora batesi</i>	large	22.5	divided	0	0.7	4	3.3	sparse	transverse	0.73	narrower	angulate	absent	small	T*
<i>Rhytiphora bimaculata</i>	small	14.5	divided	0	1	5.7	2.4	sparse	subquadrate	0.8	narrower	angulate	absent	small	T*
<i>Rhytiphora browni</i> C563	large	26	deep-emarg	3	1	3.4	3.1	dense	subquadrate	0.8	narrower	sloped	absent	absent	AZ
<i>Rhytiphora callosa</i>	medium	16.5	divided	0	0.9	4.3	2.2	sparse	subquadrate	0.8	narrower	angulate	absent	small	MT
<i>Rhytiphora cinerascens</i> C537	small	14.5	deep-emarg	2	1	2.9	2.3	dense	subquadrate	0.9	narrower	sloped	present	large	MZ
<i>Rhytiphora cinnamomea</i> C541	medium	18.5	deep-emarg	1	0.8	3.4	2	dense	transverse	0.75	narrower	sloped	absent	large	MZ
<i>Rhytiphora cowleyi</i>	small	13.25	divided	0	1.5	4.7	2.7	sparse	subquadrate	0.8	narrower	sloped	absent	small	T
<i>Rhytiphora crassicollis</i>	small	11.5	divided	0	0.9	4.4	2.8	sparse	subquadrate	0.8	narrower	sloped	absent	small	AZ
<i>Rhytiphora cretata</i> C560	large	21.5	emarg	4	0.9	3.8	2.2	dense	transverse	0.75	narrower	sloped	absent	large	MZ
<i>Rhytiphora crucensis</i>	medium	21	deep-emarg	1	0.9	3.7	2.1	dense	transverse	0.75	narrower	sloped	absent	large	MZ**
<i>Rhytiphora dallasii</i> C556	large	27	deep-emarg	2	0.9	4.7	3	dense	transverse	0.7	narrower	sloped	absent	absent	AZ
<i>Rhytiphora deserti</i>	small	11.5	deep-emarg	2	1.1	2	2	dense	subquadrate	0.9	narrower	sloped	present	large	AZ
<i>Rhytiphora deserti</i> C662	small	12.25	deep-emarg	2	1	2.6	2.4	dense	subquadrate	0.9	narrower	sloped	present	large	MT
<i>Rhytiphora detrita</i> C655	small	12	deep-emarg	2	1	2.5	2.1	dense	subquadrate	0.8	narrower	sloped	absent	large	MZ**
<i>Rhytiphora dispersa</i>	small	7.75	divided	0	0.9	3.6	2.4	sparse	subquadrate	0.9	narrower	sloped	absent	small	MT
<i>Rhytiphora diva</i>	small	10.5	divided	0	1	5.1	2.9	sparse	subquadrate	0.8	narrower	sloped	absent	small	MT (AZ, MZ)
<i>Rhytiphora fasciata</i> C659	medium	21	deep-emarg	2	0.9	2.9	2.1	dense	subquadrate	0.8	narrower	sloped	absent	small	MT
<i>Rhytiphora fulvescens</i> C652	small	15	deep-emarg	1	0.9	3.7	2.1	sparse	transverse	0.74	narrower	sloped	absent	small	MT
<i>Rhytiphora granulosa</i>	large	31	deep-emarg	2	0.8	2.7	2.1	sparse	transverse	0.7	narrower	sloped	absent	large	MZ
<i>Rhytiphora hathlioides</i>	small	15.5	divided	0	1.2	4.2	2.5	sparse	subquadrate	0.9	equal	sloped	absent	small	MT
<i>Rhytiphora intercalaris</i>	small	11	divided	0	1.1	5	3.2	sparse	subquadrate	0.9	narrower	angulate	absent	small	T
<i>Rhytiphora intricata</i> C542	large	23	deep-emarg	1	0.7	4.5	2.2	sparse	transverse	0.7	narrower	sloped	absent	large	MZ**
<i>Rhytiphora lateralis</i>	small	14	divided	0	1.1	3.3	2.1	dense	subquadrate	0.9	narrower	sloped	absent	large	MZ
<i>Rhytiphora neglecta</i>	medium	18	deep-emarg	2	0.9	2.4	2.1	dense	subquadrate	0.8	narrower	sloped	present	large	MZ
<i>Rhytiphora nigrovirens</i>	medium	15.5	divided	0	0.9	3.1	2.1	dense	subquadrate	0.8	narrower	sloped	absent	large	MZ
<i>Rhytiphora near bakewelli</i> C571	small	10	divided	0	0.9	5	2.7	sparse	subquadrate	0.76	narrower	angulate	absent	small	T
<i>Rhytiphora near bispinosa</i> C529	medium	18.5	deep-emarg	1	0.8	2.5	2.3	dense	subquadrate	0.9	narrower	sloped	absent	large	MZ
<i>Rhytiphora near cinnamomea</i> C555	medium	18.5	deep-emarg	1	0.9	3.7	2.3	dense	subquadrate	0.8	narrower	sloped	absent	large	MZ**
<i>Rhytiphora near delicatula</i> C756	medium	15.5	divided	0	1.1	3.6	2.1	dense	subquadrate	0.8	narrower	sloped	absent	large	MZ
<i>Rhytiphora near ferruginea</i> C546	medium	18.5	deep-emarg	2	0.9	5.3	2.6	dense	subquadrate	0.77	narrower	sloped	absent	large	MT (MZ)
<i>Rhytiphora near metuta</i>	medium	16.5	divided	0	1.1	4.4	2.8	sparse	transverse	0.72	narrower	angulate	absent	small	T*
<i>Rhytiphora near ochbas</i> C545	medium	17	deep-emarg	1	0.9	3.8	2	dense	transverse	0.75	narrower	sloped	present	large	T

Species	Body size (class)	Body size (mm, mean)	Eye shape	Eye rows	Eye upper length	Ant. separation	Scape shape	Ant. fringe	Pronotum (class)	Pron. shape	Pron. v. elytra	Mesov. angle	Protib. tubercules	Sex patch	Biome
<i>Rhytiphora oblita</i>	small	7.5	divided	0	1.2	4.9	2.3	sparse	subquadrate	0.8	narrower	angulate	absent	small	MT (MZ)
<i>Rhytiphora ochreobasalis</i> C550	small	14.5	deep-emarg	1	0.9	3.4	2.3	dense	subquadrate	0.9	narrower	sloped	absent	large	MZ
<i>Rhytiphora pardalis</i>	large	25	deep-emarg	2	0.8	3.3	2.2	sparse	transverse	0.75	narrower	sloped	absent	large	MT (AZ, MZ)
<i>Rhytiphora pedicornis</i> C660	medium	17	deep-emarg	1	1	2	2.5	dense	subquadrate	0.8	narrower	sloped	present	small	MT
<i>Rhytiphora piligera</i>	medium	19	divided	0	0.9	3	2.2	dense	subquadrate	0.9	narrower	sloped	absent	small	MZ
<i>Rhytiphora piperitia</i> C534	medium	17.5	deep-emarg	1	1	3.2	2.3	dense	subquadrate	0.8	narrower	sloped	absent	large	MT
<i>Rhytiphora pulverulens</i>	large	23	deep-emarg	2	1.1	2.5	2.5	dense	subquadrate	0.8	narrower	sloped	present	small	MT (MZ)
<i>Rhytiphora pustulosa</i> C570	medium	20	divided	0	1.2	5	2.4	sparse	transverse	0.73	narrower	sloped	absent	large	T
<i>Rhytiphora regularis</i> C657	medium	15	divided	0	1.1	4.4	2.3	dense	subquadrate	0.8	narrower	sloped	absent	large	MT
<i>Rhytiphora rubeta</i>	medium	17	deep-emarg	1	0.8	4.2	2.5	dense	subquadrate	0.8	narrower	sloped	absent	large	MZ
<i>Rhytiphora rugicollis</i>	large	22.5	deep-emarg	2	0.9	3.7	2.2	dense	transverse	0.75	narrower	sloped	absent	large	MZ
<i>Rhytiphora saundersii</i>	large	29.5	deep-emarg	2	0.9	4.4	2.6	dense	transverse	0.7	narrower	sloped	absent	large	AZ
<i>Rhytiphora solandri</i>	medium	19.5	deep-emarg	1	1	3.5	2.4	sparse	subquadrate	0.8	narrower	sloped	present	small	MZ
<i>Rhytiphora</i> sp. silver	medium	17.5	deep-emarg	2	1	3.2	2.5	dense	subquadrate	0.8	narrower	sloped	absent	large	AZ
<i>Rhytiphora</i> sp1 Cairns C536	large	26.5	deep-emarg	2	0.7	4.5	2.4	dense	transverse	0.7	narrower	sloped	absent	large	T
<i>Rhytiphora</i> sp1 Garrad. C531	medium	21	deep-emarg	2	0.8	2.9	1.9	dense	transverse	0.74	narrower	sloped	absent	large	T
<i>Rhytiphora</i> sp2	small	10	divided	0	1.1	5.4	2.6	sparse	subquadrate	0.8	narrower	angulate	absent	small	T
<i>Rhytiphora</i> sp3	small	9.5	divided	0	1.1	5	2.5	sparse	subquadrate	0.8	narrower	angulate	absent	small	T
<i>Rhytiphora</i> sp4	small	11	divided	0	1.2	4.6	2.7	sparse	subquadrate	0.8	narrower	angulate	absent	small	T
<i>Rhytiphora torquata</i> C538	medium	16.5	divided	0	0.8	3.2	2.4	dense	subquadrate	0.9	narrower	sloped	absent	large	MZ
<i>Rhytiphora tuberculigera</i> C553	medium	17.5	deep-emarg	1	0.9	4.8	2.1	dense	subquadrate	0.8	narrower	sloped	absent	small	MZ
<i>Rhytiphora variolosa</i> C645	small	13	deep-emarg	1	1	2.5	2.3	dense	subquadrate	0.8	narrower	sloped	absent	large	MZ
<i>Rhytiphora virgata</i>	small	12.5	divided	0	1	5	2.4	sparse	subquadrate	0.9	equal	sloped	absent	small	MT
<i>Rhytiphora wallacei</i>	large	24	deep-emarg	1	0.7	4.8	2	dense	subquadrate	0.76	narrower	sloped	absent	large	T*
<i>Ropica exocentroides</i> C569	small	5	divided	0	0.8	3.9	2.6	sparse	transverse	0.6	narrower	sloped	absent	small	MZ

Body size is coded as small (5–15 mm), medium (16–22 mm) or large (22+ mm); **eye shape** is coded as divided (no joining ommatidia rows), deeply emarginate (1–2 rows) or emarginate (3+ rows); **eye upper length** is the maximum length, vertex to frons, divided by antennal socket length; **antennal separation** is the distance between antennal socket inner rims divided by socket width; **scape shape** is the length to width ratio; **antennal fringe** is coded as sparse (single line of ventral setae) or dense; **pronotum shape** is coded as subquadrate (≥ 0.76 length:width) or transverse (≤ 0.75 length:width); **pronotum width relative to elytra** (equal or narrower); **curvature of mesoventrite** (sloped or angulate); presence or absence of male **protibial tubercules**; size of male abdominal **sex patches** (small ($<1/2$ ventrite 2), large ($>1/2$ ventrite 2) or absent). Illustrations of character states can be found in the Ślipiński and Escalona (2013) key to Australian lamiine genera. Biome abbreviations: arid zone (AZ), mesic zone (MZ), monsoonal tropics (MT), wet tropics (T). Secondary biome, if applicable, is in parentheses. Species from New Guinea are indicated with one asterisk (*), and species from south-west (not east) Australia are indicated with two asterisks (**).

Table S4. Results of phylogenetic signal tests on morphological traits of the Nipponini species.

Morphological trait	Statistic	<i>P</i> -value
Body size (mean)	$K = 1.35$	0.001**
Eye emargination (class)	$D = -1.25$	<0.001***
Number of joining eye rows	$K = 0.94$	0.001**
Eye upper lobe length (ratio)	$K = 0.66$	0.001**
Antennal separation (ratio)	$K = 0.80$	0.001**
Scape shape (ratio)	$K = 0.85$	0.001**
Antennal fringe (class)	$D = -1.30$	<0.001***
Pronotum type (class)	$D = 0.09$	0.006**
Pronotum shape (ratio)	$K = 0.63$	0.001**
Pronotum <i>v.</i> elytra width (class)	$D = -1.77$	<0.001***
Mesoventrite angle (class)	$D = -2.01$	<0.001***
Protibial tubercles (class)	$D = -0.90$	<0.001***
Sex patch size (class)	$D = -1.13$	<0.001***

Signal is measured by Blomberg's K (continuous traits; 0 = no signal) and the D statistic (binary traits; 1 = no signal). Significance is indicated with an asterisk (**, $P = 0.01$ – 0.001 ; ***, $P < 0.001$).

Table S5. Results of BioGeoBEARS geographic range analyses on the dated BEAST phylogeny.

Model	log-likelihood	Number of parameters	d	e	j	AICc	AICc weight
DEC	-144.6	2	8.70E-03	1.10E-02	0	293.3	4.40E-25
DEC+J	-88.37	3	1.00E-12	1.00E-12	0.15	183.1	0.37
DIVALIKE	-130.2	2	8.70E-03	3.00E-03	0	264.6	7.60E-19
DIVALIKE+J	-88.07	3	1.00E-12	1.00E-12	0.14	182.5	0.5
BAYAREALIKE	-162.5	2	4.50E-03	4.60E-02	0	329.3	6.70E-33
BAYAREALIKE+J	-89.4	3	1.00E-12	1.00E-12	0.14	185.2	0.13

Reference

Ślipiński, A., and Escalona, H. E. (2013). 'Australian Longhorn Beetles (Coleoptera: Cerambycidae) Volume 1: Introduction and Subfamily Lamiinae'. (CSIRO Publishing: Melbourne, Vic., Australia)