

1 **Supporting Information**

2 Article title: Improved transcriptome sampling pinpoints 26 ancient and more recent polyploidy events in Caryophyllales, including
3 two allopolyploidy events

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10 The following Supporting Information is available for this article:

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12 **Fig. S1** Workflow for the modified phylome approach.

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14 **Fig. S2** Maximum Quartet Support Species Tree (MQSST) from ASTRAL analysis of individual subclade orthologous gene trees.

15 Numbers on branches are multi-locus bootstrap percentages. Branch length represents coalescent units, with terminal branch lengths
16 artificially fixed to 1 as coalescent units cannot be calculated for terminal branches. (a) PHYT: the phytolaccoid clade and Aizoaceae;
17 (b) PORT: Portulacineae and Molluginaceae; (c) AMAR: Amaranthaceae and Chenopodiaceae; (d) CARY: Caryophyllaceae; and (e)
18 NCORE: the clade sister to rest of the Caryophyllales.

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20 **Fig. S3** Phylogram from RAxML analysis of the concatenated 624-gene supermatrix from modified phylomes, with ICA scores on

21 branches.

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23 **Fig. S4** Maximum Quartet Support Species Tree (MQSST) from ASTRAL analysis of 624 orthologous gene trees from modified
24 phylomes. Numbers on branches are multi-locus bootstrap percentages. Branch length represents coalescent units, with terminal
25 branch lengths artificially fixed to 1 as coalescent units cannot be calculated for terminal branches.

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27 **Fig. S5** Proportion of orthogroups showing duplications filtered by local tree topology in addition to orthogroup-wide average
28 bootstrap support. Bubble diameters are proportional to frequency of gene duplication. (a) PHYT: the phytolaccoid clade and
29 Aizoaceae; (b) PORT: Portulacineae and Molluginaceae; (c) AMAR: Amaranthaceae and Chenopodiaceae; (d) CARY:
30 Caryophyllaceae; and (e) NCORE: the clade sister to rest of the Caryophyllales.

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32 **Fig. S6** Distribution of within-taxon synonymous distances (K_s) among paralogous gene pairs based on BLASTP hits. Zoomed-in K_s
33 plots from BLASTN hits are shown in addition to the results from BLASTP hits to show more recent K_s peaks. (a) PHYT: the
34 phytolaccoid clade and Aizoaceae; (b) PORT: Portulacineae and Molluginaceae; (c) AMAR: Amaranthaceae and Chenopodiaceae; (d)
35 CARY: Caryophyllaceae; and (e) NCORE: the clade sister to rest of the Caryophyllales.

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37 **Table S1** Sources of data and settings for assembly and translation.

TAXON CODE	TAXON NAME	SUB-CLADE	SOURCE	ASSMBLY AND TRANSLATION	DATA ACCESS	CITATION
MJM1677	Achatocarpaceae Phaulothamnus spinescens	AMAR	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
HDSY	Amaranthaceae Aerva javanica	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
PDQH	Amaranthaceae Aerva lanata	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
ZBPY	Amaranthaceae Alternanthera brasiliana	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
OHKC	Amaranthaceae Alternanthera caracasana	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Alph	Amaranthaceae Alternanthera philoxeroides	AMAR	NCBI SRA	trinity2.04, transdecoder2	SRR1661509	No information
BWRK	Amaranthaceae Alternanthera sessilis	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
EYRD	Amaranthaceae Alternanthera tenella	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
XSSD	Amaranthaceae Amaranthus cruentus	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Amhy	Amaranthaceae Amaranthus hypochondriacus	AMAR	download	translated by transdecoder from downloaded transcriptome	resource.ibab.ac.in/Plant Genomics	Sunil <i>et al.</i> , 2014
AmhyPA C	Amaranthaceae Amaranthus hypochondriacus PAC	AMAR	NCBI SRA	trinity2.04, transdecoder2	SRR1698129+SRR1698126	Christin <i>et al.</i> , 2015
WMLW	Amaranthaceae Amaranthus retroflexus	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Amtr	Amaranthaceae Amaranthus tricolor	AMAR	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR924083	No information
CUTE	Amaranthaceae Blutaparum vermiculare	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
MJM1665	Amaranthaceae Froelichia latifolia	AMAR	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
MJM1807	Amaranthaceae Gossypianthus lanuginosus	AMAR	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM2445	Amaranthaceae Guilleminea densa var aggregata	AMAR	Smith Lab	trinity2.03stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM2259	Amaranthaceae Tidestromia lanuginosa	AMAR	Smith Lab	trinity2.03stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Agsq	Chenopodiaceae Agriophyllum squarrosum	AMAR	NCBI SRA	trinity2.04, transdecoder2	SRR1559276	Zhao <i>et al.</i> , 2014
ONLQ	Chenopodiaceae Atriplex hortensis	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
AAXJ	Chenopodiaceae Atriplex prostrata	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
CBJR	Chenopodiaceae Atriplex rosea	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
WGET	Chenopodiaceae Bassia scoparia	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Matasci <i>et al.</i> , 2014
FVXD	Chenopodiaceae Beta maritima	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Beta	Chenopodiaceae Beta vulgaris	AMAR	Genome	genome annotation v1.2	http://bvseq.molgen.mpg.de/	Dohm <i>et al.</i> , 2014
Bisi	Chenopodiaceae Bienertia sinuspersici	AMAR	NCBI TSA	Download transcripts,transdecoder	GCEP01000001-GCEP01073224	No information

Cham	Chenopodiaceae <i>Chenopodium giganteum</i>	AMAR	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR503600	Zhang <i>et al.</i> , 2012
SMMC	Chenopodiaceae <i>Chenopodium quinoa</i>	AMAR	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
MJM3214	Chenopodiaceae <i>Extriplex californica</i>	AMAR	Smith Lab	trinity2.03stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM3268	Chenopodiaceae <i>Grayia spinosa</i>	AMAR	Smith Lab	trinity2.03stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Hagl	Chenopodiaceae <i>Halogeton glomeratus</i>	AMAR	NCBI SRA	trinity2.03, transdecoder2; offset 64	SRX643376 all 5 runs combined	No information
Haam	Chenopodiaceae <i>Haloxylon ammodendron</i>	AMAR	NCBI SRA	trinity2.04, transdecoder2	SRR1697346	Long <i>et al.</i> , 2014
MJM2311	Chenopodiaceae <i>Krascheninnikovia lanata</i>	AMAR	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Saeu	Chenopodiaceae <i>Salicornia europaea</i>	AMAR	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR896619	Fan <i>et al.</i> , 2013
SaeuGB	Chenopodiaceae <i>Salicornia europaea</i> GB	AMAR	NCBI TSA	Download transcripts,transdecoder	GAIA01000001-GAIA01083157	Ma <i>et al.</i> , 2013
Spol	Chenopodiaceae <i>Spinacia oleracea</i>	AMAR	Genome	Download	http://bvseq.molgen.mpg.de/	Dohm <i>et al.</i> , 2014
Sufr	Chenopodiaceae <i>Suaeda fruticosa</i>	AMAR	NCBI SRA	trinity2.03, transdecoder2	SRR1946833	Diray-Arce <i>et al.</i> , 2015
MJM1679	Chenopodiaceae <i>Suaeda linearis</i>	AMAR	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
YNFJ	Microteaceae <i>Microtea debilis</i>		1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
RUUB	Physenaceae <i>Physena madagascariensis</i>		1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
CVDF	Simmondsiaceae <i>Simmondsia chinensis</i>		1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Aggi	Caryophyllaceae <i>Agrostemma githago</i>	CARY	NCBI SRA	trinity2.04, transdecoder2	SRX352988 all 4 runs combined	Sloan <i>et al.</i> , 2014
MJM1164	Caryophyllaceae <i>Arenaria serpyllifolia</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM1767	Caryophyllaceae <i>Cerastium arvense</i>	CARY	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
MJM1163	Caryophyllaceae <i>Cerastium fontanum</i> subsp <i>vulgare</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Coqu	Caryophyllaceae <i>Colobanthus quitensis</i>	CARY	NCBI TSA	Download transcripts,transdecoder2	GCIB01000001-GCIB01165386	Arthofer <i>et al.</i> , 2015
CorSFB	Caryophyllaceae <i>Corrigiola litoralis</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Dica	Caryophyllaceae <i>Dianthus caryophyllus</i>	CARY	Genome	genome annotation v1.0	http://carnation.kazusa.or.jp/	Yagi <i>et al.</i> , 2014
LCMSn	Caryophyllaceae <i>Drymaria cordata</i>	CARY	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
MJM2503	Caryophyllaceae <i>Drymaria subumbellata</i>	CARY	Smith Lab	trinity20140717stranded, transdecoder20140704stranded	SRA BioProject PRJNA388222	This study

AP35665	Caryophyllaceae <i>Eremogone hookeri</i> subsp. <i>desertorum</i>	CARY	Smith Lab	trinity2.03stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
AreSFB	Caryophyllaceae <i>Eremogone procera</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
GypSFB	Caryophyllaceae <i>Gypsophila repens</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
HerSFB	Caryophyllaceae <i>Herniaria latifolia</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
HoncSFB	Caryophyllaceae <i>Honckenya peploides</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
IlleSFB	Caryophyllaceae <i>Illecebrum verticillatum</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
LepySFB	Caryophyllaceae <i>Lepyrodiclis stellarioides</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
RXEN	Caryophyllaceae <i>Polycarpaea repens</i>	CARY	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
SKNL	Caryophyllaceae <i>Saponaria officinalis</i>	CARY	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
OLES	Caryophyllaceae <i>Schiedea membranacea</i>	CARY	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
ScISFB	Caryophyllaceae <i>Scleranthus polycarpus</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
AP01224	Caryophyllaceae <i>Silene acaulis</i> subsp. <i>subacaulescens</i>	CARY	Smith Lab	trinity2.03stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Sico	Caryophyllaceae <i>Silene conica</i>	CARY	NCBI SRA	trinity2.04, transdecoder2	SRX353031 all 4 runs combined	Sloan <i>et al.</i> , 2014
FZQN	Caryophyllaceae <i>Silene latifolia</i>	CARY	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Sila	Caryophyllaceae <i>Silene latifolia</i> SRA	CARY	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR404980-SRR404985 6 runs combined	Muyle <i>et al.</i> , 2012
Sino	Caryophyllaceae <i>Silene noctiflora</i>	CARY	NCBI SRA	trinity2.04, transdecoder2	SRX353048 all 4 runs combined	Sloan <i>et al.</i> , 2014
Sipa	Caryophyllaceae <i>Silene paradoxa</i>	CARY	NCBI SRA	trinity2.04, transdecoder2	SRX353049 all 4 runs combined	Sloan <i>et al.</i> , 2014
Sivu	Caryophyllaceae <i>Silene vulgaris</i>	CARY	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR342041	No information
Sivu_AL N	Caryophyllaceae <i>Silene vulgaris</i> ALN	CARY	NCBI SRA	trinity2.04, transdecoder2	SRX353050 all 4 runs combined	Sloan <i>et al.</i> , 2014
TJES	Caryophyllaceae <i>Spergularia media</i>	CARY	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
TelSFB	Caryophyllaceae <i>Telephium imperati</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
VeleSFB	Caryophyllaceae <i>Velezia rigida</i>	CARY	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM1652	Droseraceae <i>Aldrovanda vesiculosa</i>	NCORE	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
Dimu	Droseraceae <i>Dionaea muscipula</i>	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR916183	Jensen <i>et al.</i> , 2015

DrobinSF B	Droseraceae <i>Drosera_binata</i>	NCORE	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA350559 combined 3 stages	Walker <i>et al.</i> , 2017
DrolusSF B	Drosophyllaceae <i>Drosophyllum lusitanicum</i>	NCORE	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA350559	Walker <i>et al.</i> , 2017
WPYJ	Frankeniaceae <i>Frankenia laevis</i>	NCORE	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
WQUF	Nepenthaceae <i>Nepenthes alata</i>	NCORE	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
NepSFB	Nepenthaceae <i>Nepenthes alata_SFB</i>	NCORE	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA350559 combined 3 stages	Walker <i>et al.</i> , 2017
WOBD	Plumbaginaceae <i>Limonium spectabile</i>	NCORE	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
CGGO	Plumbaginaceae <i>Plumbago auriculata</i>	NCORE	1KP	1KP (SOAPdenovo-Trans)+trinity20140413p1, transdecoder16JAN2014	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
MJM1811	Polygonaceae <i>Antigonon leptopus</i>	NCORE	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
Faes	Polygonaceae <i>Fagopyrum esculentum</i>	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRX112838 all seven runs combined	No information
Fata	Polygonaceae <i>Fagopyrum tataricum</i>	NCORE	NCBI SRA	trinityrnaseq_r20140717, transdecoder_r20140704	SRR1552215	Zhu <i>et al.</i> , 2015
FYSJ	Polygonaceae <i>Fallopia convolvulus</i>	NCORE	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
MJM1170	Polygonaceae <i>Muehlenbeckia platyclada</i>	NCORE	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Pomi	Polygonaceae <i>Persicaria minor</i>	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR1536192	No information
Pomi2	Polygonaceae <i>Persicaria minor2</i>	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR1536245	No information
Poti	Polygonaceae <i>Persicaria tinctoria</i>	NCORE	NCBI SRA	trinityrnaseq_r20140717, transdecoder_r20140704	SRR1565474	No information
MJM1162	Polygonaceae <i>Persicaria virginiana</i>	NCORE	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM2667	Polygonaceae <i>Polygonum aviculare</i>	NCORE	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
PterSFB	Polygonaceae <i>Pterostegia drymarioides</i>	NCORE	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Pocu	Polygonaceae <i>Reynoutria japonica</i>	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR292345	Hao <i>et al.</i> , 2012
EmexSFB	Polygonaceae <i>Reynoutria japonica 2</i>	NCORE	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Rhno	Polygonaceae <i>Rheum nobile</i>	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR1449867	No information
Rhrh	Polygonaceae <i>Rheum rhabarbarum</i>	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR867377	No information
Ruac	Polygonaceae <i>Rumex acetosa</i>	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	ERR216274+ERR216275 combined	No information

Ruha	Polygonaceae Rumex_hastatulus	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR1266797	No information
Rupa	Polygonaceae Rumex_palustris	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	ERR216276+ERR216277 combined	No information
RuprSFB	Polygonaceae Ruprechtia_salicifolia	NCORE	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA350559	Walker <i>et al.</i> , 2017
Reso	Tamaricaceae Reaumuria_soongarica	NCORE	NCBI SRA	trinity2.03, transdecoder2	SRR1232022	No information
Retr	Tamaricaceae Reaumuria_trigyna	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR350859+SRR364263 combined	No information
Tama	Tamaricaceae Tamarix_hispida	NCORE	NCBI SRA	trinity20140413p1, transdecoder16JAN2014	SRR522908+SRR527758+SRR527759+SRR527762+SRR527765+SRR527772+SRR527773+SRR527780 combined	Wang <i>et al.</i> , 2014
GJNX	Aizoaceae Cypselea_humifusa	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
BJKT	Aizoaceae Delosperma_echinatum	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Mecr	Aizoaceae Mesembryanthemum_crystallinum	PHYT	NCBI SRA	trinity2.04, transdecoder2	SRR1698355+SRR1701857 combined	Christin <i>et al.</i> , 2015
HZTS	Aizoaceae Sesuvium_portulacastrum	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
EDIT	Aizoaceae Sesuvium_verrucosum	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
OMYK	Aizoaceae Trianthema_portulacastrum	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Trpo	Aizoaceae Trianthema_portulacastrum SRA	PHYT	NCBI SRA	trinity2.04, transdecoder2	SRR1698227+SRR1698228 combined	Christin <i>et al.</i> , 2015
BERS	Aizoaceae Zaleya_pentandra	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
MJM2189	Nyctaginaceae Abronia_bigelovii	PHYT	Smith Lab	trinity2.03stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM1751	Nyctaginaceae Abronia_nealleyi	PHYT	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
MJM2247	Nyctaginaceae Acleisanthes_acutifolia	PHYT	Smith Lab	trinity20140717stranded, transdecoder20140704stranded	SRA BioProject PRJNA388222	This study
MJM2246	Nyctaginaceae Acleisanthes_chenopodioides	PHYT	Smith Lab	trinity20140717stranded, transdecoder20140704stranded	SRA BioProject PRJNA388222	This study
MJM1741	Nyctaginaceae Acleisanthes_lanceolata	PHYT	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
MJM1697	Nyctaginaceae Acleisanthes_obtusa	PHYT	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
EGOS	Nyctaginaceae Allionia_incarnata	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
DVXD	Nyctaginaceae Allionia_incarnata2	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
MJM2362	Nyctaginaceae Anulocaulis_erosolenus	PHYT	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM1070	Nyctaginaceae Anulocaulis_leiosolenus_var_gypsogenus	PHYT	Smith Lab	trinity20140413p1non-stranded, transdecoder16JAN2014	SRA BioProject PRJNA261527	Yang <i>et al.</i> , 2015
VJPU	Nyctaginaceae Boerhavia_burbidgeana	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015

ZBTA	Nyctaginaceae <i>Boerhavia_coccinea</i>	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Boco	Nyctaginaceae <i>Boerhavia_coccinea_SRA</i>	PHYT	NCBI SRA	trinity2.04, transdecoder2	SRR1698115+SRR1698114 combined	Christin <i>et al.</i> , 2015
MJM2201	Nyctaginaceae <i>Boerhavia_purpurascens</i>	PHYT	Smith Lab	trinity20140717stranded, transdecoder20140704stranded	SRA BioProject PRJNA388222	This study
MJM2202	Nyctaginaceae <i>Boerhavia_torreyana</i>	PHYT	Smith Lab	trinity20140717stranded, transdecoder20140704stranded	SRA BioProject PRJNA388222	This study
JAFJ	Nyctaginaceae <i>Bougainvillea_spectabilis</i>	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
SFB32	Nyctaginaceae <i>Bougainvillea_stipitata</i>	PHYT	Smith Lab	trinity20140413p1non-stranded, transdecoder16JAN2014	SRA BioProject PRJNA261527	Yang <i>et al.</i> , 2015
MJM1714	Nyctaginaceae <i>Cyphomeris_gypsophiloides</i>	PHYT	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
SFB27	Nyctaginaceae <i>Guapira_obtusata</i>	PHYT	Smith Lab	trinity20140413p1non-stranded, transdecoder16JAN2014	SRA BioProject PRJNA261527	Yang <i>et al.</i> , 2015
JGAB	Nyctaginaceae <i>Mirabilis_jalapa</i>	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Mija	Nyctaginaceae <i>Mirabilis_jalapa_SRA</i>	PHYT	NCBI SRA	trinityrnaseq_r20140717, transdecoder_r20140704	ERR324436	No information
MJM1771	Nyctaginaceae <i>Mirabilis_multiflora</i>	PHYT	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
MJM2585	Nyctaginaceae <i>Nyctaginia_capitata</i>	PHYT	Smith Lab	trinity20140717stranded, transdecoder20140704stranded	SRA BioProject PRJNA388222	This study
SFB28	Nyctaginaceae <i>Pisonia_aculeata</i>	PHYT	Smith Lab	trinity20140413p1non-stranded, transdecoder16JAN2014	SRA BioProject PRJNA261527	Yang <i>et al.</i> , 2015
SFB29	Nyctaginaceae <i>Pisonia_umbellifera</i>	PHYT	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
MJM3267	Nyctaginaceae <i>Tripterocalyx_crux_maltae</i>	PHYT	Smith Lab	trinity2.03stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
SFKQ	Petiveriaceae <i>Hillieria_latifolia</i>	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
AZBL	Petiveriaceae <i>Petiveria_alliacea</i>	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
MJM1651	Petiveriaceae <i>Rivina_humilis</i>	PHYT	Smith Lab	trinity20140413p1non-stranded, transdecoder16JAN2014	SRA BioProject PRJNA261527	Yang <i>et al.</i> , 2015
SFB30	Petiveriaceae <i>Seguieria_aculeata</i>	PHYT	Smith Lab	trinity20140413p1non-stranded, transdecoder16JAN2014	SRA BioProject PRJNA261527	Yang <i>et al.</i> , 2015
AniSFB	Phytolaccaceae <i>Anisomeria_littoralis</i>	PHYT	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM1649	Phytolaccaceae <i>Ercilla_volubilis</i>	PHYT	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
BKQU	Phytolaccaceae <i>Phytolacca_americana</i>	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
MRKX	Phytolaccaceae <i>Phytolacca_bogotensis</i>	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
SFB31	Phytolaccaceae <i>Phytolacca_dioica</i>	PHYT	Smith Lab	trinity20140413p1stranded, transdecoder16JAN2014stranded	SRA BioProject PRJNA280277	Brockington <i>et al.</i> , 2015
GIWN	Sarcobataceae <i>Sarcobatus_vermiculatus</i>	PHYT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015

MJM1773	Sarcobataceae Sarcobatus vermiculatus MJM	PHYT	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
DBGStha	Stegnospermataceae Stegnosperma halimifolium	PHYT	Smith Lab	trinity2.03stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Anfi	Anacampserotaceae Anacampseros filamentosa	PORT	NCBI SRA	trinity2.04, transdecoder2	SRR1698105	Christin <i>et al.</i> , 2015
MJM2441	Anacampserotaceae Talinopsis frutescens	PORT	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
CTYH	Basellaceae Basella alba	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Ecpe	Cactaceae Echinocereus pectinatus	PORT	NCBI SRA	trinity2.04, transdecoder2	SRR1698109	Christin <i>et al.</i> , 2015
Lebl	Cactaceae Leuenbergeria bleo	PORT	NCBI SRA	trinity2.04, transdecoder2	SRR1698112	Christin <i>et al.</i> , 2015
Lely	Cactaceae Leuenbergeria lychnidiflora	PORT	NCBI SRA	trinity2.04, transdecoder2	SRR1698113	Christin <i>et al.</i> , 2015
CPKP	Cactaceae Lophophora williamsii	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Noco	Cactaceae Nopalea cochenillifera	PORT	NCBI SRA	trinity2.04, transdecoder2	SRR1698231+SRR1698229 combined	Christin <i>et al.</i> , 2015
JLOV	Cactaceae Pereskia aculeata	PORT	1KP	1KP (SOAPdenovo- Trans)+trinity20140413p1, transdecoder16JAN2014pfamAB	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Pegr	Cactaceae Pereskia grandifolia	PORT	NCBI SRA	trinity2.04, transdecoder2	SRR1698106	Christin <i>et al.</i> , 2015
RNBN	Molluginaceae Mollugo cerviana	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
SCAO	Molluginaceae Mollugo nudicaulis	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
HURS	Molluginaceae Mollugo pentaphylla	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
NXTS	Molluginaceae Mollugo verticillata	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
TRS2027	Montiaceae Claytonia nevadensis	PORT	Smith Lab	trinity2.03stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM1156	Montiaceae Claytonia virginica	PORT	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
MJM2214	Montiaceae Phemeranthus parviflorus	PORT	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
LDEL	Portulacaceae Portulaca amilis	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
LLQV	Portulacaceae Portulaca cryptopetala	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
CPLT	Portulacaceae Portulaca grandiflora	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
UQCB	Portulacaceae Portulaca molokiniensis	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
EZGR	Portulacaceae Portulaca oleracea	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Pool	Portulacaceae Portulaca oleracea_SRA	PORT	NCBI SRA	trinity2.04, transdecoder2	SRR1698123+SRR1698125 combined	Christin <i>et al.</i> , 2015
IWIS	Portulacaceae Portulaca pilosa	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
GCYL	Portulacaceae Portulaca suffrutescens	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
KDCH	Portulacaceae Portulaca umbraticola	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015

MJM1789	Talinaceae <i>Talinum_paniculatum</i>	PORT	Smith Lab	trinity2.04stranded, transdecoder2stranded	SRA BioProject PRJNA388222	This study
Tapo	Talinaceae <i>Talinum_portulacifolium</i>	PORT	NCBI SRA	trinity2.04, transdecoder2	SRR1698110	Christin <i>et al.</i> , 2015
LKKX	Talinaceae <i>Talinum_sp</i>	PORT	1KP	1KP	Matasci <i>et al.</i> , 2014	Yang <i>et al.</i> , 2015
Achn	Actinidiaceae <i>Actinidia_chinensis</i>	outgroup	genome	genome annotation	http://bioinfo.bti.cornell.edu/cgi-bin/kiwi/download.cgi	Huang <i>et al.</i> , 2013
Atrichopoda	<i>Amborella_trichopoda</i>	outgroup	genome	v1.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Acoerulea	<i>Aquilegia_coerulea</i>	outgroup	genome	v1.1	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Athaliana	<i>Arabidopsis_thaliana</i>	outgroup	genome	TAIR10	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Elgu	Arecaceae <i>Elaeis_guineensis</i>	outgroup	genome	genome annotation v2	http://genomsawit.mpob.gov.my/	Singh <i>et al.</i> , 2013
Phoe	Arecaceae <i>Phoenix_dactylifera</i>	outgroup	genome	genome annotation v3	http://qatar-weill.cornell.edu/research/datepal/mGenome/download	Al-Mssallem <i>et al.</i> , 2013
Bstricta	<i>Boechera_stricta</i>	outgroup	genome	v1.2	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Brapa	<i>Brassica_rapa</i>	outgroup	genome	v1.3	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Rara	Brassicaceae <i>Raphanus_raphanistrum</i>	outgroup	genome	genome annotation	http://radish.plantbiology.msu.edu/index.php/Genome_sequence/analysis	Moghe <i>et al.</i> , 2014
Crubella	<i>Capsella_rubella</i>	outgroup	genome	v1.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Cpapaya	<i>Carica_papaya</i>	outgroup	genome	ASGPBv0.4	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Cclementina	<i>Citrus_clementina</i>	outgroup	genome	v1.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Csinensis	<i>Citrus_sinensis</i>	outgroup	genome	v1.1	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Csativus	<i>Cucumis_sativus</i>	outgroup	genome	v1.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Cila	Cucurbitaceae <i>Citrullus_lanatus</i>	outgroup	genome	genome annotation v1	ftp://www.icugi.org/pub/genome/watermelon/97103/v1/	Guo <i>et al.</i> , 2013
Egrandis	<i>Eucalyptus_grandis</i>	outgroup	genome	v2.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Esalsuginum	<i>Eutrema_salsugineum</i>	outgroup	genome	v1.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Fvesca	<i>Fragaria vesca</i>	outgroup	genome	v1.1	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012

Gmax	Glycine_max	outgroup	genome	Wm82.a2.v1	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Graimondii	Gossypium_raimondii	outgroup	genome	v2.1	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Utri	Lentibulariaceae Utricularia_gibba	outgroup	genome	genome annotation+transdecoder20131117	https://genomeevolution.org/CoGe	Ibarra-Laclette <i>et al.</i> , 2013
Lusitatissimum	Linum_usitatissimum	outgroup	genome	v1.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Mesculenta	Manihot_esculenta	outgroup	genome	v4.1	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Mtruncatula	Medicago_truncatula	outgroup	genome	Mt4.0v1	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Mguttatus	Mimulus_guttatus	outgroup	genome	v2.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Musa	Musaceae Musa_acuminata	outgroup	genome	genome annotation DH-Pahang v1	http://banana-genome-hub.southgreen.fr	D'Hont <i>et al.</i> , 2012
Nenu	Nelumbonaceae Nelumbo_nucifera	outgroup	genome	genome annotation	http://lotus-db.wbgcas.cn/	Ming <i>et al.</i> , 2013; Wang <i>et al.</i> , 2015
Pheq	Orchidaceae Phalaenopsis_equestris	outgroup	genome	genome annotation	ftp://ftp.genomics.org.cn/from_BGISZ/20130120/02.annotation/	Cai <i>et al.</i> , 2015
Osativa	Oryza_sativa	outgroup	genome	v7.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Ptrichocarpa	Populus_trichocarpa	outgroup	genome	v3.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Ppersica	Prunus_persica	outgroup	genome	v2.1	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Rcommunis	Ricinus_communis	outgroup	genome	v0.1	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Coca	Rubiaceae Coffea_canephora	outgroup	genome	genome annotation	http://coffee-genome.org/download	Denoeud <i>et al.</i> , 2014
Spurpurea	Salix_purpurea	outgroup	genome	v1.0	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Caan	Solanaceae Capsicum_annuum_var_glabriusculum	outgroup	genome	genome annotation v2.0	ftp://ftp.solgenomics.net/genomes/Capsicum_annuum/C.annuum_glabriusculum/	Qin <i>et al.</i> , 2014
Slycopersicum	Solanaceae Solanum_lycopersicum	outgroup	genome	iTAGv2.3	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Spolyrhiza	Spirodela_polyrhiza	outgroup	genome	v2	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Tcacao	Theobroma_cacao	outgroup	genome	v1.1	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
Vvinifera	Vitis_vinifera	outgroup	genome	Genoscope.12X	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012

Zmays	Zea_mays	outgroup	genome	6a	https://phytozome.jgi.doe.gov/	Goodstein <i>et al.</i> , 2012
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40 **Table S2** Information for the 43 newly sequenced transcriptomes. YY=Ya Yang, MJM=Michael J. Moore, SFB=Samuel F.

41 Brockington, JM=Jessica Mikenas, JO=Julia Olivieri, JFW=Joseph F. Walker. Details for collection, RNA extraction, and library
42 preparation protocols can be found in Yang et al. (2017)

43

44 **Methods S1** All-by-all homology search for subclade datasets. Coding sequences from each transcriptome were reduced using cd-hit-
45 est (-c 0.99 -n 10) as part of the CD-HIT package. Homology searches were carried out using all-by-all BLASTN with an *E*-value
46 cutoff of 10 and max_target_seqs set to 1000. BLASTN output was filtered by requiring the alignment to cover 40% of both the query
47 and hit sequences. Clustering was performed using Markov CLuster algorithm [MCL v12-068 (van Dongen, 2000; van Dongen &
48 Abreu-Goodger, 2012)] from filtered hits with the *E*-value cutoff set to 10^{-5} and an inflation value of 1.4. Ends of sequences with no
49 interspecific BLASTN hit coverage were clipped. Remaining sequences shorter than 40 characters were removed, and clusters with
50 more than 2 taxa missing were ignored. Each resulting cluster was aligned, alignments were trimmed as in the modified phylome
51 approach, and phylogenetic trees were estimated with RAxML using the model GTRCAT. Spurious tips were trimmed using a relative
52 tip cutoff of 0.2 and an absolute tip length cutoff of 0.4 (0.3 and 0.6 for NCORE and 0.1 and 0.3 for CARY, respectively), and
53 isoforms were removed with the same criteria as in the modified phylome approach. Internal branches longer than 0.3 (0.4 for

54 NCORE and 0.2 for CARY and AMAR) were separated. The same procedure was repeated once before producing the final homolog
55 trees with 200 fast bootstrap replicates.

56

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Figure S1 The modified phylome approach

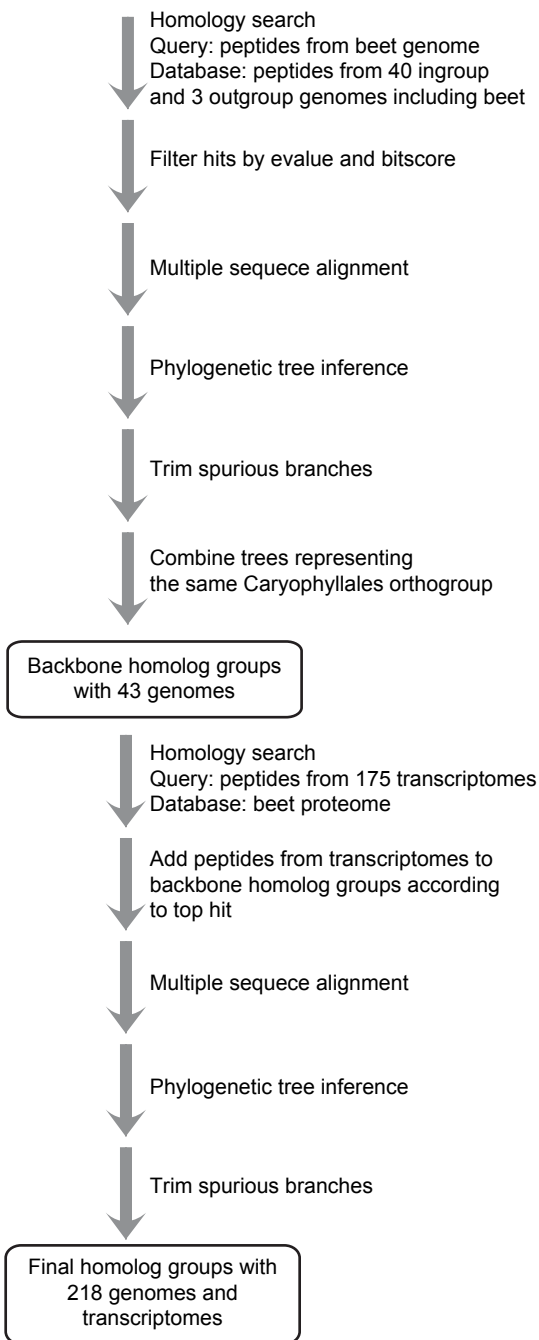


Figure S2

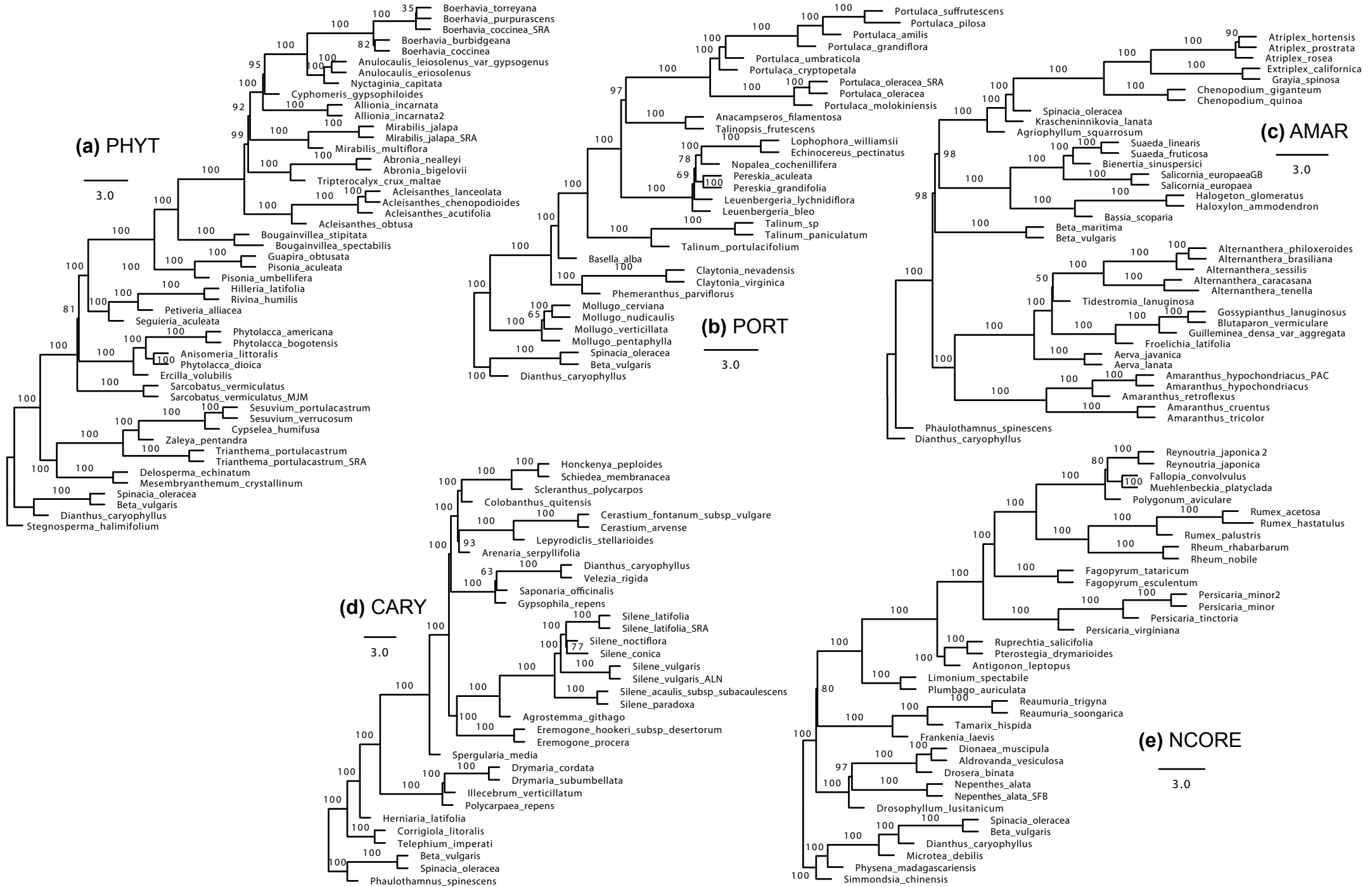


Figure S3

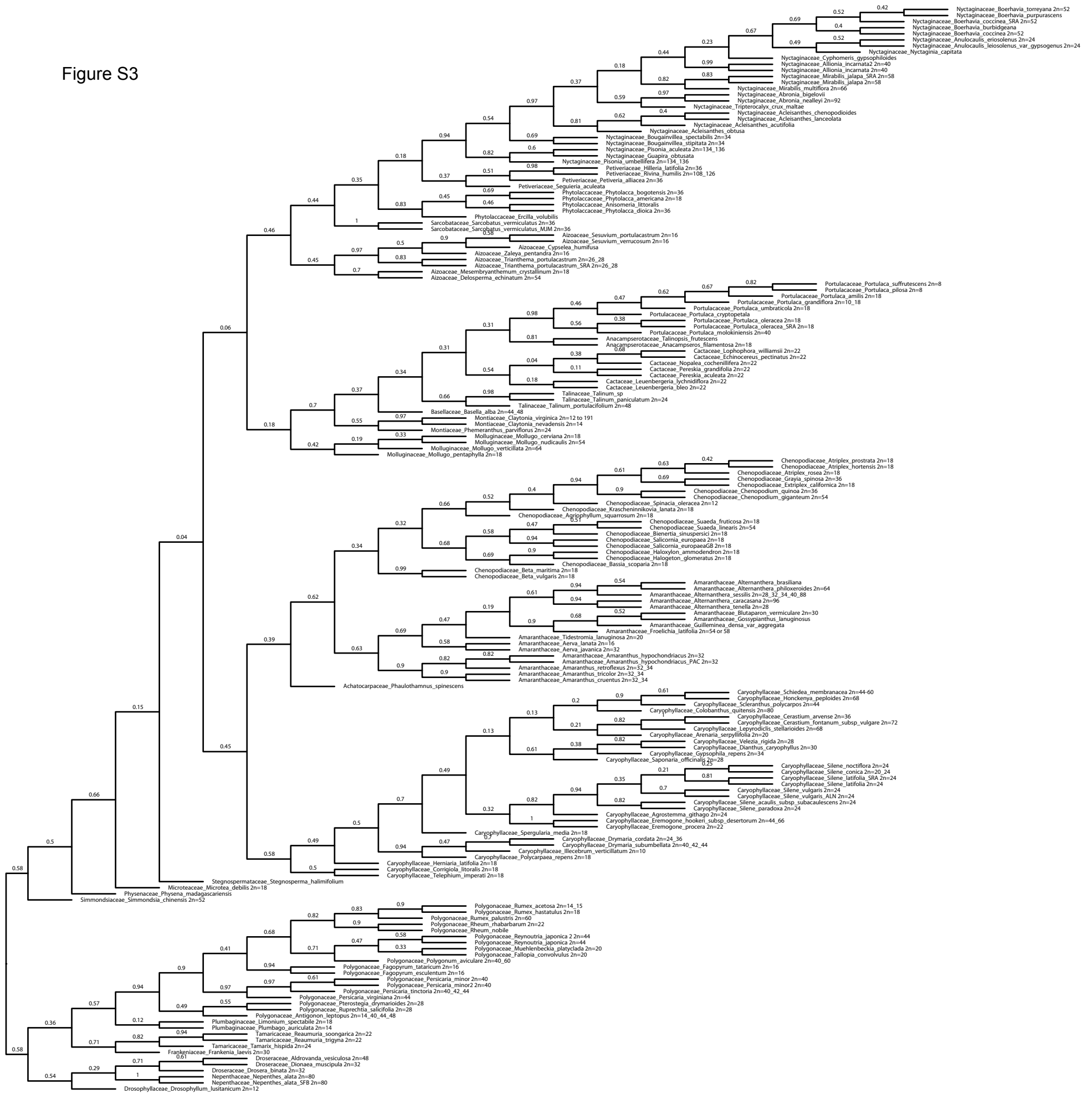


Figure S4

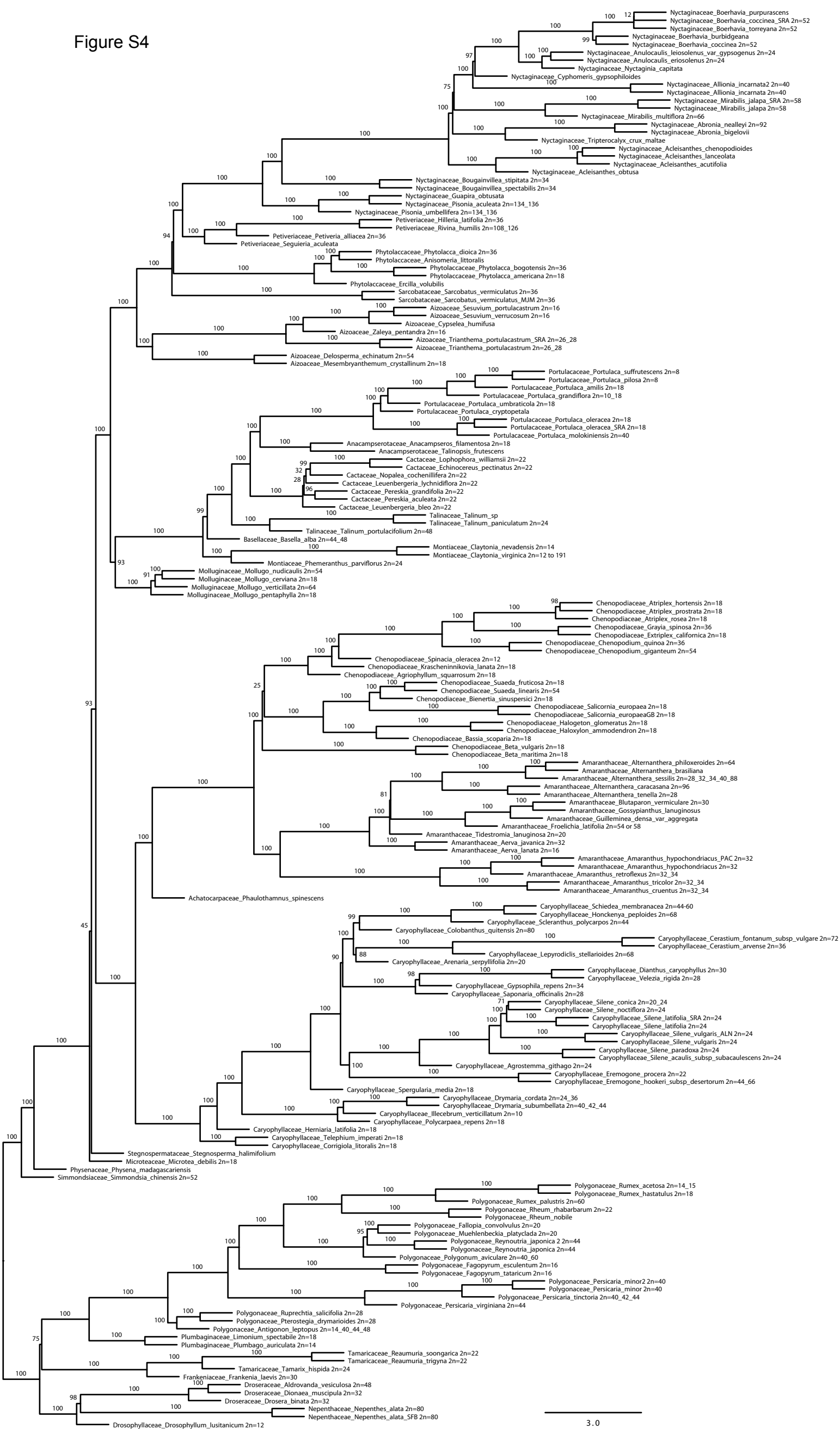


Figure S5

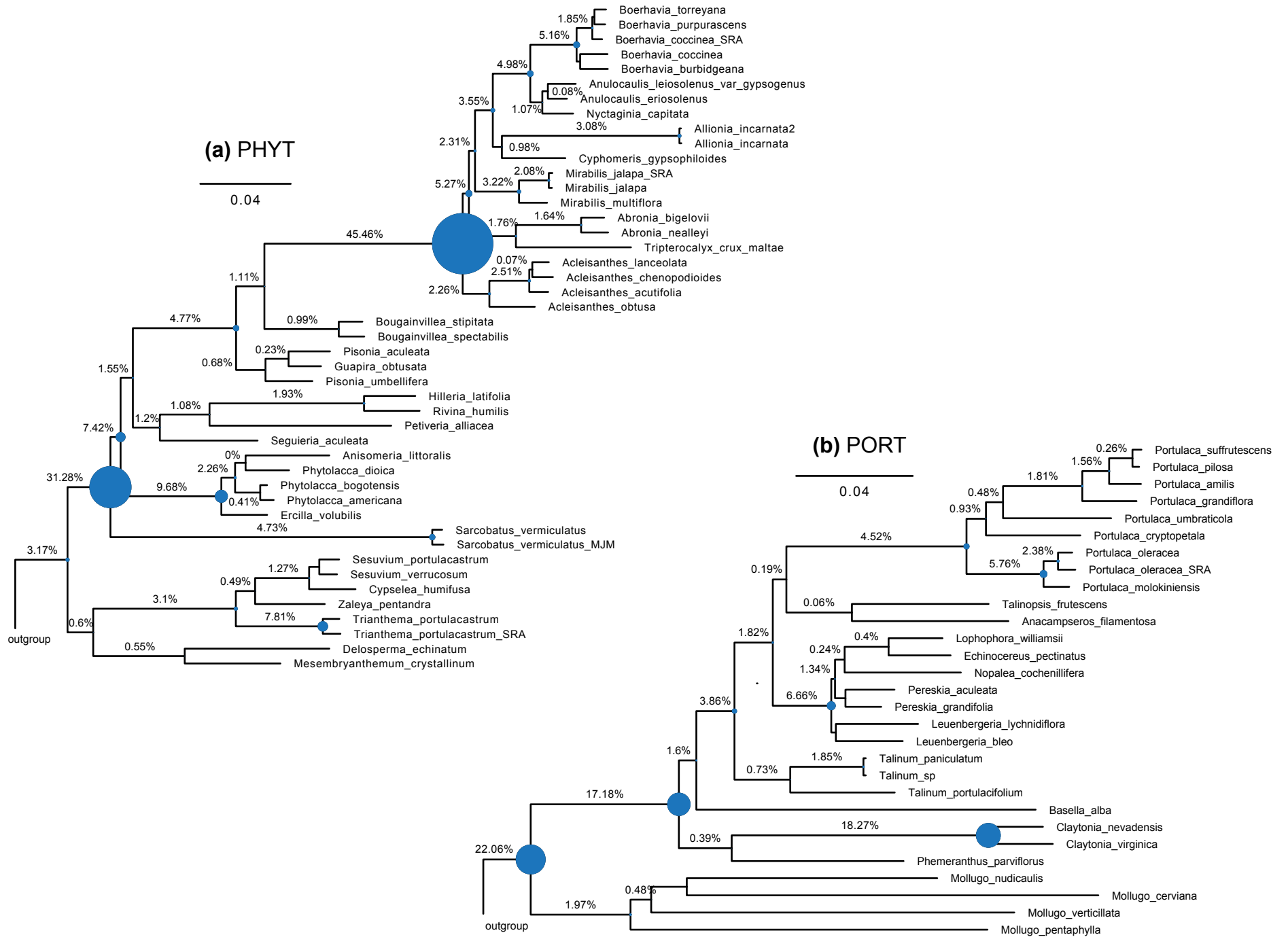
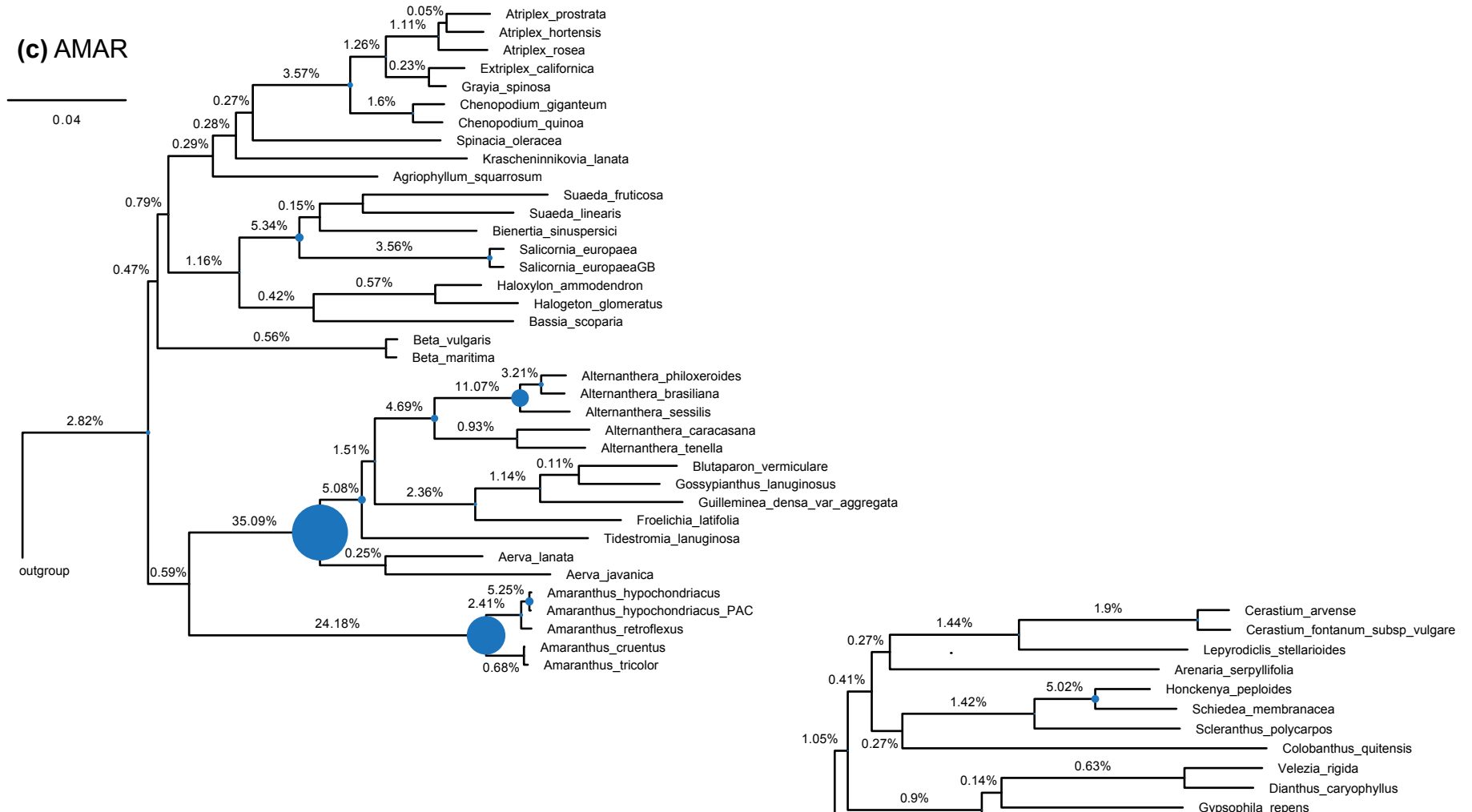


Figure S5

(c) AMAR



(d) CARY

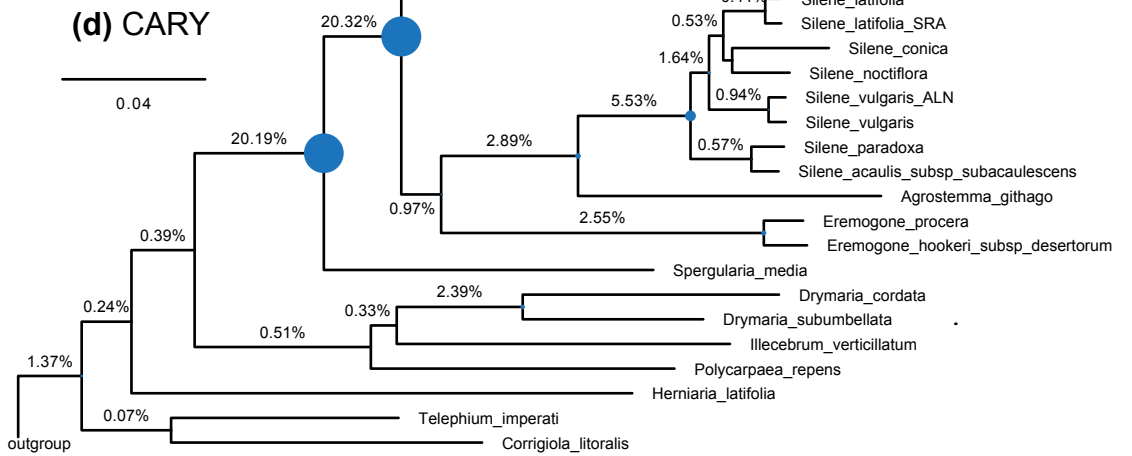


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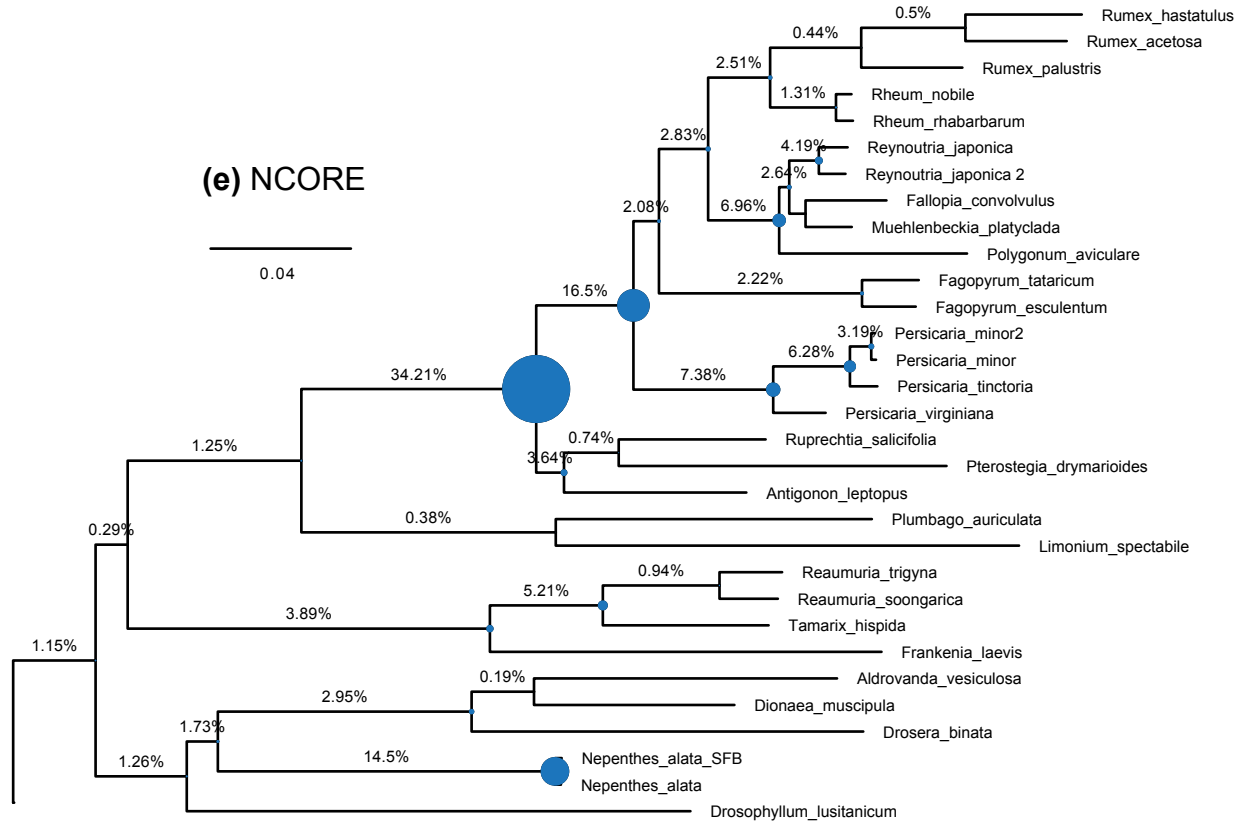


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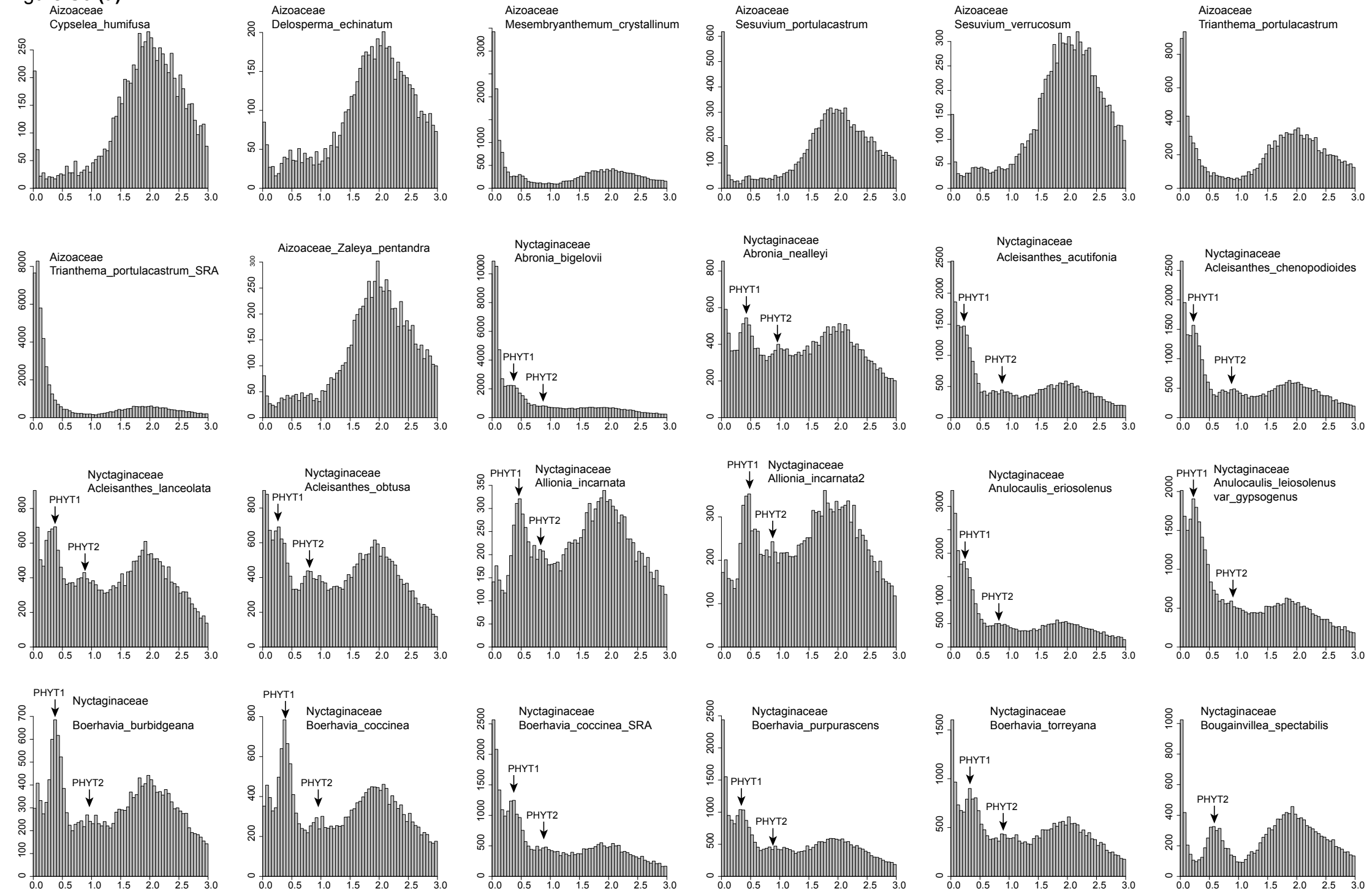


Figure S6 (a) PHYT (continued)

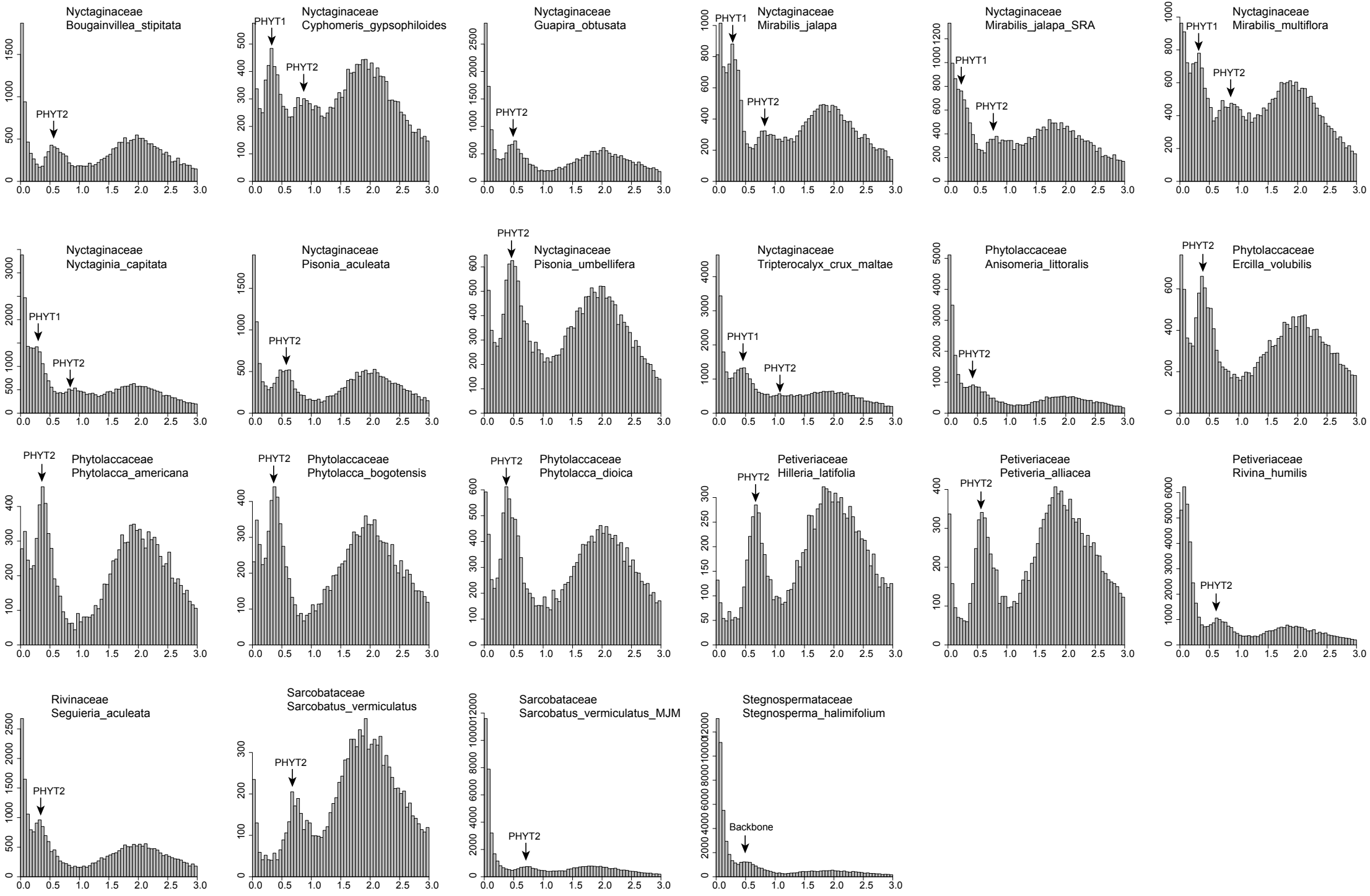


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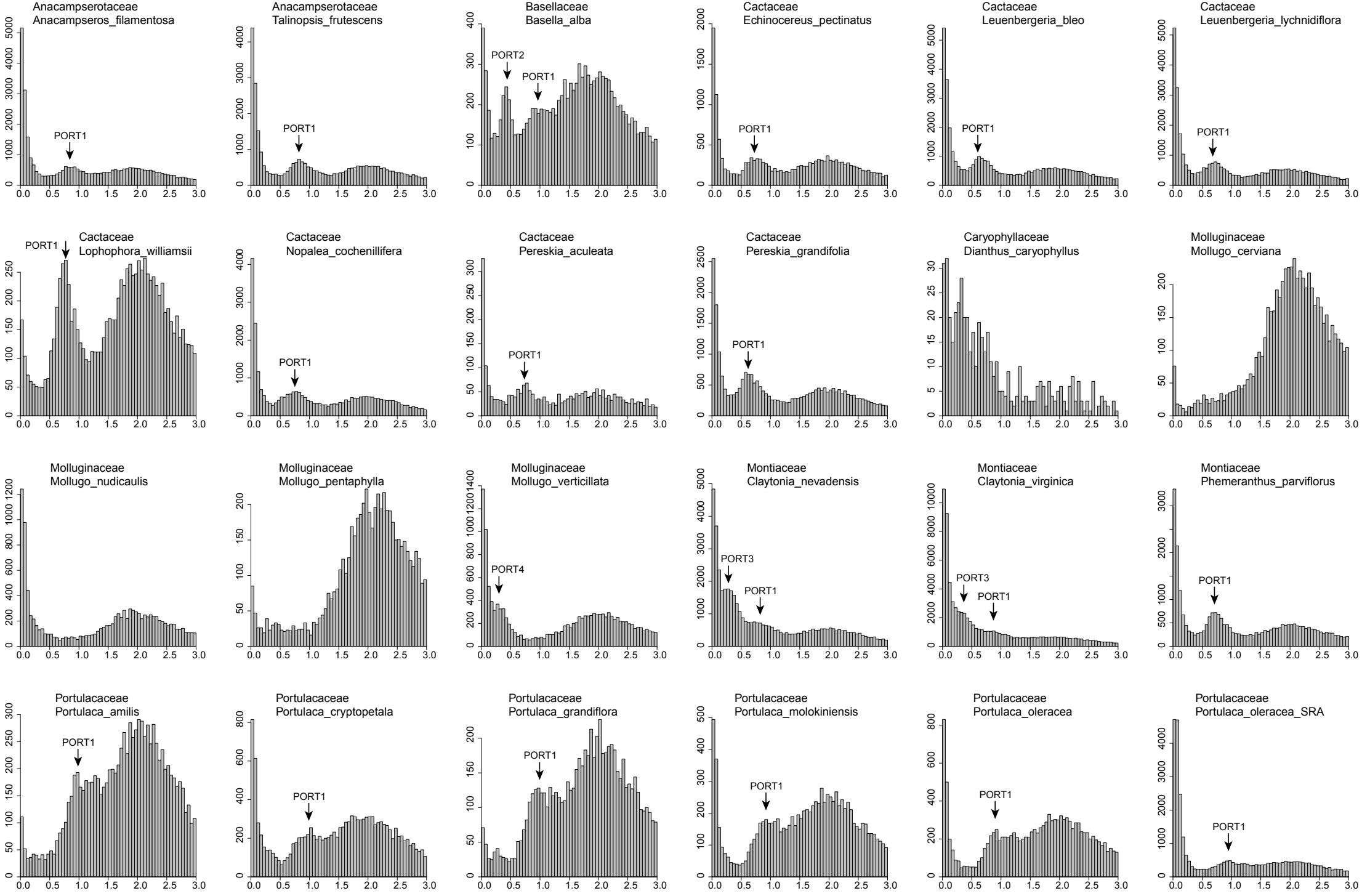


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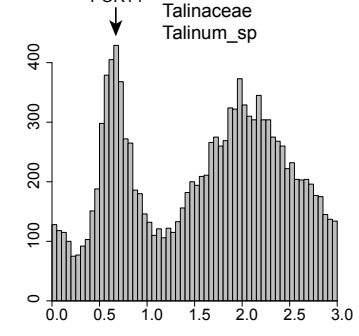
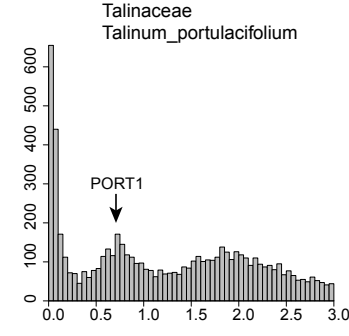
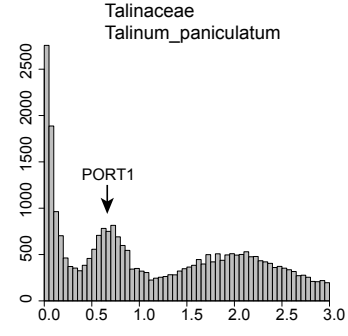
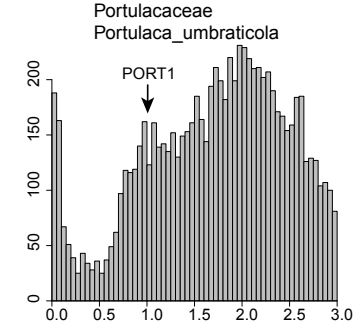
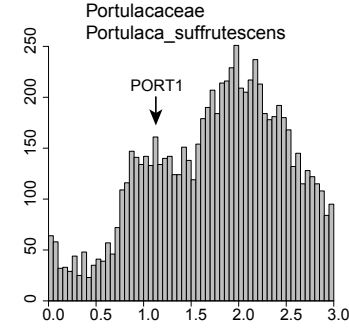
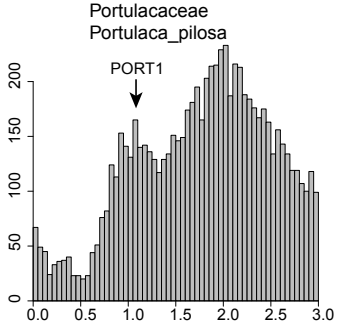


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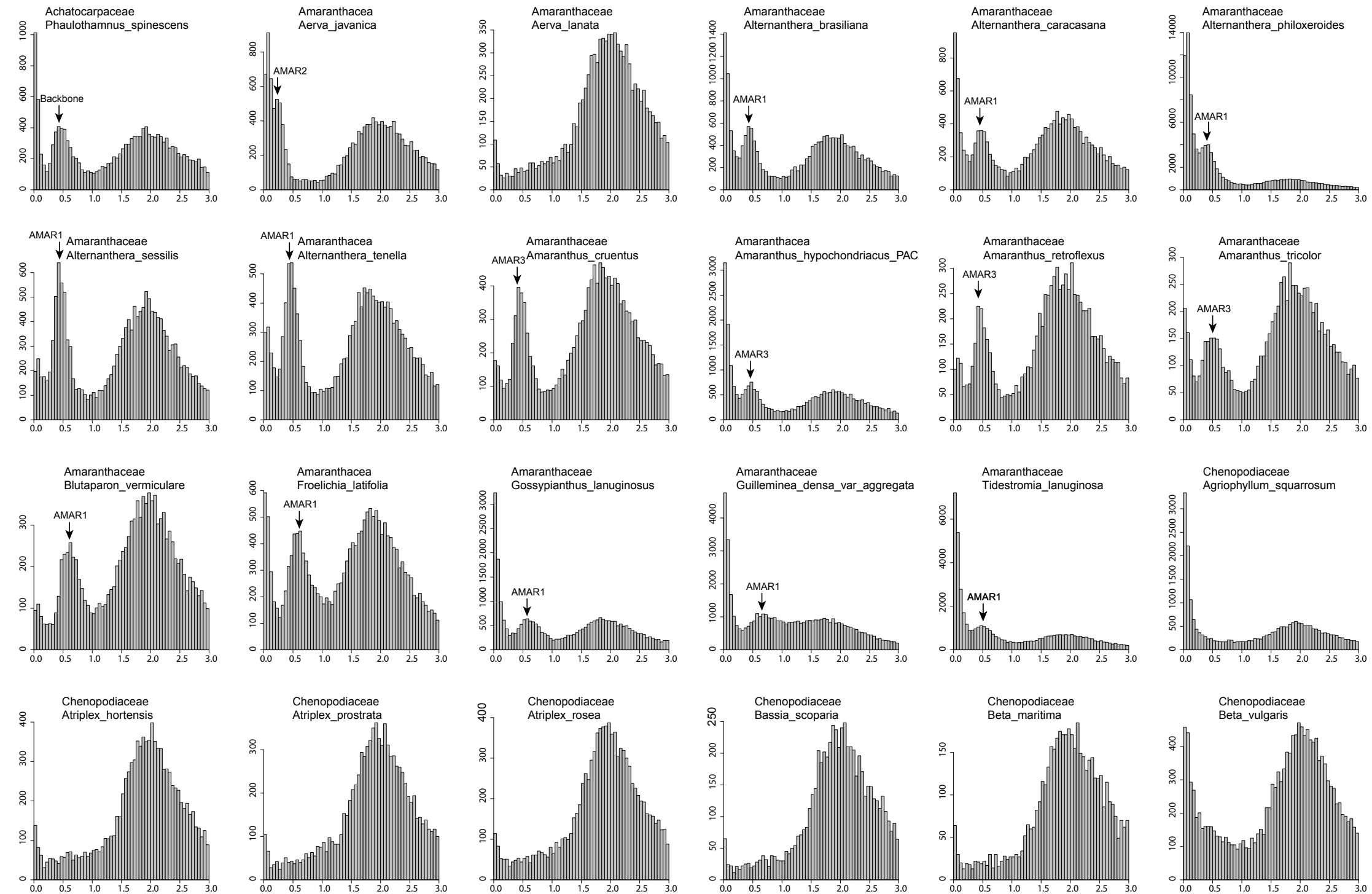


Figure S6 (c) AMAR continued

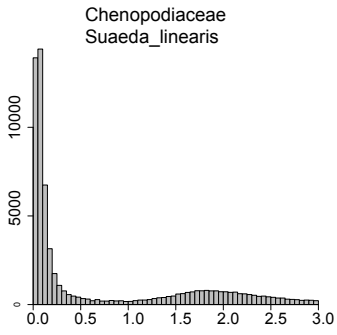
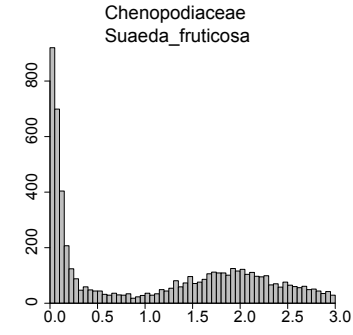
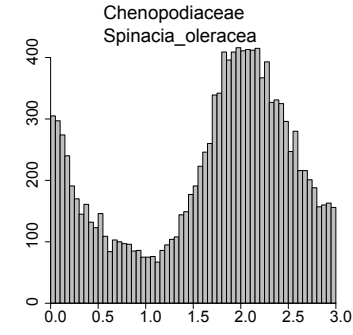
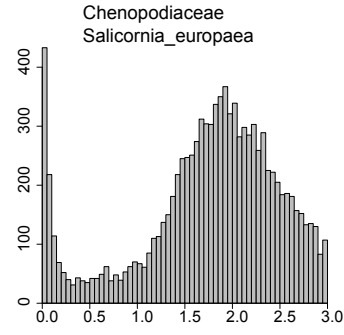
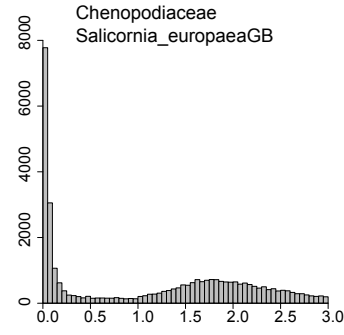
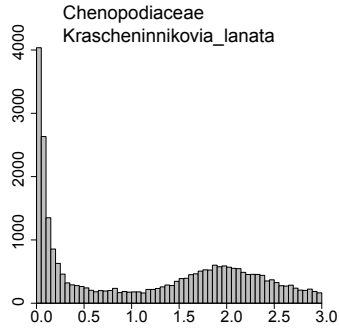
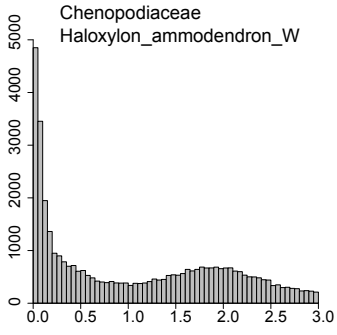
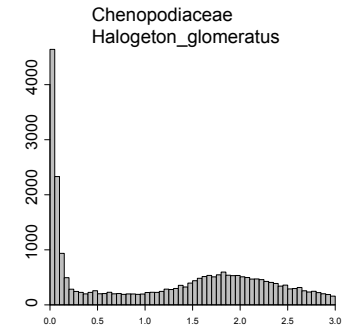
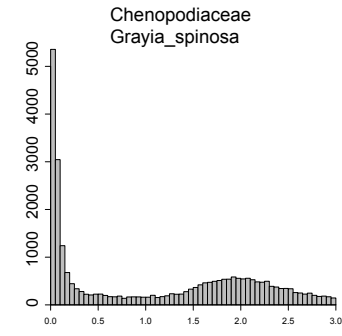
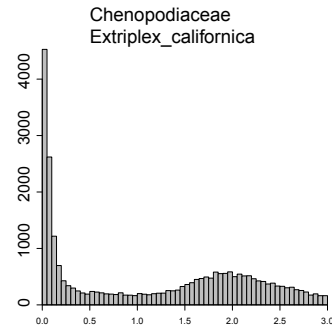
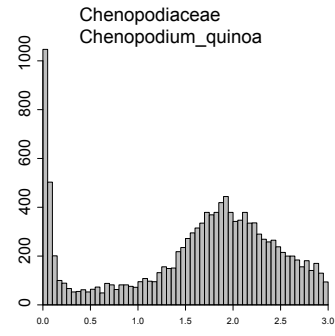
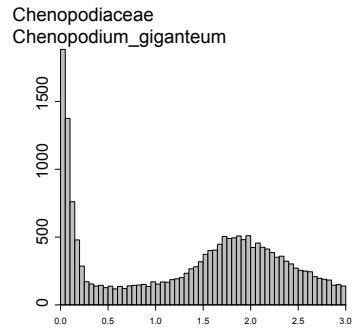
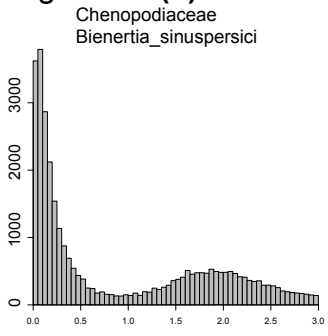


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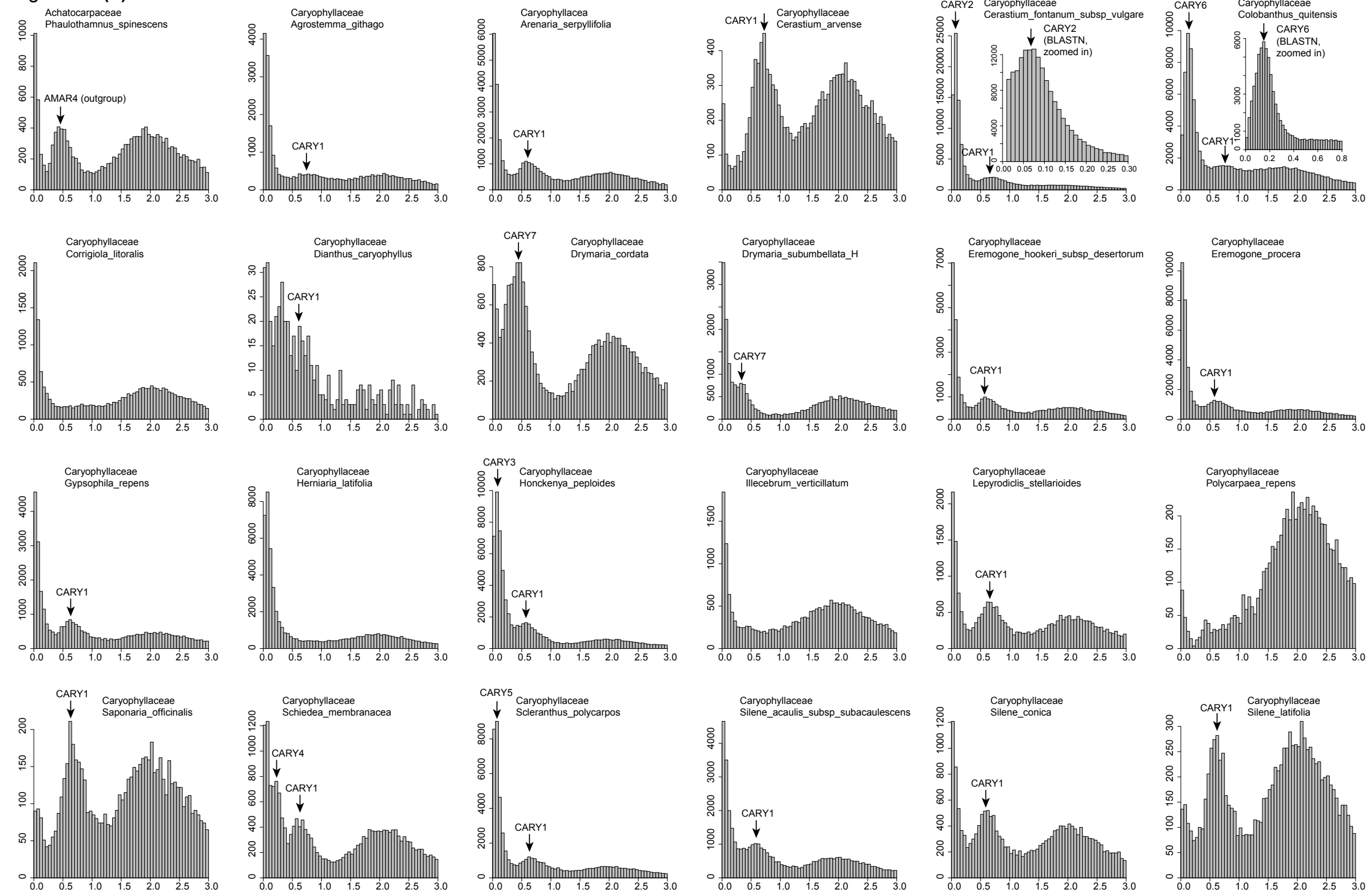


Figure S6 (d) CARY (continued)

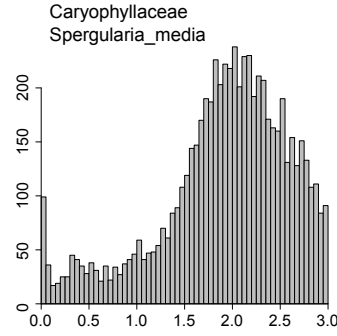
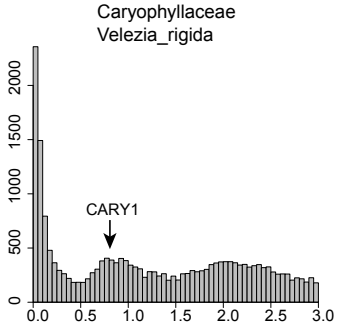
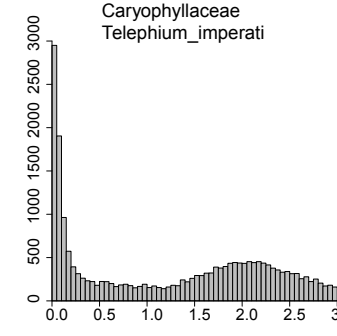
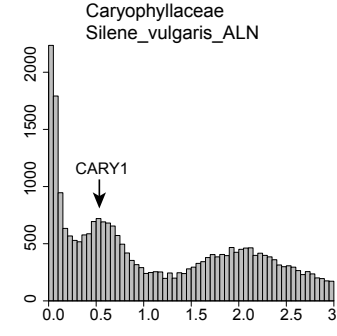
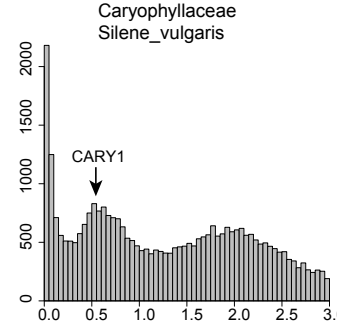
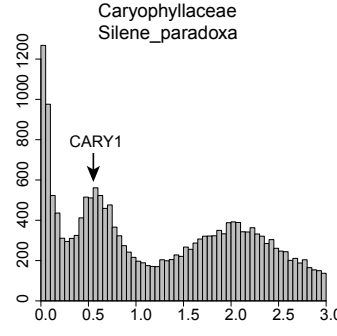
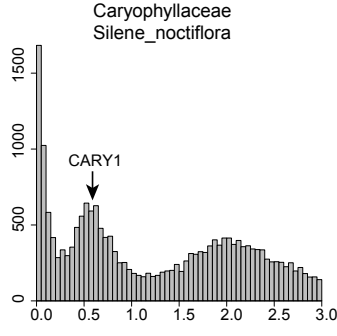
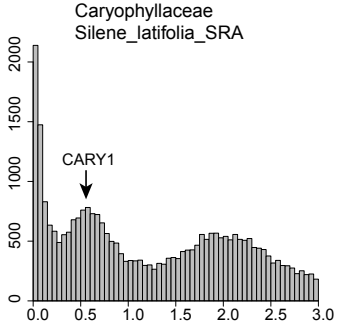


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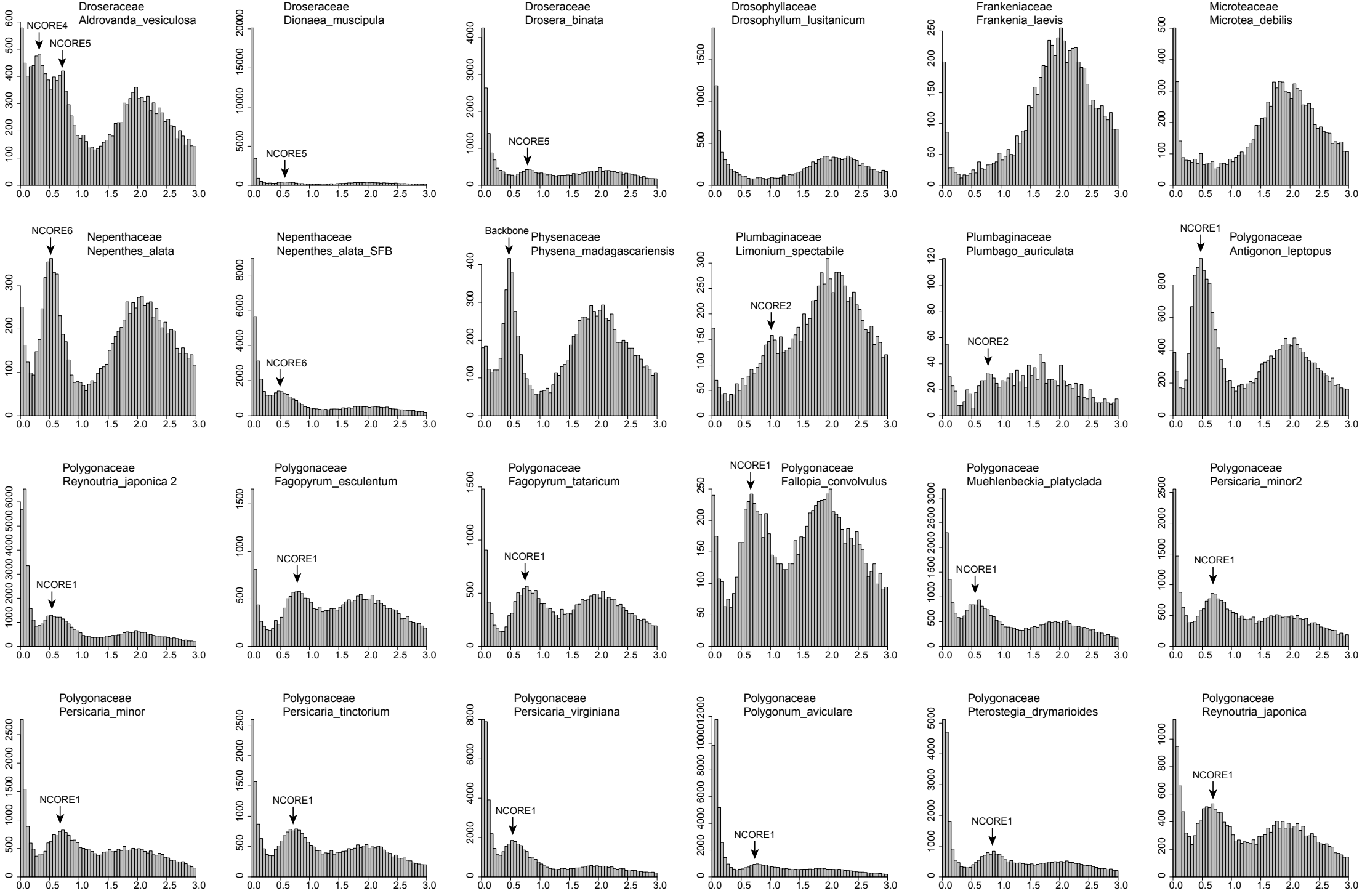


Figure S6 (e) NCORE continued

