

Molecular phylogeny and divergence time estimates in pennatulaceans (Cnidaria: Octocorallia: Pennatulacea)

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Supplementary material

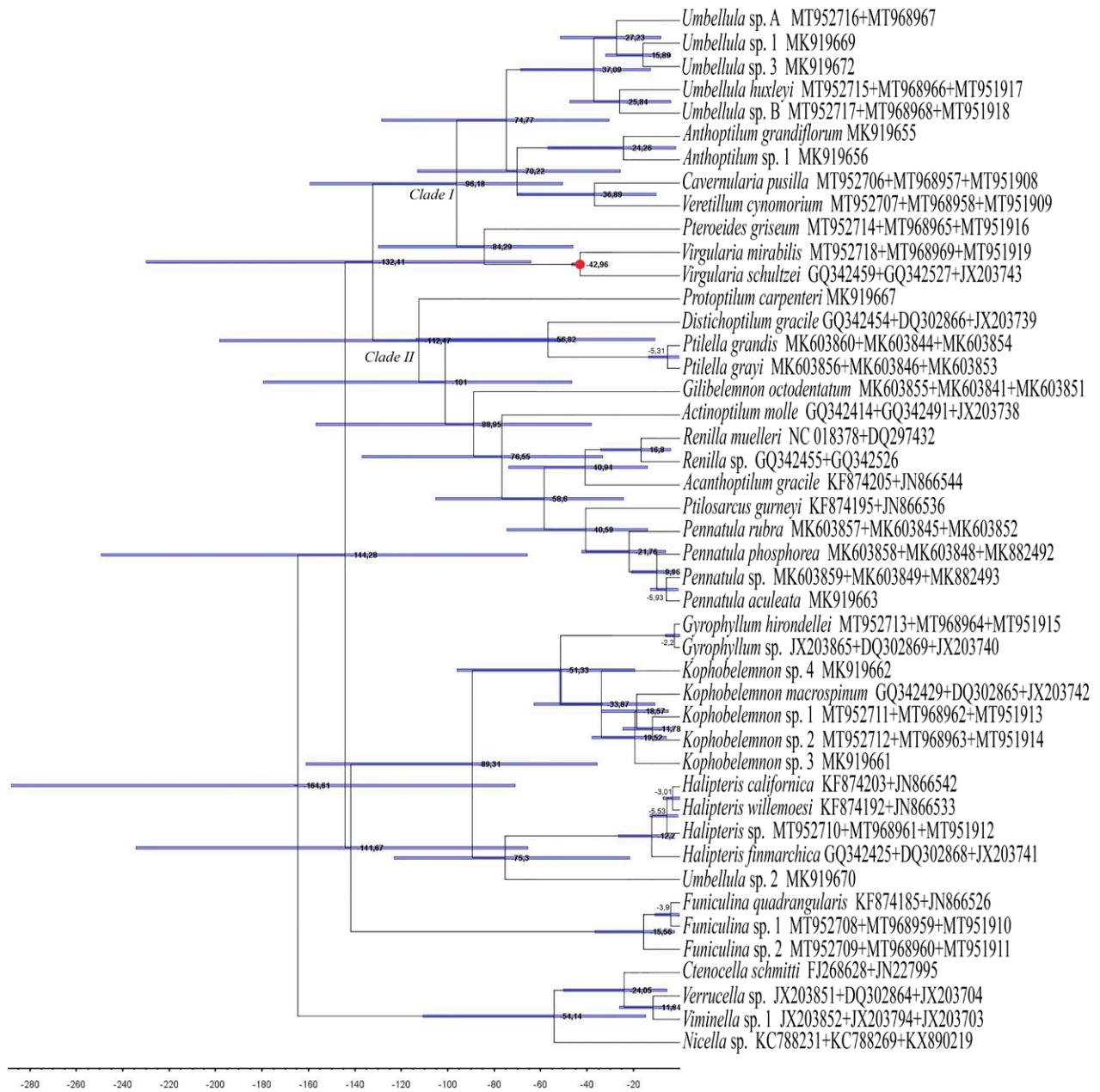


Fig. S1. – Calibrated tree from time divergence analysis. Phylogenetic relationships were based on Bayesian inference methods for combined regions *mtMutS+Cox1+28S*. Bars indicate the 95% highest posterior density with the inferred mean age. Red dot indicates fossil calibration point.

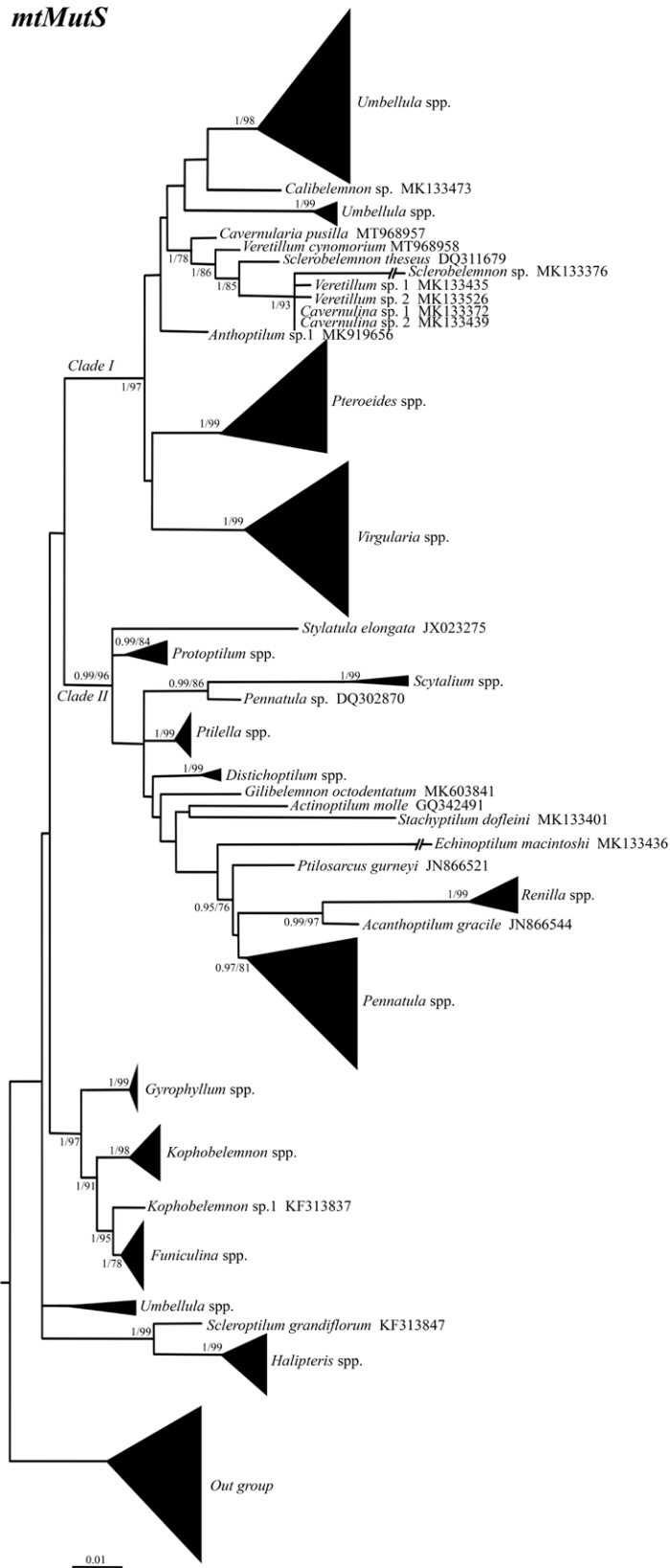


Fig. S2. – Phylogenetic relationships in the order Pennatulacea based on the maximum likelihood method for the marker *mtMutS*. Posterior probability and bootstrap supporting values are indicated on the different nodes. See Table S3 for species and GenBank accession numbers used in this tree.

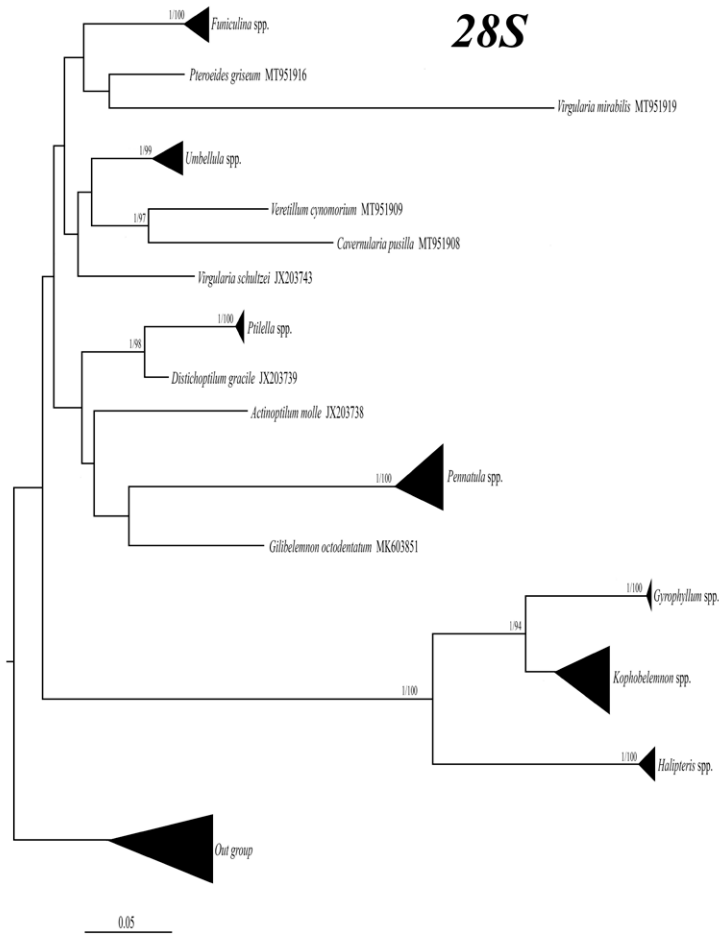


Fig. S5. – Phylogenetic relationships in the order Pennatulacea based on the maximum likelihood method for the nuclear marker 28S. Posterior probability and bootstrap supporting values are indicated on the different nodes. See Table 1 for species and GenBank accession numbers used in this tree.

Table S1. – Different arrangement of genera in “Clade III” according to the markers and methods used. G, *Gyrophyllum*; K, *Kophobelemnon*; F, *Funiculina*; H, *Halipteris*; ML, maximum likelihood method; BI, Bayesian inference.

Markers	CLADE III // out		Source
	ML	BI	
<i>CoxI+mtMutS+28S</i>	G-(K-F) // H	(G-K)-H // F	Present study (Fig. 1)
<i>mtMutS</i>	G-(K-F) // H	G-(K-F) // H	Present study (Fig. S2)
<i>CoxI</i>	G-K // F-H	G-K // F-H	Present study (Fig. S3)
<i>CoxI+mtMutS</i>	(G-K)-F // H	(G-K)-F // H	Present study (Fig. S4)
<i>28S</i>	(G-K)-H // F	(G-K)-H // F	Present study (Fig. S5)
<i>mtMutS+ND2</i>	G-(K-F) // H	G-(K-F) // H	Dolan et al. 2013, Kushida and Reimer 2018

Table S2. – Results from the molecular clock model comparisons.

Model	Marginal likelihood	Bayes factor
Relaxed log-normal	-13209.7	5.6
Relaxed exponential	-13215.3	209.2
Strict	-13424.5	1161.2
Random local	-14585.7	-

Table S3. – GenBank accession number of *mtMutS* sequences used in Figure S2.

Species	<i>mtMutS</i>	Species	<i>mtMutS</i>
<i>Acanthoptilum gracile</i>	JN866544	<i>Ptilella grayi</i>	MK603846
<i>Actinoptilum molle</i>	GQ342491	<i>Ptilosarcus gurneyi</i>	JN866521
<i>Anthoptilum</i> sp.1	MK919656	<i>Renilla muelleri</i>	DQ297432
<i>Calibelemnon</i> sp.	MK133473	<i>Renilla reniformis</i>	EU293803
<i>Cavernularia pusilla</i>	MT968957	<i>Renilla</i> sp.	GQ342526
<i>Cavernulina</i> sp.1	MK133372	<i>Renilla</i> sp.	MK133484
<i>Cavernulina</i> sp.2	MK133439	<i>Sclerobelemnon</i> sp.	MK133376
<i>Distichoptilum gracile</i>	KF313843	<i>Sclerobelemnon theseus</i>	DQ311679
<i>Distichoptilum gracile</i>	DQ302866	<i>Scleroptilum grandiflorum</i>	KF313847
<i>Distichoptilum gracile</i>	MK919657	<i>Scyatium martensi</i>	MK133361
<i>Echinoptilum macintoshi</i>	MK133436	<i>Scyatium</i> sp.1	MK133363
<i>Funiculina armata</i>	KF313833	<i>Stachyptilum dofleini</i>	MK133401
<i>Funiculina quadrangularis</i>	JN866526	<i>Stylatula elongata</i>	JX023275
<i>Funiculina quadrangularis</i>	JN866545	<i>Umbellula carpenteri</i>	KF313848
<i>Funiculina quadrangularis</i>	MK919658	<i>Umbellula encrinus</i>	KF313849
<i>Funiculina</i> sp.	JN227941	<i>Umbellula huxleyi</i>	KF313850
<i>Funiculina</i> sp.1	MT968959	<i>Umbellula huxleyi</i>	MK919668
<i>Funiculina</i> sp.2	MT968960	<i>Umbellula huxleyi</i>	MT968966
<i>Gilibelemnon octodentatum</i>	MK603841	<i>Umbellula magniflora</i>	KF313851
<i>Gyrophyllum hirondelei</i>	MT968964	<i>Umbellula</i> sp.	JN866562
<i>Gyrophyllum hirondelei</i>	KY039182	<i>Umbellula</i> sp.	JN866532
<i>Gyrophyllum</i> sp.	DQ302869	<i>Umbellula</i> sp.	JN227908
<i>Gyrophyllum</i> sp.	KF313845	<i>Umbellula</i> sp.	DQ302867
<i>Gyrophyllum</i> sp.	KF313846	<i>Umbellula</i> sp. 1	MK919669
<i>Halipterus californica</i>	JN866560	<i>Umbellula</i> sp. 3	MK919672
<i>Halipterus californica</i>	JN866542	<i>Umbellula</i> sp. A	MT968967
<i>Halipterus finmarchica</i>	DQ302868	<i>Umbellula</i> sp. B	MT968968
<i>Halipterus finmarchica</i>	KF313835	<i>Umbellula</i> sp.1	KF313855
<i>Halipterus</i> cf. <i>finmarchica</i>	MK919659	<i>Umbellula</i> sp.2	KF313856
<i>Halipterus willemoesi</i>	JN866533	<i>Umbellula</i> sp.2	MK919670
<i>Halipterus</i> sp.	MT968961	<i>Umbellula thomsoni</i>	KF313853
<i>Kophobelemnon macrospinum</i>	DQ302865	<i>Umbellula thomsoni</i>	KF313854
<i>Kophobelemnon pauciflorum</i>	KF313836	<i>Umbellula monocephalus</i>	KF313852
<i>Kophobelemnon</i> sp.1	KF313837	<i>Veretillum cynomorium</i>	MT968958
<i>Kophobelemnon</i> sp.1	MK919660	<i>Veretillum</i> sp.1	MK133435
<i>Kophobelemnon</i> sp.1	MT968962	<i>Veretillum</i> sp.2	MK133526
<i>Kophobelemnon</i> sp.2	KF313838	<i>Virgularia</i> cf. <i>gustaviana</i>	MK133518
<i>Kophobelemnon</i> sp.2	MT968963	<i>Virgularia</i> cf. <i>halisceptrum</i>	MK133359
<i>Kophobelemnon</i> sp.3	KF313839	<i>Virgularia</i> cf. <i>rumphi</i>	MK133423
<i>Kophobelemnon</i> sp.3	MK919661	<i>Virgularia mirabilis</i>	MT968969
<i>Kophobelemnon</i> sp.4	MK919662	<i>Virgularia mirabilis</i>	KF313857
<i>Pennatula rubra</i>	MK603845	<i>Virgularia mirabilis</i>	KF313858
<i>Pennatula aculeata</i>	MK919663	<i>Virgularia mirabilis</i>	MK919673
<i>Pennatula aculeata</i>	KF313840	<i>Virgularia schultzei</i>	GQ342527
<i>Pennatula murrayi</i>	KF313842	<i>Virgularia</i> sp.1	MK133378
<i>Pennatula phosphorea</i>	MK603848	<i>Virgularia</i> sp.3	MK133393
<i>Pennatula phosphorea</i>	JN866531	<i>Virgularia</i> sp.4	MK133400
<i>Pennatula phosphorea</i>	KF313841	<i>Virgularia</i> sp.5	MK133410
<i>Pennatula phosphorea</i>	KX904975	<i>Virgularia</i> sp.7	MK133424
<i>Pennatula</i> cf. <i>phosphorea</i>	MK133428	<i>Virgularia</i> sp.9	MK133449
<i>Pennatula</i> sp.	DQ302870	<i>Virgularia</i> sp.10	MK133462
<i>Pennatula</i> sp.	MK603849	OUTGROUP	
<i>Protophilum carpenteri</i>	MK919667	<i>Ctenocella barbadensis</i>	AY533651
<i>Protophilum</i> sp.	DQ297431	<i>Ctenocella schmitti</i>	JN227995
<i>Protophilum</i> sp.	EU293804	<i>Ellisella</i> sp.	JN227994
<i>Protophilum</i> sp.	KF313844	<i>Nicella americana</i>	KF803719
<i>Pteroeides</i> sp.	DQ302871	<i>Nicella carinata</i>	KF803720
<i>Pteroeides griseum</i>	MT968965	<i>Nicella obesa</i>	KF803727
<i>Pteroeides caledonicum</i>	MK133429	<i>Nicella toepitziae</i>	KF803730
<i>Pteroeides</i> sp.1	MK133370	<i>Nicella</i> sp.	KC788269
<i>Pteroeides</i> sp.2	MK133387	<i>Nicella</i> sp.	KF803728
<i>Pteroeides</i> sp.2	MK133452	<i>Nicella</i> sp.	KC788269
<i>Pteroeides</i> sp.3	MK133371	<i>Nicella</i> sp.	KF803729
<i>Pteroeides</i> sp.4	MK133467	<i>Verrucella</i> sp.	DQ302864
<i>Pteroeides</i> sp.5	MK133521	<i>Viminella flagellum</i>	KF803745
<i>Pteroeides</i> sp.6	MK133527	<i>Viminella</i> sp.	GQ342493
<i>Ptilella grandis</i>	MK603844	<i>Viminella</i> sp.	JX203794