

**Supplementary material**

**Across the benthic and pelagic realms: a species-level phylogeny of Benthescymidae  
(Crustacea : Decapoda)**

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**Table S1. Material used for morphological analyses**

MNHN and BSM numbers - National Museum of Natural History (Paris, France); NMNH and USNM numbers, National Museum of Natural History, Washington, DC, USA; NHMD and ZMA numbers, National History Museum, Copenhagen, Denmark; NHMUK numbers, Natural History Museum, United Kingdom; YPM numbers, Yale Peabody Museum

Species	Coordinates	Cruise and station information	Museum number
<i>Altelatipes carinatus</i>	20°47.4'S; 55°04.4'E	“Marion Dufrense”, MD/32 St. CP 105	MNHN-Na-6448
<i>Bentheogennema corbariae</i> <b>holotype</b>	01°43'N; 87°08'E	“Marion Dufresne”, SAFARI II, St. CP 10. Central Indian Ocean, 2.08.1981., Prof. 4350 m.	MNHN-Na-6453
<i>Bentheogennema corbariae</i> , <b>paratype</b>	13°22'S; 43°38'E	Madagascar GS 2 13:30-14:00, Grand Shmidt, 0- 2000 m, 4/12/1974	MNHN-IU-2016-11805
<i>Bentheogennema intermedia</i> , <b>holotype</b>	-	“Challenger” Exp., off Sierra Leone	NHMUK:ecatalogue:1256676
<i>Bentheogennema intermedia</i>	32°28'N; 59°75'W	“Knorr” Exp., 18.03.1974 St. RHB 3114, depth 3100 m	USNM-167826
<i>Bentheogennema intermedia</i>	39°59.1'N; 15°00.2'W	ABYPLANE, St. CP14, chaultage 5330 m. 8.06.1981, 14:55 – 16:00.	MNHN-Na-12445
<i>Bentheogennema intermedia</i>	39°59.1'N; 15°00.2'W	ABYPLANE, St. CP14, chaultage 5330 m. 8.06.1981, 14:55 – 16:00.	MNHN-Na-12445
<i>Bentheogennema intermedia</i>	15°13'S, 42°14'E	“Vityaz”, 17 cruise, St. 2616	-
<i>Bentheogennema intermedia</i>	30°17'N. 20°44'W	“Dana” 1921/1922, St. 1152 (1). 22.10.1921 M.W. 7000, 19:30. E. 300	-
<i>Bentheogennema intermedia</i>	15°59'S, 5°52.3'W	“Dana”, St. 3986, 22-2-1930. 3550 m	-
<i>Bentheogennema intermedia</i>	15°13'S, 42°14'E	“Vityaz”, 17 cruise, St. 2616	-
<i>Bentheogennema intermedia</i>	23°18'S, 42°14'E	“Vityaz”, 17 cruise, St. 2642	-
<i>Bentheogennema intermedia</i>	3°38'S; 52°43'E	Galathea, 266; TOT. Mombasa-Seychelles, 27.3.1951, 4700-4970 m	NHMD-228678
<i>Bentheogennema stephenseni</i>	23°40'S; 168°05'E	New Caledonia	BSM51
<i>Bentheogennema stephenseni</i>	22°51'S; 166°23'E	New Caledonia	MNHN-IU-2016-11804
<i>Bentheogennema stephenseni</i>	28°17.6'S, 177°1.0'E	Dana st. 3624-1, ca. 760 km N of New Zealand depth 4170 m, 5000 m wire, ring trawl, 10.12.1928.	YPM IZ 009397.CR
<i>Bentheogennema stephenseni</i>	20°00'S, 174°29'E	Dana st. 3602-6, W of Fiji Islands, depth 3100 m, 4000 m wire, ring trawl, 22.11.1928	YPM IZ 040238
<i>Bentheogennema stephenseni</i>	25°47'S, 172°24'E	Dana st. 3621-1, SE of New Caledonia, depth 4090 m, 5000 m wire, ring trawl, 8.12.1928	YPM IZ 040239
<i>Bentheogennema torbenwolffi</i> , <b>holotype</b>	3°38' S; 52°43' E	“Galathea”, St. 266. Mombasa-Seishelles 27.3.51, 4700-4970 m.	NHMD-228683
<i>Bentheogennema torbenwolffi</i> <b>paratype</b>	3°38'S; 52°43'E	“Galathea”, 266. Mombasa-Seychelles. Depth 4700-4970; 27.3.1951	NHMD-228681
<i>Benthesicymus altus</i>	11°59.8'S; 45°42.6'E	BENTHEDI, St. 82 CH, Entre Mayotte et le ban du Geyser. 3450 m, 01.04.1977.	MNHN-Na-6380et9998
<i>Benthesicymus altus</i>	20°32.7'S; 55°40.9'E	“Marion Dufense”, MD/32, La Reunion Station CP 146; 2830-2850 m, 4.09.1982.	MNHN-Na-6390
<i>Benthesicymus howensis</i>	24°16'S; 167°38'E	“Tagangaroo” campagne HALIPRO2 Nouvelle-Caledonie: Ride de Norfolk. Stn. BT75, 1128-1150 m, 21.11.1996	-
<i>Benthesicymus iridescens</i>	37°20'N; 15°38'W	ABYPLANE, St. CP02 Chaulage 4490 – 4330 m, 18.05.1981, 9:44-10:35. 12422	-
<i>Benthesicymus iridescens</i>	44°41.9'N; 17°59.1'W	ABYPLANE, St. CP22 Chaulage 4990 m. 21.07.1981, 6:15-7:25. 12427	-
<i>Benthesicymus iridescens</i>	14°20'S; 45°09'E	“Galathea”, St. No. 217	-
<i>Benthesicymus investigatoris</i>	02°41'S; 150°03'E	N.O. “Alice”, Stn. CP3651, PAPOUASIE NOUVELLE-GUINEE: Sub de la Nouvelle Hanovre, BIOPAPUA. 840-865 m, 24.08.2010	-
<i>Benthesicymus investigatoris</i>	05°59'S; 147°39'E	N.O. “Alise”, Stn. CP3724, PAPOUASIE NOUVELLE-GUINEE: Vitiaz strait, BIOPAPUA. 860-880 m. 07.10.2010	-
<i>Benthonectes filipies</i>	03°57'S; 153°49'E	N.O. “Alis”, BIOPAPUA. Stn. CP3762	-
<i>Boreogennema borealis</i>	28°03.95'N; 130°31.89'E	“Tansei-Maru”, KT-02 cruise, ST-IK-1, 0-2000 m, IKMT-net. 15-04.2002.	MNHN-IU-2016-9205
<i>Boreogennema borealis</i> <b>holotype</b>	-	Sta 3783, U.S. Fish Comission, R/V Albatross, Off Copper (Mednyi) Isl., Kamchatka. 25.06.1900. Depth 2866 m.	NMNH-25241
<i>Gennadas barbari</i>	25°04'S, 97°30'W	RV «Professor Stockman», 18 cruise, St. 1985	-

<i>Gennadas bouvieri</i>	12°20'S; 60°46'E	RV Vityaz, 17 cruise St. 2785	NHMD-138935
<i>Gennadas bouvieri</i>	12°28'S; 48°06'E	RV Vityaz, 17 cruise, St. 2604	NHMD-138936
<i>Gennadas bouvieri</i>	10°18'N; 56°17'E	RV Vityaz, 17 cruise, St. 2578	NHMD-138934
<i>Gennadas bouvieri</i>	St 112 IKMT	RV Logatchev, 37 cruise	NHMD-138937
<i>Gennadas brevirostris</i>	St.234	RV Thor, 1910	NHMD-138939
<i>Gennadas brevirostris</i>	35°53'N; 7°21'W	RV Thor, St.65, 1300 m, 24.2.1909 160 mw	NHMD-138940
<i>Gennadas brevirostris</i>	36°28'N; 9°5'W	RV Thor, St.232, 3760 m, 300 mw. 9.9.1910	NHMD-138941
<i>Gennadas brevirostris</i>	St. 4149(4)	Dana 1930, 11.6.1930	NHMD-138938
<i>Gennadas capensis</i>	23°18'S; 43°19'E	RV Vityaz, 17 cruise St. 2642	NHMD-138944
<i>Gennadas capensis</i>	12°28'S; 48°06'E	RV Vityaz, 17 cruise, St. 2604	NHMD-138942
<i>Gennadas capensis</i>	17°09.821'N. 46°24.913'W	RV Logatchev, 37 cruise, St.99 IKMT	NHMD-138945
<i>Gennadas capensis</i>	12°20'S; 60°46'E	RV Vityaz, 17 cruise, St. 2785	NHMD-138943
<i>Gennadas crassus</i>	5°39'00 S; 39°38'30"E	Indian Ocean (E. African) John Murray Expd, 1933-34. St.121, 21.02.1934, 570 fms.	NHM 1958.6.3.12
<i>Gennadas elegans</i>		ZMUC Dana 1930, St.4139 (3)	-
<i>Gennadas elegans</i>	29°11'N. 14°14'W	ZMUC Dana 1930, St 4017 (1)27.3.1930 M.W. 5000	-
<i>Gennadas gilchristi</i>	32°51'S, 45°16'E	ZMUC RV «Vityaz», 17 cruise, St. 2675	-
<i>Gennadas gilchristi</i>	23°18'S, 43°19'E	ZMUC RV «Vityaz», 17 cruise, St. 2642	-
<i>Gennadas gilchristi</i>	33°22'S, 43°50'E	ZMUC RV «Vityaz», 17 cruise, St. 2714	-
<i>Gennadas incertus</i>	12°28'S, 48°06'E	ZMUC RV «Vityaz», 17 cruise, St. 2604	-
<i>Gennadas incertus</i>	11°58'S, 60°36'E	ZMUC RV «Vityaz», 17 cruise, St. 2789	-
<i>Gennadas incertus</i>	12°28'S, 48°06'E	ZMUC RV «Vityaz», 17 cruise, St. 2604	-
<i>Gennadas kempi</i>	29°39'S, 37°01'E	ZMUC Galathea Exp, 1950-52, St.200, depth 5110, 18.2.1951	-
<i>Gennadas kempi</i>		ZMUC Galathea Exp. 1950-1952, St. 200, Off Natal. HOT., Depth 5100 m, 18.2.1951, 21-55.	-
<i>Gennadas parvus</i>	29°39'S, 37°01'E		-
<i>Gennadas parvus</i>	12°06'S, 60°39'E	ZMUC RV «Vityaz», 17 cruise St. 2788	-
<i>Gennadas parvus</i>	12°28'S, 48°06'E	ZMUC RV «Vityaz», 17 cruise, St. 2604	-
<i>Gennadas parvus</i>	32°51'S, 45°16'E	ZMUC RV «Vityaz», 17 cruise, St. 2675	-
<i>Gennadas parvus</i>	St.3919(2)	ZMUC Dana 1929, St.3919(2), 8.12.29	-
<i>Gennadas propinquus</i>	11°58'S, 60°36'E	ZMUC RV «Vityaz», 17 cruise St. 2789	-
<i>Gennadas propinquus</i>	12°28'S, 48°06'E	ZMUC RV «Vityaz», 17 cruise, St. 2604	-
<i>Gennadas pasithea</i>			
<b>holotype</b>	03°14'N. 75°21'E	“Siboga”, St. 230, 03°58' S, 128°20' E, 0-2000 m	ZMA.CRUDS.D.102591
<i>Gennadas pasithea</i>			
<b>paratype</b>	04°52 N. 77°08'E	“Siboga”, St. 230, 03°58' S, 128°20' E, 0-2000 m	ZMA.CRUDS.D.102591
<i>Gennadas pasithea</i>	12°05'S, 96°45'E	“Dana”, St. 3844-5, 1000 MW E-300 11.10.1929	-
<i>Gennadas pasithea</i>	05°18'N. 90°55'	“Dana”, St. 3904-1, E 3500 MW E-300 18.11.1929	-
<i>Gennadas pasithea</i>	05°21'N. 80°38'E	“Dana”, St. 3909-3, 3500 MW E-300 22.11.1929	-
<i>Gennadas pasithea</i>	01°20'S, 138°42'E	“Dana”, St. 3768-4, 2500 MW E-300 24.07.1929	-
<i>Gennadas pasithea</i>	09°09'S, 114°47'	“Dana”, St. 3804-1, E 1000 MW E-300 30.08.1929	-
<i>Gennadas pasithea</i>	04°03'N. 123°26'	“Dana”, St. 3683-1, E 5000 MW E-300 02.04.1929	-
<i>Gennadas pasithea</i>	03°36'N. 58°19'E	“Dana”, St. 3921-2, 600 MW S-200, 11.12.1929	-
<i>Gennadas pasithea</i>	00°06'N. 118°43'	“Dana”, St. 3795-1, E 1000 MW E-300 14.08.1929	-
<i>Gennadas pasithea</i>	01°45'N. 71°05'E	“Dana”, St. 3917-1, 4200 MW E-300, 05.12.1929	-
<i>Gennadas pasithea</i>	04°05'S, 128°16'E	“Dana”, St. 3678-2, 4000 MW S-150 24.03.1929	-
<i>Gennadas pasithea</i>	05°62'S, 131°14'E	“Dana”, St. 3676-9, 3000 MW S-150 23.03.1929	-
<i>Gennadas pasithea</i>	03°20'N. 123°50'	“Dana”, St. 3739-8, E 3000 MW E-300 02.07.1929	-
<i>Gennadas pasithea</i>	05°18'N. 90°55'E	“Dana”, St. 3904-3, 2500 MW E-300 18.11.1929	-
<i>Gennadas pasithea</i>	01°42'N. 96°05'E	“Dana”, St. 3828-7, 3000 MW E-300 08.09.1929	-

<i>Gennadas pasithea</i>	03°45'N. 56°33'E	“Dana”, St. 3922-1, 1000 MW E-300, 12.12.1929	-
<i>Gennadas scutatus</i>	12°28'S; 48°06'E	RV Vityaz, 17 cruise, St. 2604	NHMD 138959
<i>Gennadas scutatus</i>	10°18'N; 56°17'E	RV Vityaz, 17 cruise, St. 2578	NHMD-138960
<i>Gennadas sordidus</i>	10°18'N. 56°17'E	ZMUC RV «Vityaz», 17 cruise St. 2578	-
<i>Gennadas talismani</i>	3°45'S, 10°00'W	Dana 1930, St. 3999, mw 600, S 200	NHMD-138962
<i>Gennadas talismani</i>	St. 3999-2	Dana 1930	NHMD-138963
<i>Gennadas tinayrei</i>	10°18'N. 56°17'E	ZMUC RV «Vityaz», 17 cruise, St. 2578	-
<i>Gennadas tinayrei</i>	31°06'S, 46°14'E	ZMUC RV «Vityaz», 17 cruise, St. 2777	-
<i>Gennadas valens</i>	17°08.210'N. 46°30.09'W	RV Logatchev, 37 cruise, St. 112 RTAK	NHMD-138966
<i>Gennadas valens</i>	35°53'N; 7°21'W	RV Thor St. 65, 1300 m, 24.2.1909, 1600 mw	NHMD-138967

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**Table S2. Character scoring**

Character		State
<b>CARAPACE</b>		
0. Carapace, hepatic spine	absent	present
1. Carapace, well-developed branchiostegal spine set on anterior margin	absent	present
2. Carapace, rudimentary branchiostegal spine set on anterior margin	absent	present
3. Carapace, branchiostegal spine set behind anterior margin	absent	present
<b>PLEON</b>		
4. Pleon, III somite, carina	absent	present
5. Pleon, III somite, a short posteromedian spine	absent	present
6. Pleon, IV somite, carina	absent	present
7. Pleon, IV somite, posterolateral margin	not crenate	crenate
8. Pleon, V somite, carina	absent	present
9. Pleon, V somite, long posteromedian lash	absent	present
10. Pleon, VI somite, dorsolateral carina	absent	present
11. Pleon, VI somite, ventrolateral carina	absent	present
12. Pleon, somite VI greatly elongate, >2.5 times as long as somite V	absent	present
13. Pleon, VI somite, Posteromedian margin	not curved upward	curved upward
14. Pleon, VI somite, dorsolateral groove	absent	present
15. Telson apically	subtriangular	truncate
16. Telson, dorsolateral spines in addition to apical spines	absent	present
17. Telson, a single dorsolateral movable spine set near dorsal margin	absent	present
18. Telson, three (rarely 2) dorsolateral movable spines along lower margin	absent	present
19. Telson, a single dorsolateral movable spine set near ventral margin at ~3/4 of telson length	absent	present
<b>MOUTHPARTS</b>		
20. Maxilliped I, exopod distally gently tapering to tip	absent	present
21. Maxilliped I, exopod distally suboval	absent	present
22. Maxilliped I, exopod distally abruptly narrowing to segmented distal part	absent	Present
23. Maxilliped II, merus	not significantly expanded	greatly expanded
	>3 times as long as broad	<3 times as long as broad
	broad	broad
24. Maxilliped III, triangular dactylus	absent	present
25. Maxilliped III, subrectangular dactylus	absent	present
26. Maxilliped III, unarmed dactylus	absent	present
27. Maxilliped III, dactylus bearing a single strong spine at tip	absent	present
28. Maxilliped III, dactylus bearing several strong spines at tip	absent	present
<b>PEREPODS</b>		
29. Pp 1, basis, a specialized distal tooth	absent	present
30. Pp 1, ischium, distal tooth	absent	present
31. Pereopods IV, dactyl	entire	multiarticulate
32. Pereopods V, dactyl	entire	multiarticulate
<b>THELYCUM</b>		
33. S6 modified	absent	present
34. S6 with posterior smooth cucullate projection	absent	present
35. S6 entire, with elaborate relief (shields and protuberances)	absent	present
36. P6 simple	absent	present
37. S6, wide rounded larbrum-like posterior scutum	absent	present
38. S6 with a strong medial tooth	absent	present
39. S6, posterior subtriangular prominence bearing tufts of sensory setae	absent	present
40. S6, a pair of posterior setose protuberances	absent	present
41. S6 with posteriorly directed scutum in anterior part	absent	present
42. S6, large entire posteriorly extended scutum in posterior part	absent	present
43. S6, beak-like posterior shield directed posteriorly	absent	present
44. S7 modified in shape	absent	present
45. S7	entire	divided into two parts
46. S7 pentagonal	absent	present
47. S7 trapezoid, anteriorly widening	absent	present
48. S7 shortened, half as long as S6	absent	present
49. S7 as a trapezoid scutum narrowing anteriorly	absent	present
50. S7 as a suboval scutum directed forward	absent	present
51. S7 as anteriorly directed scutum with the bat-like anterior profile	absent	present
52. S7 as anteriorly directed scutum lacking sensory setae	absent	present
53. S7 with additional posteriorly directed scutum	absent	present
54. S7 as a simple oval plate	absent	present
55. S7 trapezoid, anteriorly narrowing	absent	present
56. S7, a single protuberance projecting anteriorly	absent	present
57. S7, a long linguiform protuberance	absent	present
58. S7, a suboval protuberance	absent	present
59. S7, robust setae on posterior margin	absent	present
60. AS7 as two separate structures	absent	present
61. PS7 subrectangular or trapezoid, not extending laterally beyond level of coxae	absent	present

Character		State
62. PS7 subtriangular, beak-like tip directed forward	absent	present
63. PS7 trapezoid, anteriorly bifid	absent	present
64. PS7 as a narrow transverse crest	absent	present
65. PS7 laterally produced beyond coxae	absent	present
66. PS7 with 2 groups of sublateral setae in addition to 2 groups of sublateral setae	absent	present
67. S7, tufts of sensory setae extending from deep invaginations	absent	present
68. S8 with enlarged specialized sternite	absent	present
69. S8, tufts of sensory setae extending from deep invaginations	absent	present
70. S8, solitary setae extending from deep invaginations	absent	present
71. S8 medial tooth in anterior part	absent	present
PETASMA		
72. Petasma as a wide unserrated lamina	absent	present
73. Petasma with lateral part produced into PM or PE	absent	present
74. Petasma as a narrow armed lamina	absent	present
75. Petasma moderately elongate with convex outer margin	absent	present
76. Petasma greatly elongate with convex outer margin	absent	present
77. Petasma, greatly elongate with concave outer margin	absent	present
78. Petasma, setae on basal part	absent	present
79. LA	absent/rudimentary	present
80. LA with a greatly extended apron-like apical structure	absent	present
81. Petasma 2-branched (except gs and LA)	absent	present
82. Petasma 3-branched (except gs and LA)	absent	present
83. Petasma 4-branched (except gs and LA)	absent	present
84. PI with specialized gs in distal part	absent	present
85. PI with gs elaborated, enlarged, bearing modified cincinnuli	absent	present
86. PI, a semicircular lamina	absent	present
87. PI, a semicircular lamina serrate	absent	present
88. PI, fanlike appendix armed with strong teeth	absent	present
89. PM elaborate, developed	absent	present
90. PM as a simple straight lamina	absent	present
91. PM serrate	absent	present
92. PM as a serrate lamina	absent	present
93. PM armed with circinnuli in numerous rows	absent	present
94. PM armed with long lashes	absent	present
95. PM, long lashes in numerous rows	absent	present
96. PM, forming an elaborate grasping structure	absent	present
97. PM, a "devil s throat"	absent	present
98. PE	absent	present
99. PE entire, unspecialized	absent	present
100. PE modified (divided or scoop-like)	absent	present
101. PE furciform	absent	present
102. PE furciform with external part straight	absent	present
103. PE furciform with external part hooked	absent	present
104. PE modified, shallowly cleft or entire	absent	present











**Table S4. Primers and PCR programs**

Fragment	Primer name	Primer sequence	PCR protocol	Primer reference
<i>COI</i>	COL6	TYTCHACAAAACATAAAGAYATYGG	45"/60"/60" 48°C	Schubart, 2009
<i>16S</i>	COH6	TADACTTCDGGRTGDCCAAARAAYCA	40 cycles	Schubart, Huber 2006
	16L2	TGCCTGTTTATCAAAAACAT	25"/25"/60" 47°C	Schubart <i>et al.</i> 2002
	16H3	CCGGTTTGAACTCAAATCATGT	37 cycles	Reuschel and Schubart, 2006
<i>H3</i>	H3A	ATGGCTCGTACCAAGCAGACVGC	40"/40"/45" 54-58°C	Colgan <i>et al.</i> 1998
	H3B BenthH3F	ATGGCTCGTACCAAGCAGAC CAAGGCTCCTCGCAAGCA	40 cycles 40"/40"/45" 54°C	Colgan <i>et al.</i> 1998 Vereshchaka <i>et al.</i> 2019
<i>18S</i>	BenthH3R	RTGGATGGCACACAGGTTG	40 cycles	Vereshchaka <i>et al.</i> 2019
	A (revers is L)	AACCTGGTTGATCCTGCCAGT	20"/25"/60"	Apakupakul <i>et al.</i> 1999
	L	CCAACTACGAGCTTTTTAACTG	55°C	Apakupakul <i>et al.</i> 1999
	C (revers is Y)	CGGTAATTCCAGCTCCAATAG	40 cycles	Apakupakul <i>et al.</i> 1999
	Y	CAGACAAATCGCTCCACCAAC		Apakupakul <i>et al.</i> 1999
	O (revers is B)	AAGGGCACCACCAGGAGTGGAG		Apakupakul <i>et al.</i> 1999
	18Sar (primer pair is A, length ~400 bp)	GATGTGGTAGCCGTTTCTCAGG	90"/60"/60"	Vereshchaka <i>et al.</i> 2019
	D18s4R	TGGTAATTCTAGAGCTAATAC	52°C	Bracken <i>et al.</i> 2009
	D18s4Fm (primer pair is D18s4R, length ~450 bp)	GCAACAACCTTAAATATACGC	40 cycles	modified of Bracken <i>et al.</i> 2009
	D18s3R	TGGAGGGCAAGTCTGGTG		Bracken <i>et al.</i> 2009
	D18s3F (primer pair is D18s3R, length ~500 bp)	GGT TAG AAC TAG GGC GGT ATC		Bracken <i>et al.</i> 2009
	D18s2R	AGATACCGCCCTAGTTCTAACC		Bracken <i>et al.</i> 2009
	D18s2F (primer pair is D18s2R, length ~600 bp)	TCTAAGGGCATCACAGACCTG		Bracken <i>et al.</i> 2009
	7Fm (primer pair is B, length ~500 bp)			Giribet <i>et al.</i> 1996
<i>PEPCK</i>	18sBF1	TCCGATAACGAACGAGACTCTA	90"/60"/60"	Vereshchaka <i>et al.</i> 2019
	18sBR1 (primer pair is 18sBF1, length ~300 bp)	CCAGAACATCTAAGGGCATCA	52°C	Vereshchaka <i>et al.</i> 2019
	18sBF2	ATAACAGGTCTGTGATGCCCTTA	37 cycles	Vereshchaka <i>et al.</i> 2019
	18sBR2 (primer pair is 18sBF2, length ~200 bp)	GGGCGGTGTGTACAAAAGG		Vereshchaka <i>et al.</i> 2019
	18sBF3	CGATTTAGTCCCTGCCCTTT		Vereshchaka <i>et al.</i> 2019
	18sBR3 (primer pair is 18sBF2, length ~250 bp)	CCTTGTTACGACTTTTACTTCCTC		Vereshchaka <i>et al.</i> 2019
	for	GTAGGTGACGACATTGCTGATGAA	60"/40-60"/60"	Tsang <i>et al.</i> 2008
	rev3	CGGGYCTCCATGCTGCTSAGCCARTG	55-60°C	Tsang <i>et al.</i> 2008
	benth-rev1 (primer pair is for ~340 bp)	CTGGTGTACAGAACCCTGGAGTTG	37 cycles	This study
	benth-for2 (primer pair is rev3 ~310 bp)	GCTCATCCCAACTCCAGTTCT		This study
<i>NaK</i>	for-b	ATGACAGTTGCTCATATGTGGTT	30-60"/40-60"/60"	Tsang <i>et al.</i> 2008
	rev2	ATAGGGTGATCTCCAGTRACCAT	50-56°C	Tsang <i>et al.</i> 2008
	benth-rev1 (primer pair is for-b ~380 bp)	GGGCTCCCTTCATCACAAG	37 cycles	This study
	benth-for2 (primer pair is rev2 ~415 bp)	ACCAACAAGTACCAAGTGTCCA		This study
	benth-for3 (primer pair is benth-rev1 ~350 bp)	TGACAAAYACCATCATTGAAGC		This study
	benth-rev3 (used only in sequencing reaction after amplification with the primers benth-for2/rev2 to prevent the sequencing of pseudogenes, ~380 bp)	TGATACCAGCRGAYCGRAC		This study

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**Table S5. Numbers of synapomorphies of each group (see grouping in Fig. 1) supporting branches on the morphological tree (Fig. 3)**

Clades	Carapace 0-3	Pleon 4-19	Mouthparts 20-28	Pereopods 29-32	Thelycum 33-71	Petasma 72-104
1.	0	0	1	0	2	2
2.	0	1	0	2	0	4
3.	0	0	0	0	2	0
4.	0	1	0	0	1	0
5.	0	0	0	0	1	0
6.	0	1	2	2	0	1
7.	0	0	0	0	1	1
8.	1	1	0	0	1	2
9.	0	1	2	0	0	0
10.	0	1	0	0	0	0
11.	0	1	0	0	0	0
12.	0	0	0	0	0	3
13.	0	1	0	0	0	0
14.	0	1	2	0	0	0
15.	0	1	0	0	0	0
16.	0	0	0	0	0	1
17.	1	0	0	0	2	2
18.	0	0	4	0	0	0
19.	0	0	0	0	3	0
20.	0	0	1	0	1	0
21.	0	1	0	0	1	3
22.	2	0	0	0	2	5
23.	0	3	1	0	0	3
24.	0	1	0	0	1	0
25.	2	0	0	0	3	0
26.	0	1	0	0	0	0
27.	0	0	0	0	1	0
28.	0	1	0	0	1	0
29.	0	1	0	0	0	0
30.	0	1	0	1	0	0
31.	0	0	0	0	1	0
32.	0	0	0	0	2	0
33.	0	0	0	0	2	4
34.	0	0	0	0	0	2
35.	0	0	0	0	0	2
36.	0	0	0	0	0	1
37.	0	0	0	0	3	2
38.	0	0	0	0	1	2
39.	0	0	0	0	0	1
40.	0	0	0	0	2	3
41.	0	0	0	0	2	2
42.	0	0	0	0	1	0
43.	0	0	0	0	1	0

## Retrieved trees

GC values, 10000 replicates, cut=1 (tree 0) - Standard Bootstrap



Fig. S1. Morphological tree, bootstrap support values, Analysis 1.

Bremer supports (from 5798 trees, cut 0)



Fig. S2. Morphological tree, Bremer support values, Analysis 1.

GC values, 10000 replicates, cut=1 (tree 0) - Standard Bootstrap



Fig. S3. Morphological tree, bootstrap support values, Analysis 2.



Bremer supports (from 5832 trees, cut 0)



Fig. S4. Morphological tree, Bremer support values, Analysis 2.

GC values, 10000 replicates, cut=1 (tree 0) - Standard Bootstrap



Fig. S5. Morphological tree, bootstrap support values, Analysis 3.

Bremer supports (from 5832 trees, cut 0)

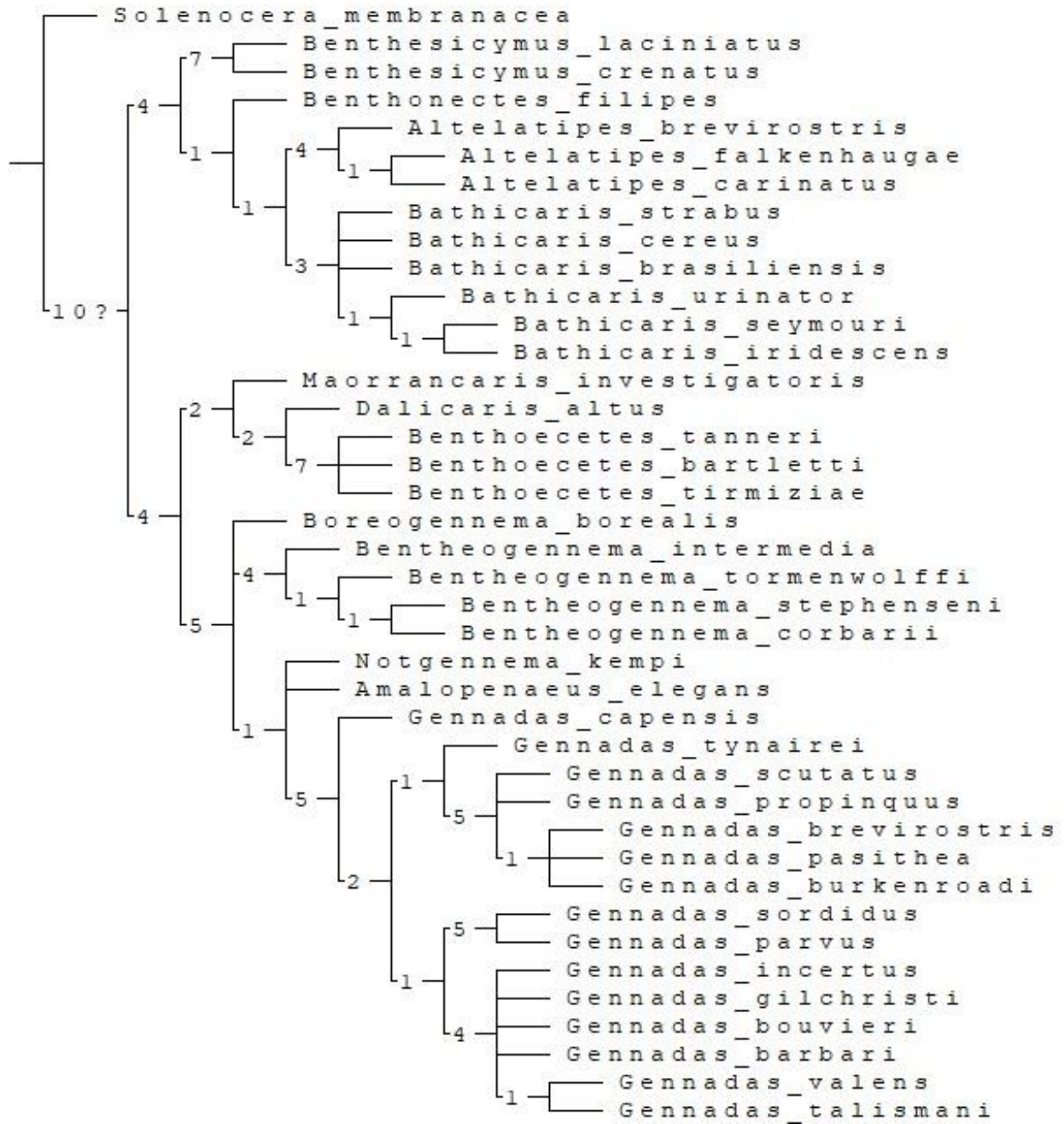
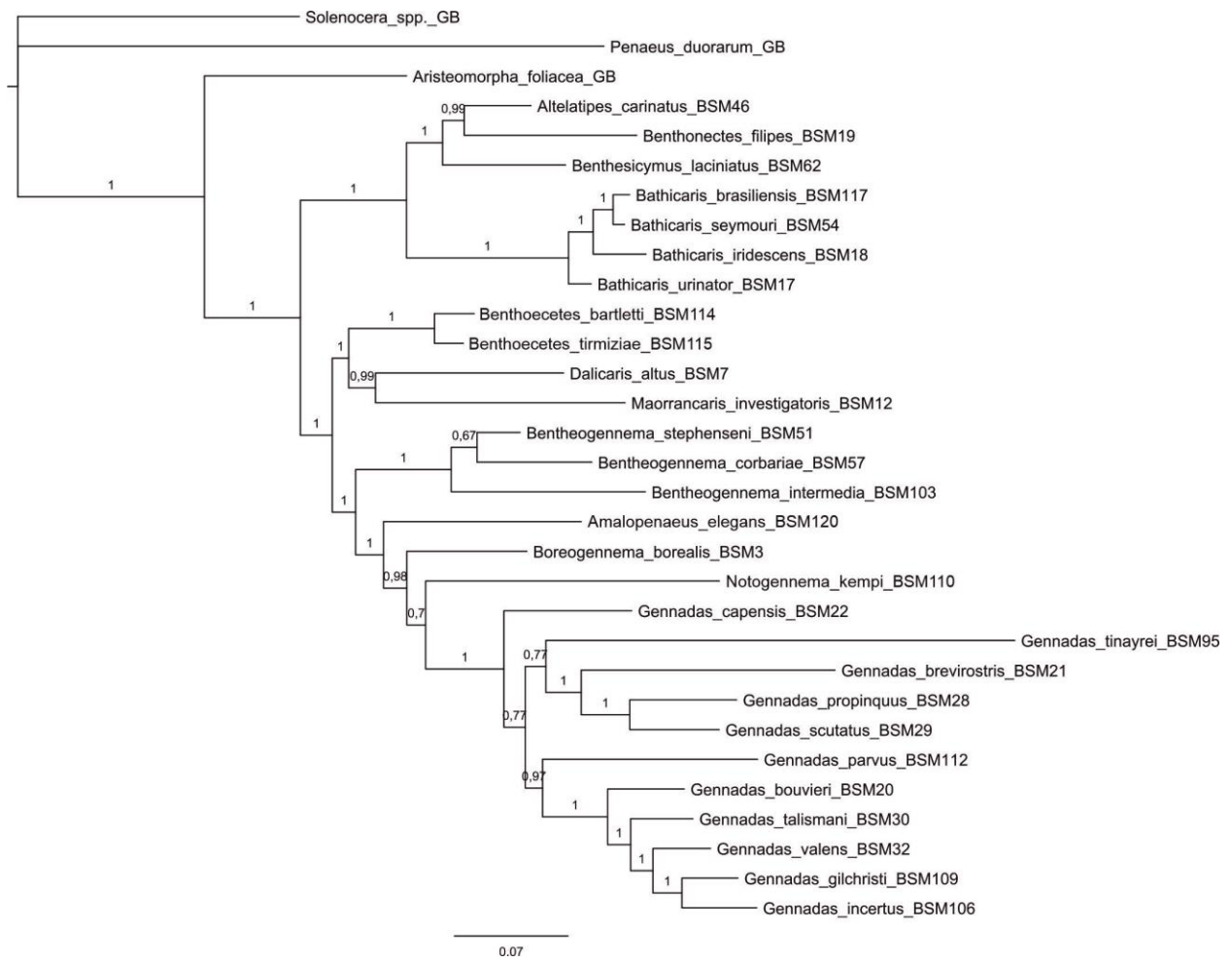
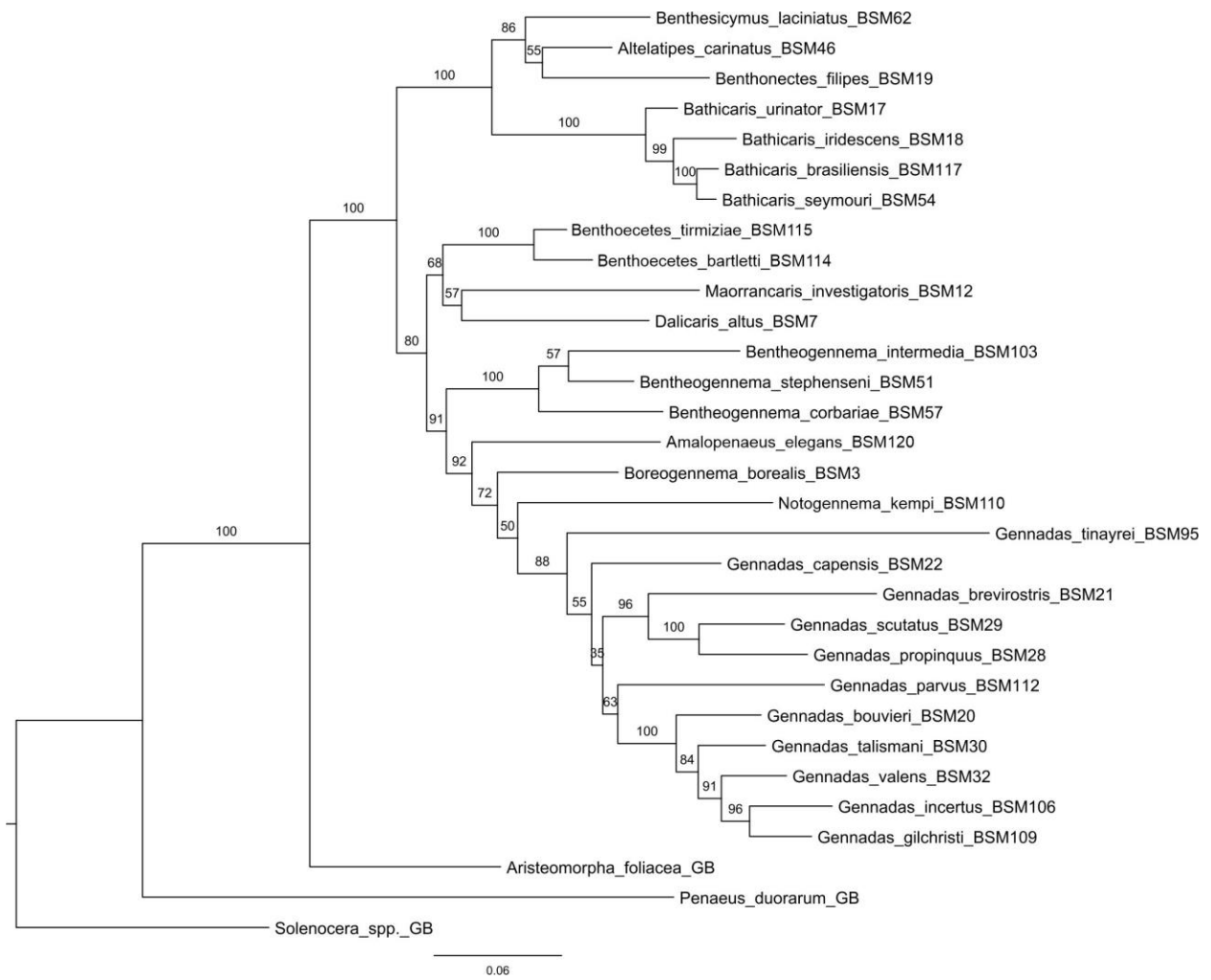


Fig. S6. Morphological tree, Bremer support values, Analysis 3.



**Fig. S7.** Benthescymidae BI molecular tree.



**Fig. S8.** Benthescymidae ML molecular tree.