

**Supporting Information, Table S1.** The character coding

No	Character	States
0	Orbital margin with acute tooth	absent; present
1	Orbital margin serrate	absent; minutely; prominently
2	Suborbital angle acute	absent; present
3	Fifth pleonic somite, dorsal elevations	absent; present
4	Fifth pleonic somite, large dorsal elevations	absent; present
5	Fifth pleonic somite, dorsal lappet	absent; present
6	Fifth pleonic somite, posterodorsal spine	absent; present
7	Sixth pleonic somite, No of teeth on ventrolateral margin	absent; 1; 2; 3
8	Sixth pleonic somite, dorsal lappet	absent; present
9	Sixth pleonic somite, posterodorsal spine	absent; present
10	Telson, one pair of dorsolateral spines	absent; present
11	Telson, two pairs of dorsolateral spines	absent; present
12	Telson, minute spines between bases of median pair of large posterior spines	absent; present

**Supporting Information, Table S2.** Dataset of character states.

	0	5	10
Pasiphaea sivado	00000000000000		
Leptochela aculeocaudata	0000000100100		
Leptochela bermudensis	0000000100101		
Leptochela carinata	1001100110010		
Leptochela chacei	0000000300100		
Leptochela crosnieri	1000000100010		
Leptochela gracilis	0000001100100		
Leptochela hawaiiensis	0100000100101		
Leptochela irrobusta	1000000100010		
Leptochela japonica	0001000100100		
Leptochela nasimae	0210000300011		
Leptochela papulata	0001000100100		
Leptochela pugnax	0010000100100		
Leptochela robusta	1000000100010		
Leptochela serratorbita	0210000100011		
Leptochela soelae	1001110110010		
Leptochela sydniensis	0000000100100		
Leptochela tuerkayi	0000001300100		
Leptochela elevata	0001110100100		

**Table S3. Primer information and protocols used for PCR amplification.**

Gene	Primer	Sequence (5'–3')	PCR protocol	Reference
COI (~320bp)	COI-Hym-F2	TGGGACAGGKTGAACTRYYTATCC	45"/60"/60" 48°C 40 cycles	Lunina et al., 2024 Schubart, Huber 2006
	COH6	TADACTTCDGGRTGDCCAAARAAYCA		
16S (~520 bp)	16L2	TGCCTGTTTATCAAAAACAT	25"/25"/60" 47°C 37 cycles	Schubart et al., 2002 Reuschel and Schubart, 2006
	16H3	CCGGTTTGAAGTCAAATCATGT		
12S (~360bp)	12S-psF1	RTRTARAWTAGGATTAGATACCC	30"/45"/60" 48°C 40 cycles	This study
	12S-psR1	GAGAKTGACGGGCRATDTGTRC		
H3 (328 bp)	H3A	ATGGCTCGTACCAAGCAGACVGC	40"/40"/45" 56°C 40 cycles	Colgan et al., 1998
	H3B	ATGGCTCGTACCAAGCAGAC		
Enolase (372 bp)	EA2	AGTTGGCTATGCAGGARTTYATGAT	30"/30"/60" 53°C 40 cycles	[55]
	ES2	ACCTGGTCGAATGGRTCCTC		

**Bibliography :**

Tsang LM, Ma KY, Ahyong ST, Chan TY, Chu KH. 2008. Phylogeny of Decapoda using two nuclear protein-coding genes: origin and evolution of the Reptantia. *Molecular Phylogenetics and Evolution* 48: 359–368.

**Table S4. Details of the analyzed species and sequences used in the study.** Newly generated sequences are highlighted in bold.

Taxon	Voucher	Sampling locality	COI	16S	12S	H3	Enolase
Family Pasiphaeidae							
<i>Leptochela crosnieri</i>	OUMNH.ZC. 2013-05-067	Australia	–	MF279501	MF279462	MF279391	MF279359
<i>Leptochela elevata</i> sp n.	MNHN-IU- 2010-4966 (PSP76)	Madagascar	PQ576544	PQ587577	PQ587578	PQ594820	PQ594821
<i>Leptochela gracilis</i>	NTOU	Taiwan	OL877198	MF279502	MF279463	MF279392	–

	M02029, NSMK-MS- 0025576						
<i>Leptochela japonica</i>	NTOU M02030	Taiwan	–	MF279503	MF279464	MF279393	MF279360
<i>Leptochela robusta</i>	NMV J58410	Australia	–	MF279504	MF279465	MF279394	–
<i>Leptochela serratorbita</i>	OUMNH.ZC. 2009-18-006, USP:CCDB:4 120	Panama, Brazil	OM672406	MF279505	–	MF279395	MF279361
<i>Eupasiphae gilesii</i>	OUMNH.ZC. 2011-07-023, HBG6102	Indian Ocean, Gulf of Mexico	MH572595	MF279497	MF279458	MF279387	MF279355
<i>Eupasiphae serrata</i>	NTOU M02028, HBG4189	Taiwan, Gulf of Mexico	MH572540	MF279499	MF279460	MF279389	MF279357
<i>Glyphus marsupialis</i>	MNHN IU- 2014-6331, MNHN-IU- 2011-5630	Papua New Guinea, Solomon Islands	KP759402	MF279500	MF279461	MF279390	MF279358
<i>Parapasiphae sulcatifrons</i>	NTOU M0203	Taiwan	–	MF279507	MF279466	MF279397	MF279362
<i>Pasiphaea sivado</i>	OUMNH.ZC. 2004-21-033, Crust 18652V	North Sea	MG935259	MF279526	MF279485	MF279416	MF279380
<i>Psathyrocaris fragilis</i>	NTOU M02034	Taiwan	–	MF279527	MF279486	MF279417	MF279380
Family Acanthephyridae							
<i>Acanthephyra armata</i>	MNHN-IU- 2013-2686		PQ314238	PQ315558	PQ315580	PQ346668	PQ346728

**Table S5. Partitioning scheme and best models selected by PartitionFinder2. 1, first codon; 2, second codon; 3, third codon.**

Partition	Best Model
16S, 12S	GTR+I+G
COI 1	SYM+G
COI 2	TVM+I
COI 3	TIM+G
H3 1	TIM+G
H3 2	JC+I
H3 3	TVM+G
Enolase 1	GTR+I
Enolase 2	TVM+G
Enolase 3	TVM+I