

Supporting Information Appendix S1. Parental females of larvae used for morphological analysis of first stage zoea

Charybdis hellerii (A. Milne-Edwards, 1867): coll. J. Dineen, April 1995, Fort Pierce Inlet, Indian River Lagoon, Florida, United States, became ovigerous 13 September 1995, hatched 26 September, reg. no. NHM 2000.420–500. — *Dacryopilumnus rathbunae* Balss, 1932: coll. P. Ng, 30 May 1998, Okinawa, Japan. — *Epixanthus frontalis* (H. Milne Edwards, 1834): coll. P. Clark and J. Paula, Ponta Ponduine, South West Inhaca Island, Mozambique, 15 November 1997, hatched 5 December 1997, reg. no. NHM 2003:192. — *Hypothalassia armata* (De Haan, 1835): coll. A. Gerbault, Nouvelle-Calédonie. — *Epixanthus frontalis* (H. Milne Edwards, 1834): coll. P. Clark and J. Paula, Ponta Ponduine, South West Inhaca Island, Mozambique, 15 November 1997, hatched 5 December 1997, reg. no. NHM 2003:192. — *Eriphia smithii* MacLeay, 1838: coll. S. S. Hashmi, Buleji Rocks, Native Jetty, Manora Island, Karachi, Pakistan, reg. no. NHM reg. 1986:908. — *Lydia annulipes* (H. Milne Edwards, 1834): coll. J. Paula, Cabo Inhaca, North East Inhaca Island, Mozambique, 31 January 2002, hatched 2 February 2002, reg. no. NHM reg. 2003:193. — *Menippe mercenaria* (Say, 1818): coll. P. Clark, potting, 21 April 1997, off Link Port, Smithsonian Marine Station, Harbor Branch Oceanographic Institute, Off Indian River Lagoon, St. Lucie County, Florida, United States, hatched 26–27 April 1997. — *Menippe nodifrons* Stimpson, 1859: coll. L. Scotto, 5 June 1977, sabellarid worm reef, Seminole Shores, Florida, United States, hatched 26 June 1977, reg. no. Harbor Branch Museum I.D. 89:4156. — *Menippe rumphii* (Fabricius, 1798): coll. K. L. Yeo, 8 May 2000, East Coast Park, Singapore, hatched 21 May 2000. — *Myomenippe hardwickii* (Gray, 1831): coll. P. Clark et al. 13 May 2000, Sungel Mandai Kechil mangrove, off Western Johor Straits, Singapore, hatched 19 May 2000. — *Ozius truncatus* H. Milne Edwards, 1834: coll. North Island, New Zealand, 1964, reg. no. NMNZ Cr. 2494, 3071. — *Pseudocarcinus gigas* (Lamarck, 1818): coll. C. Gardener, 300–380m, off east coast of Tasmania, Australia, 41°17'S, 148°40'E, June 1995, reg. no. NHM 1999.1195. — *Trapezia cymodoce* (Herbst, 1801): coll. R. Gurney, Abu Sada, Harghada, Egypt, Red Sea, 1936. — *Xantho hydrophilus* (Herbst, 1790): coll. R. Ingle and J. Paula, Mira Estuary, Portugal, 8 June 1988, reg. no. NHM 2000.1907.

11. First maxilliped endopod segment 1 (character 17 of Clark and Guerao 2008): 3 setae (**0**), 2 setae (**1**).
12. First maxilliped endopod segment 3 with seta (character 18 of Clark and Guerao 2008): absent (**0**), present (**1**).
13. Second maxilliped endopod segment 1, seta 1 (character 21 of Clark and Guerao 2008): present (**0**), absent (**1**).
14. Second maxilliped endopod segment 3, seta 3.5 (character 22 of Clark and Guerao 2008): present (**0**), absent (**1**).
15. Second maxilliped endopod segment 3, seta 3.4 (character 23 of Clark and Guerao 2008): present (**0**), absent (**1**).
16. Abdomen dorsolateral process on somite 4 (character 24 of Clark and Guerao 2008): present (**0**), absent (**1**).
17. Abdomen dorsolateral process on somite 5 (character 25 of Clark and Guerao 2008): present (**0**), absent (**1**).
18. Telson lateral spine 1 (Fig 1): developed (**0**), vestigial (**1**), absent (**2**).
19. Telson lateral spine 2 (Fig 1): developed (**0**), vestigial (**1**), absent (**2**).
20. Telson dorsomedial spine (Fig 1): developed (**0**), vestigial (**1**), absent (**2**).

Supporting Information Table S1. List of species used in DNA analysis with locality data and Genbank accession numbers.

Species	Catalogue number	Sampling Locality	Genbank Accession Numbers				
			12S	16S	18S	COI	H3
<i>Baptozius vinosus</i> (H. Milne Edwards, 1834)	ZRC 2000.1663	Malaysia: Sabah, Kota Kinabalu, Sg. Likas estuary, edge of mangrove	HM637938	HM637963	HM637987	-	HM596612
<i>Carpilius convexus</i> (Forskål, 1775)	ZRC 2008.174	Indonesia: Sulawesi, Manado, reefs off Bunaken Island.	HM637948	HM637981	HM637988	HM638025	HM596605
<i>Carpilius maculatus</i> (Linnaeus, 1758)	ULLZ 7164	United States: Hawaii	GU144423	GU144450	HM637989	HM638026	GU144479
<i>Dacryopilumnus rathbunae</i> Balss, 1932	ZRC 1999.1291	Japan: Okinawa	HM637953	HM637971	HM637990	HM638027	HM596642
<i>Dairoides kusei</i> (Sakai, 1938)	ULLZ 9183	United States: Hawaii, French Frigate Shoals	HM637941	HM637979	HM637992	HM638030	HM596607
<i>Daira perlata</i> (Herbst, 1790)	ZRC 1998.389	Taiwan: Pingtung county, Heng Chun peninsula, Hsiang Chiao Wan	HM637952	HM637983	-	HM638029	HM596632
<i>Daira americana</i> Stimpson, 1860	ULLZ 9049	Panama: Seca Islands	HM637951	HM637982	HM637991	HM638028	HM596630
<i>Daldorfia horrida</i> (Linnaeus, 1758)	ZRC 2003.0651	Guam: Pago Bay, outside University of Guam, Marine Laboratory	HM637940	GQ249177	HM637993	HM638031	GQ249174
<i>Epixanthus corrosus</i> A. Milne-Edwards, 1873	UF 17949	Oman: near Qurum	KC771010	KC771004	KC770998	KC771022	KC771016
<i>Epixanthus dentatus</i> (White, 1848)	ZRC 2000.1745	Indonesia: Sulawesi, mangrove between Mapane and Poso	HM637927	HM637958	HM637995	HM638033	-
<i>Epixanthus frontalis</i> (H. Milne Edwards, 1834)	ZRC 2000.1652	Malaysia: Sabah, Pulau Manukan, under rocks	HM637929	HM637960	HM637996	-	HM596611
<i>Eriphia ferox</i> Koh & Ng, 2008	ZRC 1999.0589	Taiwan: Ma Gang, 45 km east of Kee Lung	HM637932	HM637968	HM637997	HM638034	HM596636
<i>Eriphia gonagra</i> (Fabricius, 1781)	ULLZ 5463	United States, Florida, Ft. Pierce	HM637933	HM637964	HM637998	HM638035	HM596633
<i>Eriphia granulosa</i> A. Milne-Edwards, 1880	ULLZ 5495	Mexico: Baja California, Sur Mulege	HM637935	HM637966	HM637999	HM638036	HM596635
<i>Eriphia scabricula</i> Dana, 1852	UF 13728	Republic of the Marshall Islands: Majuro Atoll, Kolalen	KC771011	KC771005	KC770999	KC771023	KC771017
<i>Eriphia sebana</i> (Shaw and Nodder, 1803)	UF 13417	Republic of the Marshall Islands: Majuro Atoll, Rita	KC771012	KC771006	KC771000	KC771024	KC771018
<i>Eriphia smithii</i> MacLeay, 1838	UF 7807	Oman: near Qurum Beach	KC962405	KC962407	KC962406	KC962408	KC962409
<i>Eriphia squamata</i> Stimpson, 1860	ULLZ 4087	Mexico: Veracruz, Punta Delgada	HM637934	HM637965	HM638000	HM638037	HM596634
<i>Eriphia verrucosa</i> (Forskål, 1775)	ULLZ 4275	Spain: Cadiz	EU863332	EU863398	HM638001	HM638038	GU144467

Species	Catalogue number	Sampling Locality	Genbank Accession Numbers				
			12S	16S	18S	COI	H3
<i>Eriphides hispida</i> (Stimpson, 1860)	ULLZ 9325	Panama: Seca Islands	HM637926	HM637978	HM638002	HM638039	HM596639
<i>Euryozius camachoi</i> Ng and Liao, 2002	ZRC 2008.1478	Philippines: Northwest coast of Panglao, tangle net, 120-160 m	HM637950	HM637970	HM638004	HM638040	HM596643
<i>Eupilumnus laciniatus</i> (Sakai, 1980)	ZRC 2009.0287	Philippines: Panglao 2005, stn CP2359, 437-476 m. 8°49.9'N, 123°34.9'E	HM637937	HM637972	HM638003	-	HM596641
<i>Eupilumnus africanus</i>	ULLZ 11966	Cape Verde Islands, Boavista Is.	KC771013	KC771007	KC771001	KC771025	KC771019
<i>Homalaspis plana</i> (H. Milne Edwards, 1834)	ULLZ 9032	Chile: Coquimbo	HM637939	HM637957	HM638007	HM638043	HM596638
<i>Hypothalassia armata</i> (De Haan, 1835)	ZRC 1999.0999	Taiwan: I-Lan county, Su-ao, Nangfang-ao	HM637936	HM637967	HM638008	HM638044	FJ548933
<i>Ladomedaeus serratus</i> (Sakai, 1965)	ZRC 2009.0342	Taiwan: stn KS13, near shallow hydrothermal vent, just outside port, Tahsi.	HM637923	HM637955	HM638009	HM638045	HM596617
<i>Lobopilumnus agassizii</i> (Stimpson, 1871)	ULLZ 7121	Southwestern Gulf of Mexico	EU863336	EU863402	HM638010	HM638046	GU144475
<i>Lydia annulipes</i> (H. Milne Edwards, 1834)	ZRC 1999.206	Taiwan: Chuan Fan Shr, opposite Longyuanju.	HM637931	HM637961	HM638011	HM638047	HM596610
<i>Menippe adina</i> Williams and Felder, 1986	ULLZ 8639	United States: Florida, Panama City, St. Andrew State Park Jetties	HM637943	HM637973	HM638012	HM638048	HM596625
<i>Menippe mercenaria</i> (Say, 1818)	ULLZ 5464	United States: Florida, Tampa Bay	HM637944	HM637974	HM638013	HM638049	HM596627
<i>Menippe nodifrons</i> Stimpson, 1859	ULLZ 4351	Mexico: Veracruz, Punta Delgada	HM637945	HM637975	HM638014	HM638050	HM596628
<i>Menippe rumphii</i> (Fabricius, 1798)	ZRC 2003.211	Singapore: Labrador Beach	HM637946	HM637976	HM638015	HM638051	HM596626
<i>Myomenippe hardwickii</i> (Gray, 1831)	ZRC 2000.1136	Singapore: Changi River mouth	HM637947	HM637977	-	HM638052	HM596629
<i>Ozium guttatus</i>	ZRC 2005.105	Singapore: Semakau Island	HM637930	HM637959	HM638016	HM638053	-
<i>Ozium reticulatus</i> (Desbonne, in Desbonne and Schramm, 1867)	ULLZ 8420	Mexico: Veracruz, Punta Delgada	GU144414	GU144446	HM638017	HM638054	GU144468
<i>Ozium rugulosus</i> Stimpson, 1858	UF 17613	Australia: Queensland, Mossman	KC924960	KC924959	KC924958	KC924962	KC924961
<i>Ozium tenuidactylus</i> (Lockington, 1877)	ULLZ 5496	Mexico: Baja California, Sur Mulege	HM637928	HM637962	HM638018	HM638055	HM596609
<i>Panopeus herbstii</i> H. Milne Edwards, 1834	ULLZ 8457	United States: Charleston, South Carolina	EU863296	EU863362	HM638019	HM638056	GU144466
<i>Pilumnus floridanus</i> Stimpson, 1871	ULLZ 7317	Southern Gulf of Mexico	HM637949	HM637980	HM638020	HM638057	HM596621
<i>Otmaroxanthus balboai</i> Garth, 1940	ULLZ 11363	Panama: E. Pacific	KC771014	KC771008	KC771002	KC771026	KC771020

Species	Catalogue number	Sampling Locality	Genbank Accession Numbers				
			12S	16S	18S	COI	H3
<i>Platyxanthus orbignyi</i> (H. Milne Edwards and Lucas, 1843)	ULLZ 11714	Peru: bought from fish market	KC771015	KC771009	KC771003	KC771027	KC771021
<i>Pseudocarcinus gigas</i> (Lamarck, 1818)	ZRC 1997.0145	Australia: Purchased from Sydney fish market, collected from waters off Tasmania	HM637942	HM637969	HM638021	HM638058	HM596631
<i>Pseudozius caystrus</i> (Adams and White, 1849)	ZRC 2000.727	Guam: Pago Bay, outside University of Guam, Marine Laboratory	HM637954	HM637984	-	HM638059	HM596624
<i>Tiaramedon spinosum</i> (Miers, 1879)	ULLZ 4563	South Africa: Sodwana Bay	GU144413	GU144441	HM638022	HM638060	GU144476
<i>Xantho pilipes</i> A. Milne-Edwards, 1867	NHM 2010.477	Ireland: Flaggy Shore	HM637925	HM637956	-	HM638061	HM596616

Supporting Information Table S2. Primers used in this study.

Name	Sequence (5'–3')	Reference
12Sf	GAA ACC AGG ATT AGA TAC CC	Buhay <i>et al.</i> 2007
12Slr	AGC GAC GGG CGA TAT GTA C	Buhay <i>et al.</i> 2007
crust16sF1	CCG GTY TGA ACT CAA ATC ATG TAA A	Lai <i>et al.</i> 2009
crust16sR2	TTG CCT GTT TAT CAA AAA CAT GTY TRT T	Lai <i>et al.</i> 2009
16Sar	CGCCTGTTTATCAAAAACAT	Palumbi <i>et al.</i> 1991
16Sbr	CCGGTCTGAACTCAGATCACGT	Palumbi <i>et al.</i> 1991
16L2	TGCCTGTTTATCAAAAACAT	Schubart <i>et al.</i> 2002
1472	AGATAGAAACCAACCTGG	Crandall & Fitzpatrick 1996
18SA	AAC CTG GTT GAT CCT GCC AGT	Medlin <i>et al.</i> 1988
18SL	CCA ACT ACG AGC TTT TTA ACT G	Medlin <i>et al.</i> 1988
18SC	CGG TAA TTC CAG CTC CAA TAG	Medlin <i>et al.</i> 1988
18SY	CAG ACA AAT CGC TCC ACC AAC	Medlin <i>et al.</i> 1988
18SB	TGA TCC TTC CGC AGG TTC ACC T	Medlin <i>et al.</i> 1988
18SO	AAG GGC ACC ACC AGG AGT GGA G	Medlin <i>et al.</i> 1988
LCO-1490	GGTCAACAAATCATAAAGATATTG	Folmer <i>et al.</i> 1994
HCO-2198	TAAACTTCAGGGTGACCAAAAAATCA	Folmer <i>et al.</i> 1994
COI-PanoF	GGT GCA TGA GCY GGH ATA GTW GG	Thoma <i>et al.</i> in press
COI-PanoR	RTG TTG RTA TAR TAC AGG RTC TCC	Thoma <i>et al.</i> in press
H3af	ATG GCT CGT ACC AAG CAG ACV GC	Colgan <i>et al.</i> 1998
H3ar	ATA TCC TTR GGC ATR ATR GTG AC	Colgan <i>et al.</i> 1998

- Buhay, J., Moni, G., Mann, N., & Crandall, K. A. (2007). Molecular taxonomy in the dark: Evolutionary history, phylogeography, and diversity of cave crayfish in the subgenus *aviticambarus*, genus *cambarus*. *Molecular Phylogenetics and Evolution*, 42, 435–448.
- Colgan, D., McLauchlan, A., Wilson, G., Livingston, S., Edgecombe, G., Macaranas, J., et al. (1998). Histone h3 and u2 snrna DNA sequences and arthropod molecular evolution. *Australian Journal of Zoology*, 46, 419–438.
- Crandall, K. A., & Fitzpatrick Jr, J. F. (1996). Crayfish molecular systematics: Using a combination of procedures to estimate phylogeny. *Systematic Biology*, 45, 1–26.
- Folmer, O., Black, M., Hoeh, W., Lutz, R., & Vrijenhoek, R. (1994). DNA primers for amplification of mitochondrial cytochrome c oxidase subunit i from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology*, 3, 294–299.
- Lai, J. C. Y., Ahyong, S. T., Jeng, M. S., and Ng, P. K. L. (2009). Are coral-dwelling crabs monophyletic? A phylogeny of the Trapezioida (Crustacea: Decapoda: Brachyura). *Invertebrate Systematics*, 23, 402–408.
- Medlin, L., Elwood, H. J., Stickel, S., & Sogin, M. L. (1988). The characterization of enzymatically amplified eukaryotic 16s-like rna-coding regions. *Gene*, 71, 491–499.
- Palumbi, S. R., & Benzie, J. (1991). Large mitochondrial DNA differences between morphologically similar penaeid shrimp. *Molecular Marine Biology and Biotechnology*, 1, 27–34.

Schubart, C. D., Cuesta, J. A., & Felder, D. L. (2002). Glyptograpsidae, a new brachyuran family from central america: Larval and adult morphology, and a molecular phylogeny of the grapsodea. *Journal of Crustacean Biology*, 22, 28-44.

Supporting Information Table S3. Data matrix for ‘eriphiid’ first stage zoea analysis, comprising 14 taxa and 20 characters.

Taxon	Character Number																			
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
<i>Charybdis hellerii</i>	0	1	1	0	0	0	0	0	1	0	1	0	0	1	0	1	1	0	0	0
<i>Dacryopilumnus rathbunae</i>	2	0	0	0	1	1	0	0	0	1	0	1	0	1	0	1	1	0	0	0
<i>Epixanthus frontalis</i>	2	0	0	0	1	1	0	0	0	1	0	1	0	0	0	1	1	0	0	0
<i>Eriphia smithii</i>	2	0	0	0	1	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0
<i>Hypothalassia armata</i>	2	0	0	0	1	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0
<i>Lydia annulipes</i>	2	0	0	0	1	1	1	1	0	1	0	1	0	0	0	1	1	0	0	0
<i>Menippe mercenara</i>	2	1	1	2	1	1	0	0	1	1	0	1	1	1	1	0	0	1	2	1
<i>Menippe nodifrons</i>	2	1	1	2	1	1	0	0	1	1	0	1	1	1	1	0	0	1	2	0
<i>Menippe rumphii</i>	2	1	1	2	1	1	0	0	0	1	1	1	1	1	1	1	0	1	2	1
<i>Myomenippe hardwicki</i>	2	1	1	2	1	1	0	0	1	1	0	1	1	1	1	0	0	2	2	1
<i>Ozium truncatus</i>	1	1	0	0	1	1	1	0	0	1	0	1	0	0	0	1	1	0	1	1
<i>Pseudocarcinus gigas</i>	1	0	0	0	1	1	1	1	0	1	0	1	0	0	0	1	1	0	0	0
<i>Trapezia cymodoce</i>	1	0	0	1	1	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
<i>Xantho hydrophilus</i>	1	0	0	0	1	0	0	0	0	1	0	1	0	0	0	1	1	0	0	0

Zoea 1 character scoring (for Table 3 matrix):

1. Antennule exopod terminal aesthetascs (character 2 of Clark and Guerao 2008): 3 (**0**), 4 (**1**), 5 (**2**), 6 (**3**).
2. Antenna exopod terminal seta 1 (character 6 of Clark and Guerao 2008): free (**0**), fused (**1**).
3. Antenna exopod terminal seta 2 (character 7 of Clark and Guerao 2008): present (**0**), absent (**1**).
4. Maxillule endopod, distal segment, subterminal setae (character 8 of Clark and Guerao 2008, allowing additional state of no subterminal setae): two subterminal setae (**0**), one subterminal seta (**1**), no subterminal setae (**2**).
5. Maxilla coxal setation of proximal endite seta 4 (character 9 of Clark and Guerao 2008): absent (**0**), present (**1**).
6. Maxilla coxal setation of proximal endite seta 5 (character 10 of Clark and Guerao 2008, appendix Fig 7): absent (**0**), present (**1**).
7. Maxilla coxal setation of proximal endite seta 6 (character 11 of Clark and Guerao 2008, appendix Fig 7): absent (**0**), present (**1**).
8. Maxilla coxal setation of proximal endite seta 7 (see Clark and Guerao 2008, appendix fig 7d): absent (**0**), present (**1**).
9. Maxilla subterminal setae of distal endopod lobe (character 13 of Clark and Guerao 2008): 2 setae (**0**), absent (**1**).
10. Maxilla setation of distal endopod lobe seta 4 (character 15 of Clark and Guerao 2008): present (**0**), absent (**1**).

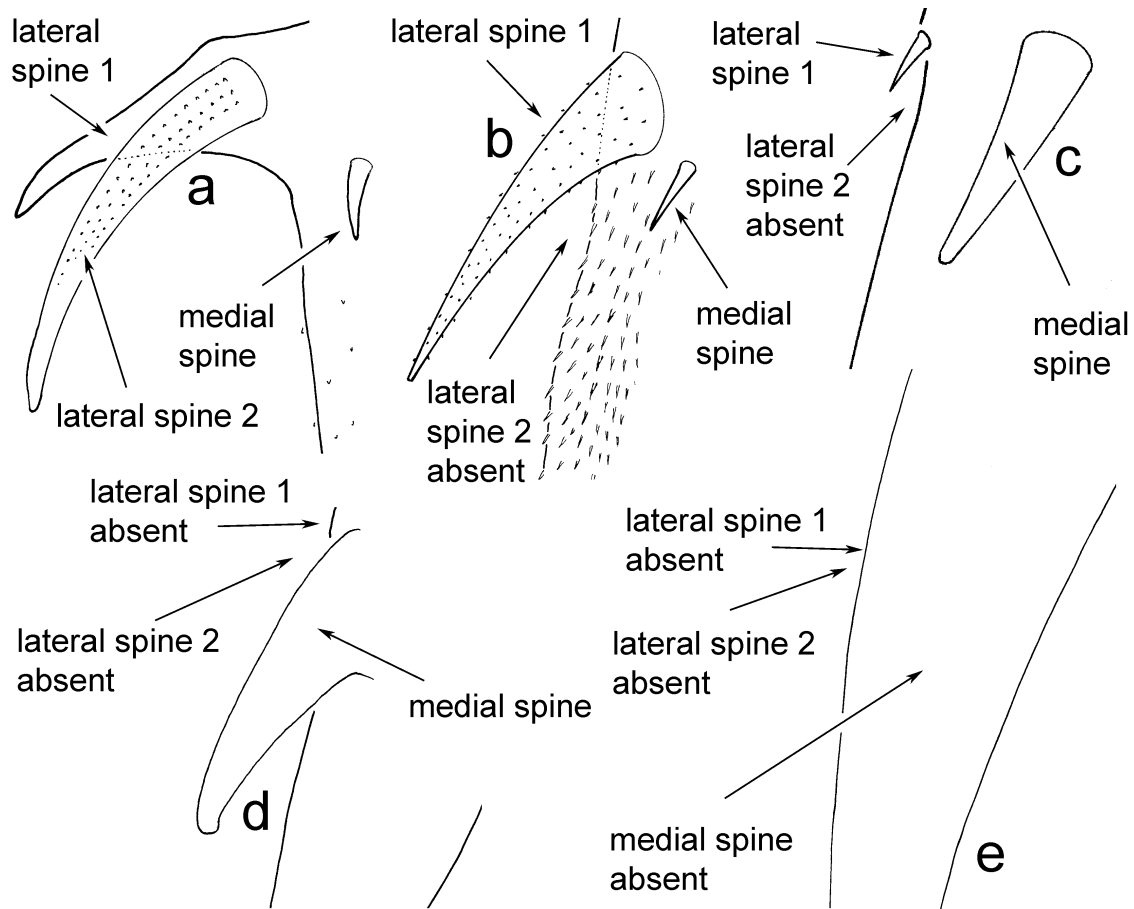


Fig 1. Telson: lateral & medial spines; a. *Quadrella maculosa* Alcock, 1898; b. *Tanaocheles bidentata* (Nobili, 1901); c. *Rhinolambrus pelagicus* (Rüppell, 1830); d. *Ozius truncatus* H. Milne Edwards, 1834; e. *Hexapanopeus paulensis* Rathbun, 1930.