



HOKKAIDO UNIVERSITY

| | |
|------------------|---|
| Title | Apseudes ranma sp. nov. (Tanaidacea: Apseudidae) found in a public aquarium, with notes on phylogeny and a presumptive stridulatory organ |
| Author(s) | Matsushima, Yoshinobu; Kakui, Keiichi |
| Citation | Bulletin of Marine Science, 100(3), 451-470 https://doi.org/10.5343/bms.2024.0030 |
| Issue Date | 2024-04-19 |
| Doc URL | https://hdl.handle.net/2115/91919 |
| Type | journal article |
| File Information | 2024Matsushima_Kakui_Apseudes_AAM.pdf |



Title:

Authors:

DOI:

Date submitted:

Date accepted:

Available online:

Citation:

Special issue:

IMPORTANT—This version of an accepted manuscript that will appear in *Bulletin of Marine Science* is a submission that has been peer reviewed and accepted for publication; however, it has not yet been edited and/or formatted, and items that will appear in the final publication may be missing. During the article production process, the text and other elements of this article are likely to change.

When the final article is available, this FastTrack article will be removed and the final version will replace it. The date the article was first made available online will be carried over, but the year of publication will correspond to the volume/issue of inclusion.

Accepted manuscripts can be cited in text as “In Press”.

1 *Apseudes ranma* sp. nov. (Tanaidacea: Apseudidae) found in a public aquarium,
2 with notes on phylogeny and a presumptive stridulatory organ

3

4 Yoshinobu Matsushima^{a,*}, Keiichi Kakui^b

5

6 ^aDepartment of Natural History Sciences, Graduate School of Science, Hokkaido

7 University, Sapporo 060-0810, Japan

8 ^bDepartment of Biological Sciences, Faculty of Science, Hokkaido University, Sapporo

9 060-0810, Japan

10

11 *Corresponding author E-mail: <mattuu901@eis.hokudai.ac.jp>

12

13 Runnong title: *Apseudes ranma* sp. nov. found in an aquarium

14

15 ORCID: Keiichi Kakui, 0000-0003-4630-9065

16

17

Abstract

18 We describe *Apseudes ranma* sp. nov. from the Port of Nagoya Public Aquarium,

19 Nagoya, Japan. It resembles two congeners, *Apseudes curtiramus* (Guțu, 2007) and
20 *Apseudes orghidani* Guțu and Iliffe, 1989, in having the rostrum triangular, wider than
21 long, the carapace without lateral spines, distinct and round eye lobes, pereonites 3–6
22 with a pair of tongue-shaped anterolateral projections, and the pleotelson with two pairs
23 of lateral projections, but differs from them in having lateral setae on the anterolateral
24 margin of the carapace and a ventro-subproximal spine on the pereopod-1 basis, and in
25 the number of spiniform setae on articles of pereopods 2–4. We determined partial
26 nucleotide sequences for the cytochrome *c* oxidase subunit I (COI) and 18S rRNA (18S)
27 genes in *A. ranma* sp. nov. for future DNA barcoding and phylogeny reconstruction. In
28 an 18S tree, *A. ranma* sp. nov. was the sister taxon to *Apseudes nipponicus* Shiino,
29 1937, and this clade was the sister group to moderately supported *Carpoapseudes* clade.
30 We discovered a presumptive stridulatory organ in *A. ranma* sp. nov. consisting of a
31 cylindrical protrusion and knobby area on the inner surface of each of the left and right
32 chelipedal bases. The location of the protrusion and knobby area suggests that these
33 may be a plectrum and pars stridens, respectively.

34

35 Introduction

36 *Apseudes* Leach, 1814 is the most species-rich genus in Apseudidae, with 45
37 valid species worldwide (WoRMS 2024). *Apseudes* tanaidaceans are burrowers (cf.
38 Holdich and Jones 1983), and most have been reported from shallow waters. The genus
39 contains several species confirmed to be simultaneously hermaphroditic by examination
40 of external and internal morphology (Kakui and Hiruta 2023). To date, the only nominal
41 species reported from Japan was *Apseudes nipponicus* Shiino, 1937 (Kakui 2016).

42 A common source of undescribed species is public aquaria, from which species
43 in groups including sponges (e.g., Pinheiro et al. 2015), sea anemones (e.g., Izumi et al.
44 2019), acoel flatworms (e.g., Shannon and Achatz 2007), nemerteans (e.g., Wilfert and
45 Gibson 1974), nematodes (e.g., Kito and Nakamura 2001), and crustaceans (e.g.,
46 Wittmann and Abed-Navandi 2021) have been described. Among these captive animals,
47 some species are known only from the aquaria. This is especially the case for species
48 having small individuals that were unintentionally introduced into aquaria along with
49 larger animals for exhibition, or with substrates such as sand, live rocks, seagrasses, and
50 seaweed.

51 *Apseudes* sp. *sensu* Kakui and Hiruta (2013) is known only from aquaria, having
52 been first discovered in 2009 from the bottom sand in a tank housing giant clams (24–

53 26°C) in the Port of Nagoya Public Aquarium (PNPA), Nagoya, Japan (Kakui and
54 Hiruta 2013). Several living *Apseudes* individuals collected in 2009 and 2010 and their
55 descendants have been maintained for over 10 years in our laboratory in Sapporo, Japan
56 (Kakui and Hiruta 2023). This species is a protandrous simultaneous hermaphrodite and
57 can self-fertilize (Kakui and Hiruta 2013), and is the only species known to undergo
58 selfing among the more than 67,000 extant species of Malacostraca (Ahyong et al.
59 2011). While this species thus may provide a good model system for investigating
60 malacostracan sexual and reproductive systems, its taxonomic status had not been
61 determined.

62 After observing the morphology of laboratory-maintained individuals, we
63 concluded that *Apseudes* sp. *sensu* Kakui and Hiruta (2013) was undescribed. Here we
64 describe this species as new, present partial sequences for its cytochrome *c* oxidase
65 subunit I (COI) and 18S rRNA (18S) genes, and present an 18S-based phylogenetic tree.
66 We also describe the morphology of presumptive stridulatory organs discovered on the
67 chelipedal bases.

68

69 Material and methods

70 The captive-bred individuals we studied were descendants of a single

71 hermaphrodite isolated in March 2019 and maintained in a small aquarium at Hokkaido
72 University (25°C; 14h L/10h D; fed every 3 days; see Kakui and Hiruta 2013); the
73 hermaphrodite was a descendant of an individual collected at PNPA on 14 June 2009 or
74 12 April 2010 and maintained in the laboratory as just described. Individuals were fixed
75 and preserved in 99% ethanol. An ethanol-fixed specimen of *Carpoapseudes spinigena*
76 Bamber, 2007 collected on 7 November 2007 during a cruise of R/V *Tansei-maru* at
77 depths of 1028–1075 m (Station KT-07-29-K1; 42°35.0'N 144°48.0'E to 42°34.7'N
78 144°49.9'E) and one of *A. nipponicus* collected on 12 October 2017 from an
79 experimental aquarium at the Shimoda Marine Research Center (SMRC), University of
80 Tsukuba, Japan, were included in the study for determination of 18S sequences (the
81 exoskeletons could not be recovered). Methods used for dissection, preparation of
82 slides, light microscopy, scanning electron microscopy (SEM), and drawing were as
83 described by Kakui and Angsupanich (2012). Specimens studied were deposited in the
84 Invertebrate Collection of the Hokkaido University Museum (ICHUM), Sapporo, Japan.

85 Orientation and terminology here follow Larsen (2003), except that the term
86 'plumose sensory seta(e)' (PSS; Bird 2011) is used instead of 'broom seta(e)' and the
87 term 'protopod' is used instead of 'basal article' for pleopods and uropods. Body length
88 (BL) was measured from the base of the antennules to the tip of the pleotelson, and

89 body width at the widest portion of the cephalothorax (CW, cephalothorax width).
90 Pleotelson length (PL) was measured between the anterior and posterior edges of the
91 pleotelson, and pleotelson width (PW) at the widest portion of the segment. Appendages
92 were measured in the holotype. Measurements were made axially from digital images
93 by using ImageJ (Schneider et al. 2012): dorsally on the body, antennules, antennae,
94 pleopods, and uropods; laterally on the chelipeds and pereopods. The length and width
95 of congeners were measured from original illustrations if these measurements were not
96 provided in descriptions. Individuals were categorized into one of three sex classes:
97 “male-like,” having a genital cone but lacking a marsupium, marsupium scars, or
98 developing oostegites; “preparatory hermaphrodite,” having a genital cone and
99 developing oostegites (see Kakui and Hiruta 2013: fig. 1); and “ovigerous
100 hermaphrodite,” having a genital cone, and marsupium or marsupium scars.

101 DNA was extracted from the whole body of one paratype (ICHUM8634), and
102 one non-type individual each of *C. spinigena* and *A. nipponicus*, by using a NucleoSpin
103 Tissue XS Kit (Macherey–Nagel, Germany). Table 1 lists the primers used for PCR and
104 cycle sequencing. PCR amplification conditions for COI with TaKaRa Ex Taq DNA
105 polymerase (TaKaRa Bio, Japan) were 94°C for 1 min; 35 cycles of 98°C for 10 s, 42°C
106 for 30 s, and 72°C for 50 s; and 72°C for 2 min. Conditions for 18S with KOD FX Neo

107 polymerase (Toyobo, Japan) were 94°C for 2 min; 45 cycles of 98°C for 10 s, 52°C for
108 30 s, and 68°C for 75 s; and 68°C for 3 min. Nucleotide sequences were determined by
109 direct sequencing with a Big Dye Terminator Kit ver. 3.1 and a 3730 DNA Analyzer
110 (Life Technologies, USA). Segments were concatenated by using MEGA7 (Kumar et al.
111 2016). The sequences we determined were deposited in the International Nucleotide
112 Sequence Database (INSD) through the DNA Data Bank of Japan under accession
113 numbers LC791410, LC791411, LC791469, and LC791470. BLAST searches (Altschul
114 et al. 1990) of the INSD were conducted to find the known sequences most like those
115 we obtained.

116 The 18S dataset for phylogenetic analysis included the three sequences we
117 determined, and 16 apseudomorph sequences and an outgroup sequence from the INSD
118 (see Supplementary Material 1). Methods for alignment (1960 positions in the final
119 dataset; Supplementary Materials 2 and 3), selecting the optimal substitution model
120 (TIM+F+R4), the ML analysis, estimating clade support (analyses of 1000
121 pseudoreplicates for both SH-like approximate likelihood ratio tests [SH-aLRT] and
122 ultrafast bootstraps [UFBoot]), and drawing the tree were as described by Shimada et al.
123 (2023).

124

125 Results

126 Systematics

127 Order Tanaidacea Dana, 1849

128 Suborder Apseudomorpha Sieg, 1980

129 Superfamily Apseudoidea Leach, 1814

130 Family Apseudidae Leach, 1814

131 Genus *Apseudes* Leach, 1814

132

133 *Diagnosis.*—Carapace as long as or longer than wide; rostrum projected; posterior region
134 of carapace swollen in dorsal view. Pereonites generally wider than long without
135 posterolateral spine. Pereonites 2–6 without lateral lamellar expansion. Pereonites 3–6
136 generally with anterolateral projection; lateral margin not divided into two lobes.
137 Pleonites without pair of ventral tubercles. Antennule: peduncular article 1 twice or more
138 longer than peduncular article 2, without mid-inner spine; inner flagellum with at least
139 four articles. Antenna with well-developed squama with many setae. Epistome spiniform,
140 not expanding in large individuals. Maxillipedal endite without leaf shaped seta. Well-
141 masculinized cheliped without large gap between fingers. Cheliped and pereopod 1 each
142 with exopod. Pereopod-1 dactylus and unguis not fused; dactylus narrow. Carpus as long

143 as or shorter than propodus in pereopods 2 and 3. Pleopods biramous, well developed, in
144 five pairs.

145 *Remakes.*—As previously pointed out, *Apseudes* is considered a heterogenous
146 group that functions as a “garbage can” taxon (Józwiak 2014). This genus contains
147 species which significantly differ from the type species *A. talpa* (Montagu, 1808) (e.g., *A.*
148 *levis* Kudinova-Pasternak, 1985; Kudinova-Pasternak 1985) and insufficiently described
149 species (e.g., *A. meridionalis* Richardson, 1912; Richardson 1912), suggesting *Apseudes*
150 needs future revision.

151

152 *Apseudes ranma* sp. nov.

153 [New Japanese name: Ranma-apuseudesu]

154 (Figs. 1–6)

155

156 *Apseudes* sp.: Kakui and Hiruta (2013), p. 892; Kakui et al. (2021b), table 1, figs. 1, 4;

157 Shiraki and Kakui (2022), table 1, fig. 2G.

158 *Apseudes* sp. *sensu* Kakui and Hiruta (2013): Kakui et al. (2017), p. 2; Kakui et al.

159 (2019), fig. 5; Shiraki and Kakui (2022), p. 271; Kakui and Hiruta (2023), p. 24;

160 Kakui and Hiruta (2024).

161

162 *Type material*.—Holotype: preparatory hermaphrodite, ICHUM8627 (BL 6.53 mm, CW
163 1.45 mm), dissected, 16 slides; descendant of individual collected at PNPA on 14 June
164 2009 or 12 April 2010.

165 Paratypes: three preparatory hermaphrodites, (ICHUM8628, CW 1.18 mm, 14
166 slides; ICHUM8629, BL 6.25 mm, CW 1.33 mm, 1 vial; ICHUM8630, BL 6.58 mm,
167 CW 1.47 mm, 1 SEM stub); five ovigerous hermaphrodites (ICHUM8631, CW 1.21
168 mm, 14 slides; ICHUM8632, CW 1.14 mm, 14 slides; ICHUM8633, CW 1.17 mm, 14
169 slides; ICHUM8634, BL 5.39 mm, CW 1.18 mm, INSD accession numbers LC791470
170 (COI) and LC791469 (18S), 1 vial; ICHUM8635, BL 6.02 mm, CW 1.34 mm, 1 vial
171 and 1 SEM stub); same collection information as for holotype.

172

173 *Etymology*.—The specific name is an indeclinable noun referring to Ranma Saotome,
174 the lead character in the Japanese manga “Ranma 1/2” created by Rumiko Takahashi. In
175 the story, Ranma (originally male) changes “its” sex from male to female and vice versa
176 when doused with cold or boiling water. The hermaphroditic condition of the new
177 species was reminiscent of Ranma.

178

179 *Diagnosis*.—Rostrum triangular, wider than long. Carapace without lateral spines;
180 anterolateral margin with 4–5 lateral setae. Eye lobes distinct, round. Pereonites 1–6
181 without lateral spines. Pereonites 3–6 with pair of tongue-shaped anterolateral
182 projections. Pleotelson with two pairs of lateral projections. Pereopod-1 basis with
183 ventro-subproximal spine. Pereopod-2 merus with three ventrodiscal spiniform setae.
184 Pereopod-3 merus with three ventrodiscal spiniform setae; carpus with outer distal
185 spiniform seta; propodus with three outer spiniform setae. Pereopod-4 merus with two
186 or three mid-ventral spiniform setae; propodus with three or four ventral spiniform
187 setae.

188
189 *Description of preparatory/ovigerous hermaphrodites (based on holotype unless noted*
190 *otherwise)*.—Body (Figs. 1, 2A–C) well calcified, dorsoventrally flattened, 4.50 times
191 as long as CW, slightly yellowish when alive (Fig. 1). Cephalothorax length 0.22 times
192 BL, 1.06 times as long as wide; anterolateral margin with five lateral setae; rostrum
193 triangular, wider than long; eye lobes distinct, round, white with reddish brown spots
194 when alive (Fig. 1); large, acute ventral keel (hyosphenium) present, posterior to
195 maxillipeds (not illustrated). Pereonites 1–6 with length ratio 1.00 : 1.10 : 1.20 : 1.13 :
196 1.21 : 0.98; each much wider than long, with numerous lateral plumose setae and

197 hyposphenium. Pereonites 3–6 with pair of tongue-shaped anterolateral projections.

198 Pleon length 0.14 times BL. Pleonites narrower than pereonites; all wider than long,

199 similar in shape, with tiny hyposphenium; epimeron (Fig. 2B, C) projected, curved

200 ventroposteriorly, with pointed apex, and covered with numerous plumose setae.

201 Pleotelson (Fig. 2B) 2.51 times as long as wide, narrower than pleonites, with two pairs

202 of lateral projections, and covered with plumose setae.

203 Antennule (Fig. 2D–F) with 13-articulate outer flagellum and seven-articulate

204 inner flagellum. Combined length of peduncle and outer flagellum 4.29 times as long as

205 cephalothorax. Peduncular articles 1–4 with length ratio of 1.00 : 0.32 : 0.14 : 0.09;

206 article 1 with numerous denticles on inner margin, one outer-subdistal, one inner

207 subproximal, and one inner subdistal simple setae, ten outer and ten inner plumose

208 setae, twelve outer PSS, and numerous outer and inner proximal fine setae; article 2

209 with two (one long) inner distal simple setae, six outer and seven inner plumose setae,

210 and four ventrodistal PSS; article 3 with mid-inner simple seta, and three outer and five

211 inner plumose setae; article 4 with simple seta at insertion of inner flagellum and two

212 PSS at insertion of outer flagellum. Outer flagellum (Fig. 2D, E) 0.61 times as long as

213 peduncle; articles 1, 3, 5, 7, 9, and 11 naked; articles 2, 4, 6, 8, 10, 12, and 13 with two,

214 two, one, three, three, one, and four distal simple setae, respectively; articles 2, 4, 6, 8,

215 10, and 12 each with distal aesthetasc. Inner flagellum (Fig. 2D, F) 0.62 times as long as
216 outer flagellum; articles 1–7 with three, one, one, one, two, one, and three distal simple
217 setae, respectively; articles 1–7 each with distal PSS.

218 Antenna (Fig. 2G) with 16 articles, 0.80 times as long as antennule; articles 1–
219 16 with length ratio 1.00 : 1.93 : 0.66 : 1.33 : 1.21 : 0.42 : 0.52 : 0.45 : 0.51 : 0.58 :
220 0.57 : 0.42 : 0.43 : 0.45 : 0.35 : 0.35. Article 1 with inner-distal rounded expansion
221 covered with serrations. Article 2 with mid-outer simple seta, three inner subproximal
222 spines, three inner distal spines, and five inner plumose setae. Article 3 with inner distal
223 simple seta. Article 4 with inner subproximal simple seta and two inner subdistal PSS.
224 Article 5 with two mid-inner and three (two long and one tiny) distal simple setae and
225 two mid-outer and four distal PSS. Article 6 with three outer bipinnate setae. Articles 7–
226 16 with two, one, four, three, three, two, two, three, two, and four distal simple setae,
227 respectively; article 7 with outer distal bipinnate seta; articles 9, 11, and 14 each with
228 distal PSS. Squama 0.15 times as long as antenna, narrow, with 14 simple setae (one
229 bipinnate).

230 Epistome thick, spiniform (not illustrated). Labrum (Fig. 2H) bipartite; proximal
231 part with distalolateral spines and 17 distal simple setae; distal part with distal setation
232 and distal fine setae.

233 Mandibles (Fig. 2I, J) with inner setulation and outer serrations on body, and
234 well-developed molar process. Left mandibular incisor (Fig. 2I) with four rounded
235 processes; setiferous lobe with sharp spiniform seta and five complex setae; lacinia
236 mobilis with four rounded processes. Right mandibular incisor (Fig. 2J) with two
237 rounded processes; setiferous lobe with sharp spiniform seta, five bifurcate setae, and
238 complex seta. Palp (Fig. 2I) with three articles; articles 1–3 with length ratio 1.00 :
239 2.90 : 1.06; article 1 with four simple setae; article 2 with simple seta and 17 pinnate
240 setae; article 3 with distal long simple seta and 16 pinnate setae.

241 Labium (Fig. 2K) with lobe bearing inner setation. Palp setulate, with spines,
242 several short and long simple setae, and two furcate setae.

243 Maxillule (Fig. 3A) with biarticulate palp; second palp-article with fine setation
244 and six biserrate-tipped setae in distal half. Outer endite with 17 mid-outer and three
245 mid-inner simple setae, outer proximal setation, nine distal spiniform setae, and two
246 distal furcate setae. Inner endite with outer and inner fine setae, four inner proximal
247 spines, two distal plumose setae, distal setulate bifurcate seta, two distal setulate furcate
248 setae, and outer projection with four tiny spines.

249 Maxilla (Fig. 3B–D) with outer and inner subdistal, outer proximal, and
250 dorsodistal serrations and mid-outer fine setae on body. Inner lobe of fixed endite with

251 ten serrate spiniform setae and 41 basally swollen setae. Outer lobe of fixed endite (Fig.
252 3C, D) with seven spiniform setae, three bipinnate setae, two trifurcate setae (Fig. 3D),
253 and serrate spiniform seta. Inner lobe of movable endite with nine basally swollen setae.
254 Outer lobe of movable endite with ten basally setulate pinnate setae.

255 Maxilliped (Fig. 3E–H) with naked coxa and basis. Endite (Fig. 3E, F; paratype
256 ICHUM8628) with dorsal simple seta, fine setae, and serration in outer region; inner
257 region with four dorsal and one inner plumose setae; distal region with fine setae, nine
258 simple setae, six spiniform setae, and three bifurcate setae (Fig. 3F). Palp article 1 with
259 two distal simple setae and two outer distal spiniform setae; article 2 with several inner
260 proximal fine setae, 30 inner simple setae and seven inner subproximal pinnate setae,
261 and two outer distal spiniform setae; article 3 with nine inner simple setae, five inner
262 serrate setae (Fig. 3H) and two inner distal pinnate setae; article 4 with six distal simple
263 setae and seven distal pinnate setae. Epignath (Fig. 3I) cup-shaped, with setulate
264 terminal seta.

265 Cheliped (Fig. 3J) with triarticulate exopod bearing five plumose setae at tip.
266 Basis 1.85 times as long as wide, with three ventroproximal, three ventro-subproximal,
267 and four ventrodistal simple setae, one mid-ventral spiniform setae; presumptive
268 stridulatory organ comprising cylindrical protrusion and knobbly area present in mid-

269 inner region (Fig. 4, based on paratypes ICHUM8630 and ICHUM8635; not illustrated
270 in Fig. 3J; see Discussion). Merus with five mid-ventral, one mid-outer distal, and six
271 ventrodiscal simple setae. Carpus 1.29 times as long as basis, 3.21 times as long as wide,
272 with three dorsoproximal, one mid-dorsal, one dorso-subdistal, two dorsodistal, four
273 ventroproximal, four mid-ventral, and five ventrodiscal simple setae. Propodus with one
274 mid-outer, one outer mid-ventral, three mid-ventral, seven ventrodiscal simple setae, and
275 triangular claw; dorsal region of palm with one middle and one distal simple setae; three
276 outer simple setae at insertion of dactylus; cutting surface with ten outer distal simple
277 setae, proximal large triangular process, and several denticles. Dactylus longer than
278 fixed finger, with five inner-subdistal simple setae and several ventral spiniform setae;
279 unguis pointed. Mesh areas present on inner distal surface of basis, merus, carpus, and
280 chelipedal palm (Fig. 4C).

281 Pereopods 1–6 with length ratio 1.00 : 0.86 : 0.68 : 0.70 : 0.73 : 0.83. Pereopod
282 1 (Fig. 5A) 0.47 times as long as BL, with length ratio of basis, ischium, merus, carpus,
283 propodus, and dactylus–unguis 1.00 : 0.11 : 0.57 : 0.46 : 0.52 : 0.42. Coxa with anterior
284 process bearing simple seta and five plumose setae; inner dorsal region with thirteen
285 plumose setae. Basis 2.36 times as long as wide, with 11 dorsal (two long), 11 ventral
286 (one long), and five ventrodiscal simple setae, and one inner subproximal simple seta,

287 one ventro-subproximal spine, ventrodiscal spiniform seta, and dorso-subproximal PSS.
288 Ischium with six ventrodiscal simple setae (two long). Merus with four inner tiny simple
289 setae, four outer dorsodiscal, one inner dorsodiscal, five mid-inner ventral, and two inner
290 ventro-subdistal simple setae, and one dorsodiscal and one ventrodiscal spiniform setae.
291 Carpus with four inner ventral tiny simple setae, two mid-dorsal, six dorsodiscal, two
292 ventral, and three ventrodiscal simple setae, six dorsodiscal pinnate setae, and one
293 dorsodiscal, one mid-ventral, and one ventrodiscal spiniform setae. Propodus with four
294 inner tiny simple setae, five dorsal, three ventral, and two ventrodiscal simple setae, two
295 dorsal and three ventral spiniform setae, inner dorsal PSS, and ventrodiscal pinnate seta.
296 Dactylus with three mid-dorsal simple setae and four ventral serrations; unguis half as
297 long as dactylus, naked. Exopod triarticulate; article 3 with six plumose setae.

298 Pereopod 2 (Fig. 5B) with length ratio of articles from basis to dactylus–unguis
299 1.00 : 0.25 : 0.45 : 0.43 : 0.47 : 0.39. Coxa naked. Basis 4.06 times as long as wide, with
300 five dorsal (one long), four ventral (one long), and seven ventrodiscal simple setae, two
301 dorsal and two ventral plumose setae, and two dorsal PSS. Ischium with six ventrodiscal
302 simple setae and two dorsodiscal pinnate setae. Merus with four dorsodiscal, four
303 ventral, and two inner ventral simple setae and two dorsodiscal, one mid-ventral, and
304 three ventrodiscal spiniform setae. Carpus with dorsodiscal row of nine simple setae,

305 three mid-ventral and two ventrodiscal simple setae, and one outer dorsodistal, one outer
306 ventro-subproximal, and two ventrodiscal spiniform setae. Propodus with seven dorsal,
307 three ventral, one outer ventrodiscal, and two inner ventral simple setae, two dorsal, two
308 ventral, and two outer spiniform setae, mid-dorsal PSS, and ventrodiscal pinnate seta.
309 Dactylus with three mid-dorsal simple setae and four ventral serrations; unguis half as
310 long as dactylus, naked.

311 Pereopod 3 (Fig. 5C) 3.28 times as long as wide, with length ratio of articles
312 from basis to dactylus–unguis 1.00 : 0.20 : 0.50 : 0.47 : 0.51 : 0.44. Coxa with simple
313 seta and four plumose setae. Basis with five dorsal and seven ventral tiny simple setae,
314 five ventrodiscal and four outer simple setae, inner proximal plumose seta, and two
315 ventro-subproximal and one dorso-subdistal PSS. Ischium with six ventrodiscal and one
316 inner distal simple setae and two dorsodistal pinnate setae. Merus with four ventral and
317 one inner mid-ventral simple setae, one mid-ventral and three ventrodiscal spiniform
318 setae, and dorsodistal plumose seta. Carpus with eight dorsodistal, two mid-ventral, and
319 two ventrodiscal simple setae and one mid-ventral, two ventrodiscal, and one outer distal
320 spiniform setae. Propodus with five dorsal and three ventral simple setae, three dorsal,
321 two ventral, and three outer spiniform setae, mid-dorsal PSS, and ventrodiscal pinnate
322 seta. Dactylus with two mid-dorsal simple setae and four ventral serrations; unguis half

323 as long as dactylus, naked.

324 Pereopod 4 (Figs. 5D, 6A) 2.56 times as long as wide, with length ratio of
325 articles from basis to dactylus–unguis 1.00 : 0.14 : 0.39 : 0.49 : 0.37 : 0.25. Coxa with
326 simple seta and four plumose setae. Basis 2.58 times as long as wide, with four dorsal
327 and four ventral tiny simple setae, three ventrodiscal simple setae, three outer and four
328 inner dorsal plumose setae, and three mid-dorsal and one ventro-subdistal PSS. Ischium
329 with seven ventrodiscal simple setae and dorsodistal pinnate seta. Merus with four
330 ventral simple setae, three mid-ventral and five ventro-subdistal spiniform setae, and
331 dorsodistal plumose seta. Carpus with eight distal simple setae and three mid-ventral
332 and six distal spiniform setae. Propodus with one mid-dorsal, one dorsodistal long, three
333 ventral, and two outer simple setae, four ventral spiniform setae, dorsoproximal PSS,
334 and dorsodistal row of 26 pinnate setae. Dactylus with two mid-dorsal simple setae and
335 four ventral serrations; unguis half as long as dactylus, naked.

336 Pereopod 5 (Figs. 5E, 6B) 2.72 times as long as wide, with length ratio of
337 articles from basis to dactylus–unguis 1.00 : 0.15 : 0.50 : 0.46 : 0.38 : 0.41. Coxa with
338 six plumose setae. Basis 2.81 times as long as wide, with five dorsal and four ventral
339 tiny simple setae, five ventrodiscal simple setae, six outer and nine inner dorsal plumose
340 setae, and three dorso-subproximal PSS. Ischium with two dorsal and four ventrodiscal

341 simple setae and dorsodistal pinnate seta. Merus with two dorsodistal, six mid-ventral,
342 one ventrodiscal, and one inner subdistal simple setae, one dorsodistal and five ventro-
343 subdistal spiniform setae, and dorsodistal plumose seta. Carpus with three inner
344 subproximal tiny simple setae, three distal and three ventrodiscal simple setae, five mid-
345 ventral, one ventrodiscal, and two inner subdistal spiniform setae, and four dorsal
346 plumose setae. Propodus with two dorsal and two inner subdistal simple setae, six distal
347 and three ventral spiniform setae, dorso-subdistal PSS, and ventrodiscal row of 15
348 pinnate setae. Dactylus with two mid-dorsal simple setae and four ventral serrations;
349 unguis half as long as dactylus, naked.

350 Pereopod 6 (Figs. 5F, 6C) 2.57 times as long as wide, with length ratio of
351 articles from basis to dactylus–unguis 1.00 : 0.18 : 0.53 : 0.57 : 0.54 : 0.50. Coxa with
352 five plumose setae. Basis with one dorso-subdistal and one ventrodiscal short simple
353 setae, 16 dorsal (three short), nine ventral, and four ventrodiscal plumose setae, and four
354 dorso-subproximal PSS. Ischium with one dorsodistal and one ventrodiscal simple setae,
355 dorsodistal pinnate seta, and five ventrodiscal plumose setae. Merus with two ventral,
356 one ventrodiscal, and one inner proximal simple setae, and five dorsal, six ventral, and
357 three inner distal plumose setae. Carpus with two mid-dorsal and five ventral simple
358 setae, one dorsodistal, one ventrodiscal, one mid-inner, and two inner subdistal

359 spiniform setae, and four dorsal, six ventral, and four inner subdistal plumose setae.
360 Propodus with three outer dorsal simple setae, three dorsal, two ventral, and three inner
361 subdistal spiniform setae, two inner distal plumose setae, and outer subdistal PSS; row
362 of 41 pinnate setae present from ventro-subproximal to dorsodistal margins. Dactylus
363 with two dorso-subdistal and one outer subdistal simple setae and three ventral
364 serrations; unguis one-third as long as dactylus, naked.

365 Pleopods (Fig. 5G–I) five pairs, all similar. Protopod biarticulate, narrow, with
366 three outer and five inner plumose setae. Exopod (Fig. 5G, H) uniarticulate, 1.36 times
367 as long as protopod, with 22 plumose setae. Endopod (Fig. 5G, I) uniarticulate, 1.30
368 times as long as exopod, with 20 plumose setae and one mid-inner hooked plumose
369 seta.

370 Uropod (Fig. 6D, E) with protopod bearing nine outer and five inner distal
371 plumose setae. Exopod with 11 articles; articles 1, 2 naked; articles 4, 6–11 with two,
372 two, one, two, two, two, and three simple setae, respectively; articles 3, 5, and 7 with
373 three, three, and one plumose setae, respectively. Endopod 3.93 times as long as
374 pleotelson (Fig. 2C), with 41 serially repeated articles bearing simple setae, plumose
375 setae, and PSS as illustrated (Fig. 6E); distal article with four simple setae.

376

377 *Variation and stability.*—In addition to the holotype, four paratypes (ICHUM8628,
378 ICHUM8631, ICHUM8632, and ICHUM8633) were dissected, and selected characters
379 were observed (see Supplementary Material 4). All specimens shared the same state for
380 the following characters (only selected characters are presented here; for all characters
381 observed, see Supplementary Material 4): rostrum with obtuse apex; carapace without
382 lateral spines; anterolateral margin of carapace with four or five setae lateral setae;
383 distinct, round eye lobes; pair of tongue-shaped lateral projections on pereonites 3–6;
384 pleotelson with two pairs of lateral projections; pereopod-1 basis with ventro-
385 subproximal spine; pereopod 2 merus with three ventrodial spiniform setae and carpus
386 with dorsodistal row of nine simple setae; pereopod 3 merus with three ventrodial
387 spiniform setae, carpus with one outer distal spiniform seta, and propodus with three
388 outer spiniform setae.

389 The following setae and articles varied in number among specimens (only
390 selected characters are presented here; for all characters observed, see Supplementary
391 Material 4) (ranges in parentheses): long simple setae on antennal articles 6–9 (0–2, 0–
392 1, 0–1, 0–1, respectively); bipinnate setae on antennal articles 6 and 7 (1–3, 0–1,
393 respectively); bipinnate setae on squama (0–4); dorsodistal pinnate setae on ischium of
394 pereopods 2–6 (0–2, 1–2, 1–2, 0–2, 0–1, respectively); mid-ventral spiniform setae on

395 merus of pereopods 2 and 3 (0–1); dorsal simple setae on pereopod-2 propodus (7–8);
396 mid-ventral spiniform setae on pereopod-4 merus (2–3); ventral spiniform setae on
397 pereopod-4 propodus (3–4); distal pinnate setae on propodus of pereopods 4–6 (21–26,
398 13–17, 32–41, respectively); ventrodiscal plumose setae on pereopod-5 basis and
399 ischium (0–1, 0–1, respectively); dorsodistal plumose setae on pereopod-5 merus (0–1).

400 The proximal large triangular process on the cutting surface of the cheliped was
401 observed in large individuals that had laid eggs one or more times (see Kakui and Hiruta
402 2023).

403
404 *Genetic information and phylogenetic analysis.*—A partial COI sequence (654 bp,
405 encoding 218 amino acids; INSD accession number LC791470) and the nearly complete
406 18S sequence (2157 bp; LC791469) were determined from paratype ICHUM8634. The
407 sequences in the INSD most similar to our sequences, determined by BLAST searches,
408 were from *Apseudes* sp. from Hawai‘i, USA (MW284787; identity score 96.02%, query
409 cover 100%; Paulay et al. unpublished) for COI and from *Carpoapseudes varindex*
410 Bamber, 2007 (AB618177; identity score 92.39%, query cover 98%; Kakui et al. 2011)
411 for 18S. Kimura (1980) 2-parameter distances for 18S among *A. ranma* sp. nov. (AR),
412 *A. nipponicus* (AN), and *C. spinigena* (CP) were 1.6% (AR–AN), 6.8% (AR–CP), and

413 6.8% (AN–CP).

414 In an 18S tree (Fig. 7), *A. ranma* sp. nov. is the sister taxon to *A. nipponicus*,
415 which together form a moderately supported clade (SH-aLRT = 85.6%; UFBoot = 77%)
416 with a clade comprising two species in *Carpoapseudes* Lang, 1968. Apseudidae,
417 Apseudinae, and Leviapseudinae were not monophyletic in the tree.

418

419 Discussion

420 *Apseudes ranma* sp. nov. closely resembles the two congeners *Apseudes*
421 *curtiramus* (Guțu 2007) and *Apseudes orghidani* Guțu & Iliffe, 1989 in having the
422 rostrum triangular and wider than long, the carapace without lateral spines, distinct and
423 round eye lobes, pereonites 3–6 with a pair of tongue-shaped anterolateral projections,
424 and the pleotelson with two pairs of lateral projections. *Apseudes ranma* sp. nov.
425 differs from these species in the combination of eight character states listed in Table 2.
426 In addition to the features in Table 2, *A. ranma* sp. nov. differs from *A. curtiramus* in
427 having the pereopod-2 carpus with a dorsodistal row of nine simple setae (six in *A.*
428 *curtiramus*) and the pereopod-2 propodus with seven or eight dorsal simple setae (four
429 in *A. curtiramus*) (Guțu, 2007); and from *A. orghidani* in having antennal article 2 with
430 three inner distal spines (spines lacking in *A. orghidani*), the pereopod-2 carpus with a

431 dorsodistal row of nine simple setae (six in *A. orghidani*), the pereopod-2 propodus
432 with seven or eight dorsal simple setae (four in *A. orghidani*), and lateral plumose
433 setae proportionally shorter than ones in *A. orghidani* (Guțu and Iliffe 1989). *Apseudes*
434 *ranma* sp. nov. also differs from *A. nipponicus*, the only *Apseudes* species previously
435 reported from Japan, in having shorter body (larger body, about 12–16 mm in *A.*
436 *nipponicus*), carapace without lateral spines (with anterolateral spines in *A.*
437 *nipponicus*), and pleotelson with two pairs of lateral projections (projections lacking in
438 *A. nipponicus*) (Shiino 1937). Kakui and Hiruta (2023, 2024) provided differences in
439 the chelipedal shape and manca size between *A. ranma* sp. nov. and *A. nipponicus*.

440 Our 18S-based tree was largely consistent with previous results from Kakui et
441 al. (2011, 2021b) in showing three clades: Kalliapseudidae, Sphyrapodidae, and a clade
442 comprising all the other apseudoideans. As with Kakui et al. (2021b), *Apseudes* formed
443 the sister clade to *Carpoapseudes*, although with only moderate support; this
444 relationship was fully supported in Kakui et al. (2021b) based on transcriptome data.
445 None of the other apseudid genera formed a moderately or strongly supported clade
446 with any confamilial genera, and the subfamilies Apseudinae and Leviapseudinae were
447 thus not monophyletic in our tree. The validity of these subfamilies based on
448 morphology has long been debated (e.g., Gouillieux et al. 2023). Lack of support for the

449 basal nodes in our tree indicates the limits 18S for investigating relationships in
450 Apseudidae and its allies, and larger datasets including additional molecular markers
451 will be necessary for this purpose.

452 We found presumptive stridulatory organs on the inner surface of the chelipedal
453 bases in *A. ranma* sp. nov. (Fig. 4), with complementary structures opposing one
454 another on the left and right chelipeds. The organs in *A. ranma* sp. nov. are similar in
455 location to presumptive stridulatory organs in the apseudid *Paradoxapseudes*
456 *shimojiensis* Kakui & Fujita, 2020 (Kakui and Fujita 2020, fig. 5), but the components
457 are slightly different. Each organ in *A. ranma* sp. nov. comprises a cylindrical protrusion
458 (Fig. 4B–E) and knobbly area (Fig. 4B–D, F), with the protrusion bearing apical
459 tubercles at its distal end, whereas that in *P. shimojiensis* consists of similar serial
460 ridges. We interpret each protrusion in *A. ranma* sp. nov. to function as a plectrum, and
461 the knobbly area as a pars stridens, with movement of the chelipeds causing each
462 protrusion to rasp the knobbly area on the opposite basis, thus producing sound. This is
463 the first known instance of presumptive stridulatory organs comprising a plectrum and
464 pars stridens in Tanaidacea; all organs previously reported contain only similarly shaped
465 serial ridges (Menzies 1953; Kakui and Shimada 2017; Kakui and Fujita 2020; Kakui
466 and Hiruta 2022). We observed mesh areas on the inner distal surface of the basis,

467 merus, carpus, and chelipedal palm; the function of these areas is unclear.

468 To date, *Apseudes ranma* sp. nov. has been found only in artificial environments,
469 and information is lacking on its distribution in the wild. However, as demonstrated by a
470 jellyfish species that had been reported only from aquaria and subsequently found from
471 wild environments (*Eirene lacteoides* Kubota and Horita 1992; Crow et al. 2023), DNA
472 barcoding studies of wild-caught *Apseudes* individuals or environmental DNA samples
473 may someday elucidate its natural range. Considering that it was found in coral sand in
474 an aquarium tank containing live rocks and giant clams, *A. ranma* sp. nov. may be a
475 shallow-water, subtropical or tropical species.

476

477 Acknowledgments

478 We thank Tsuyoshi Matsuda, Akira Ogushi, Futoshi Kakizoe, and Takahiro
479 Hoshino for help in sampling *A. ranma*; the staff of SMRC for help in sampling *A.*
480 *nipponicus*; Hironori Komatsu for providing *C. spinigena*; Rumiko Takahashi for
481 allowing us to name the species after Ranma Saotome; Satori Okamoto and Weekly
482 Shonen Sunday, Shogakukan Inc., for handling our request about naming; Shoki Shiraki
483 for help with morphological and molecular work; Rintaro Ono for help in surveying
484 literature; Kazuhiro Kogame for comments on results; and Matthew H. Dick for

485 reviewing the manuscript and editing our English. This study was supported in part by a
486 Grant-in-Aid for JSPS Fellows (JP10J01119) and KAKENHI grants (JP16K18597 and
487 JP19K06800) from the Japan Society for the Promotion of Science (JSPS).

488

489 Literature Cited

- 490 Ahyong ST, Lowry, JK, Alonso M, Bamber RN, Boxshall GA, Castro, P, Gerken S,
491 Karaman GS, Goy JW, Jones DS, Meland K, Rogers DC, Svavarsson J. 2011.
492 Subphylum Crustacea Brünnich, 1772. *In*: Zhang Z-Q, editor. Animal Biodiversity:
493 An Outline of Higher-level Classification and Survey of Taxonomic Richness.
494 Zootaxa. 3148:165–191. <https://doi.org/10.11646/ZOOTAXA.3148.1.33>
- 495 Altschul SF, Gish W, Miller W, Myers EW, Lipman DJ. 1990. Basic local alignment
496 search tool. *J Mol Biol.* 215:403–410. [https://doi.org/10.1016/S0022-](https://doi.org/10.1016/S0022-2836(05)80360-2)
497 [2836\(05\)80360-2](https://doi.org/10.1016/S0022-2836(05)80360-2)
- 498 Bamber RN. 2007. Suborders Apseudomorpha Sieg, 1980 and Neotanaidomorpha Sieg,
499 1980. *In*: Larsen K, Shimomura M, editors. Tanaidacea (Crustacea: Peracarida)
500 from Japan III. The Deep Trenches: The Kurile-Kamchatka Trench and Japan
501 Trench. *Zootaxa.* 1599:13–40. <https://doi.org/10.11646/ZOOTAXA.1599.1.3>
- 502 Bird GJ, 2011. Paratanaoidean tanaidaceans (Crustacea: Peracarida) from littoral and

- 503 shallow sublittoral habitats in New Zealand, with descriptions of three new genera
504 and seven new species. *Zootaxa*. 2891:1–62
- 505 Crow GL, Holland BS, Yamamoto G, Ikeda S, Adachi A, Niide K. 2023. Integrative
506 systematics and biogeography of the hydrozoans (Leptothecata: Eirenidae) *Eirene*
507 *menoni* Kramp, 1953 and *Eirene lacteoides* Kubota and Horita, 1992 from Japan
508 and China with comments on Pacific Ocean distributions. *Zool Stud*. 62(49).
509 <https://doi.org/10.6620/ZS.2023.62-49>
- 510 Folmer O, Black M, Hoeh W, Lutz R, Vrijenhoek R. 1994. DNA primers for
511 amplification of mitochondrial cytochrome *c* oxidase subunit I from diverse
512 metazoan invertebrates. *Mol Mar Biol Biotechnol*. 3: 294–299
- 513 Gouillieux B, Labrune C, Esquete P. 2023. *Leviapseudes tethys* (Tanaidacea:
514 Apseudidae), a new species from a submarine canyon of the French Mediterranean
515 Sea, with remarks and a diagnosis for the genus. *Eur J Taxon*. 879:24–37.
516 <https://doi.org/10.5852/ejt.2023.879.2157>
- 517 Guțu M. 2007. Contribution to the knowledge of the Indo-West-Pacific Apseudomorpha
518 (Crustacea: Tanaidacea). *Trav Mus Natl Hist Nat Grigore Antipa*. 50:47–86
- 519 Guțu M, Iliffe TM. 1989. *Apseudes orghidani*, a new species of Tanaidacea (Crustacea)
520 from an anchialine cave on Bermuda. *Trav Mus Natl Hist Nat Grigore Antipa*.

521 30:161–167

522 Holdich DM, Jones JA, 1983. The distribution and ecology of British shallow-water
523 tanaid crustaceans (Peracarida, Tanaidacea). J Nat Hist. 17:157–183.

524 <https://doi.org/10.1080/00222938300770141>

525 Izumi T, Fujii T, Yanagi K, Higashiji T, Fujita T. 2019. Redescription of *Synactinernus*
526 *flavus* for the first time after a century and description of *Synactinernus churaumi*
527 sp. nov. (Cnidaria: Anthozoa: Actiniaria). Zool Sci. 36:528–538.

528 <https://doi.org/10.2108/zs190040>

529 Józwiak P. 2014. *Zoidbergus*, a new genus of Apseudidae (Tanaidacea) with remarks on
530 *Apseudes siegi* and *Apseudes vitjazi*. Polish Polar Res. 35:389–414.

531 <https://doi.org/10.2478/popore-2014-0020>

532 Kakui K. 2016. Review of the taxonomy, diversity, ecology, and other biological aspects
533 of Order Tanaidacea from Japan and surrounding waters. In: Motokawa M,
534 Kajihara H, editors. Species Diversity of Animals in Japan. Tokyo: Springer Japan.
535 p. 603–627

536 Kakui K, Angsupanich S. 2012. *Birdotanais songkhlaensis*, a new genus and species of
537 Nototanaidae (Crustacea: Tanaidacea) from Thailand. Raffles B Zool. 60:421–432.

538 <https://doi.org/10.5281/zenodo.5349855>

- 539 Kakui K, Fleming JF, Mori M, Fujiwara Y, Arakawa K. 2021b. Comprehensive
540 transcriptome sequencing of Tanaidacea with proteomic evidences for their silk.
541 Genome Biol Evol. 13(12):evab281. <https://doi.org/10.1093/gbe/evab281>
- 542 Kakui K, Fujita Y. 2020. *Paradoxapseudes shimojiensis* sp. nov. (Crustacea:
543 Tanaidacea: Apseudidae) from a submarine limestone cave in Japan, with notes on
544 its chelipedal morphology and sexual system. Mar Biol Res. 16:195–207.
545 <https://doi.org/10.1080/17451000.2020.1720249>
- 546 Kakui K, Fukuchi J, Shimada D. 2021a. First report of marine horsehair worms
547 (Nematomorpha: *Nectonema*) parasitic in isopod crustaceans. Parasitol Res.
548 120:2357–2362. <https://doi.org/10.1007/s00436-021-07213-9>
- 549 Kakui K, Hiruta C. 2013. Selfing in a malacostracan crustacean: why a tanaidacean but
550 not decapods. Naturwissenschaften. 100:891–894. [https://doi.org/10.1007/s00114-](https://doi.org/10.1007/s00114-013-1079-5)
551 [013-1079-5](https://doi.org/10.1007/s00114-013-1079-5)
- 552 Kakui K, Hiruta C. 2022. Protogynous hermaphroditism in Crustacea: a new example
553 from Tanaidacea. Can J Zool. 100:481–487. <https://doi.org/10.1139/cjz-2022-0033>
- 554 Kakui K, Hiruta C. 2023. Differential masculinization of the chelipeds in two
555 simultaneously hermaphroditic *Apseudes* tanaidaceans (Crustacea: Malacostraca).
556 Zool Anz. 305:23–27. <https://doi.org/10.1016/j.jcz.2023.05.004>

- 557 Kakui K, Hiruta C. 2024. A smaller species releases proportionally larger juveniles in
558 *Apseudes* (Crustacea: Peracarida: Tanaidacea). *Cah Biol Mar.* 65:35–37.
559 <https://doi.org/10.21411/CBM.A.F7E539FB>
- 560 Kakui K, Hiruta C, Uyeno D. 2019. Sexual system in the tanaidacean *Falsapseudes*
561 *bowmani* (Crustacea: Malacostraca: Peracarida). *Invertebr Biol.* 138(3):e12257.
562 <https://doi.org/10.1111/ivb.12257>
- 563 Kakui K, Katoh T, Hiruta, SF, Kobayashi N, Kajihara H. 2011. Molecular systematics of
564 Tanaidacea (Crustacea: Peracarida) based on 18S sequence data, with an
565 amendment of suborder/superfamily-level classification. *Zool Sci.* 28:749–757.
566 <https://doi.org/10.2108/zsj.28.749>
- 567 Kakui K, Shimada D. 2017. A new species of *Tanaopsis* (Crustacea: Tanaidacea) from
568 Japan, with remarks on the functions of serial ridges and grooves on the
569 appendages. *Zootaxa.* 4282:324–336.
570 <https://doi.org/10.11646/ZOOTAXA.4282.2.6>
- 571 Kakui K, Shimada D. 2022. Dive into the sea: first molecular phylogenetic evidence of
572 host expansion from terrestrial/freshwater to marine organisms in Mermithidae
573 (Nematoda: Mermithida). *J Helminthol.* 96:e33.
574 <https://doi.org/10.1017/S0022149X22000256>

- 575 Kakui K, Suzuki A, Nakano H, Kohtsuka H. 2017. Habitat of a tanaidacean *Apseudes*
576 *nipponicus* Shiino, 1937. B Kitakyushu Mus Nat Hist Hum Hist Ser A. 15:1–3.
577 https://doi.org/10.34522/kmnh.15.0_1
- 578 Kimura M. 1980. A simple method for estimating evolutionary rates of base
579 substitutions through comparative studies of nucleotide sequences. J Mol Evol.
580 16:111–120. <https://link.springer.com/article/10.1007/BF01731581>
- 581 Kito K, Nakamura T. 2001. A new species of *Chromadorina* (Nematoda:
582 Chromadoridae) discovered in a laboratory aquarium. Species Div. 6:111–116.
583 <https://doi.org/10.12782/specdiv.6.111>
- 584 Kubota S, Horita T. 1992. A new Hydromedusa of the genus *Eirene* (Leptomedusae;
585 Eirenidae) from Toba, Japan. Zool Sci. 9:413–421.
586 <https://doi.org/10.34425/zs000973>
- 587 Kudinova-Pasternak RK. 1985. The abyssal Tanaidacea (Crustacea, Malacostraca) from
588 the south-west Indian Ocean. Suborders Neotanaidomorpha and Apseudomorpha.
589 Zool Zh. 64:685–695. [in Russian with English abstract]
- 590 Kumar S, Stecher G, Tamura K. 2016. MEGA7: molecular evolutionary genetics
591 analysis version 7.0 for bigger datasets. Mol Biol Evol. 33:1870–1874.
592 <https://doi.org/10.1093/molbev/msw054>

- 593 Lang K. 1968. Deep-sea Tanaidacea. *Galathea Rep.* 9:23–210.
- 594 Larsen K. 2003. Proposed new standardized anatomical terminology for the Tanaidacea
595 (Peracarida). *J Crustacean Biol.* 23:644–661. <https://doi.org/10.1651/C-2363>
- 596 Leach WE. 1814. Crustaceology. *In:* Brewster D, editor. *The Edinburgh Encyclopædia*
597 7. Edinburgh: Balfour. p. 383–429.
- 598 Menzies RJ. 1953. The apseudid chelifera of the eastern tropical and north temperate
599 Pacific Ocean. *Bull Mus Compar Zool Harvard Coll.* 107:443–496.
- 600 Montagu G. 1808. II. Description of several marine animals found on the south coast of
601 Devonshire. *Trans Linn Soc Lond.* 9:81–114, 8 pls.
- 602 Pinheiro U, Calheira L, Hajdu E. 2015. A new species of freshwater sponge,
603 *Heteromeyenia barlettai* sp. nov. from an aquarium in São Paulo, Brazil
604 (Spongillida: Spongillidae). *Zootaxa.* 4034:351–363.
605 <https://doi.org/10.11646/zootaxa.4034.2.7>
- 606 Richardson H. 1912. Description of a new species of isopod belonging to the genus
607 *Apseudes* from Ecuador. *Proc U S Natl Mus.* 42: 583–585.
- 608 Schneider CA, Rasband WS, Eliceiri KW. 2012. NIH Image to ImageJ: 25 years of
609 image analysis. *Nat Methods.* 9:671–675. <https://doi.org/10.1038/nmeth.2089>
- 610 Shannon T III, Achatz GJ. 2007. *Convolutriloba macropyga* sp. nov., an uncommonly

- 611 fecund acoel (Acoelomorpha) discovered in tropical aquaria. *Zootaxa*. 1525:1–17.
612 <https://doi.org/10.11646/zootaxa.1525.1.1>
- 613 Shiino SM. 1937. On *Apseudes nipponicus* n. sp. (Crustacea, Tanaidacea). *Ann Zool*
614 *Jpn.* 16:53–62. <https://doi.org/10.34434/za000433>
- 615 Shimada D, Kakui K, Fujita Y. 2023. A new species of free-living marine nematode,
616 *Fotolaimus cavus* sp. nov. (Nematoda, Oncholaimida, Oncholaimidae), isolated
617 from a submarine anchialine cave in the Ryukyu Islands, southwestern Japan.
618 *Zoosyst Evol.* 99:519–533. <https://doi.org/10.3897/zse.99.109097>
- 619 Shiraki S, Kakui K. 2022. Observations on predation in *Paranthura japonica*
620 Richardson, 1909 (Isopoda: Cymothoidea: Paranthuridae). *Zool Sci.* 39:270–274.
621 <https://doi.org/10.2108/zs210122>
- 622 Wilfert M, Gibson R. 1974. A new genus of hermaphroditic freshwater heteronemertean
623 (Nemertinea). *Z Morph Tiere.* 79:87–112.
- 624 Wittmann KJ, Abed-Navandi D. 2021. Four new species of *Heteromysis* (Crustacea:
625 Mysida) from public aquaria in Hawaii, Florida, and western to central Europe. *Eur*
626 *J Taxon.* 735:133–175. <https://doi.org/10.5852/ejt.2021.735.1247>
- 627 WoRMS Editorial Board. 2024. World register of marine species. Accessed January 11,
628 2024. Available from: <https://www.marinespecies.org>

Table 1. List of PCR and cycle sequencing (CS) primers used in this study.

| Marker | Primer | Reaction | Primer sequence | Source |
|--------|---------|----------|----------------------------|--------------------------|
| 18S | 18S-a1F | PCR | GGYGAAACCGYGAAWGGYTC | Kakui et al. (2011) |
| | 18S-b3F | CS | CCTGAGAAACGGCTACCACAT | Kakui and Shimada (2017) |
| | 18S-b3R | CS | ATGTGGTAGCCGTTTCTCAGG | Kakui and Shimada (2022) |
| | 18S-b4F | CS | TGCGGTAAAAAGCTCGTAGTTG | Kakui et al. (2011) |
| | 18S-b4R | CS | TCCAACACTACGAGCTTTTAACC | Kakui et al. (2011) |
| | 18S-b5F | CS | GATCGAAGGCGATYAGATACC | Kakui et al. (2021a) |
| | 18S-b6F | CS | CCTGCGGCTTAATTTGACTC | Kakui et al. (2011) |
| | 18S-a6R | CS | AACGGCCATGCACCAC | Kakui et al. (2011) |
| | 18S-b8F | CS | GGTCTGTGATGCCCTTAGATG | Kakui et al. (2011) |
| | 18S-a9R | PCR | CCTTGTTACGACTTTTAGTTCC | Kakui et al. (2011) |
| COI | LCO1490 | PCR & CS | GGTCAACAAATCATAAAGATATTGG | Folmer et al. (1994) |
| | HCO2198 | PCR & CS | TAAACTTCAGGGTGACCAAAAAATCA | Folmer et al. (1994) |

Table 2. Comparison of selected characters among *Apseudes ranma* sp. nov. and two similar congeners. SS, spiniform seta.

| Characters | <i>Apseudes ranma</i> sp. nov. | <i>Apseudes curtiramus</i> | <i>Apseudes orghidani</i> | |
|------------|-------------------------------------|----------------------------|---------------------------|---------|
| Carapace | Anterolateral margin: lateral setae | present | present | absent |
| Pereopod 1 | Basis: ventro-subproximal spine | present | absent | present |
| Pereopod 2 | Merus: ventrodiscal SS | 3 | 2 | 1 |
| Pereopod 3 | Merus: ventrodiscal SS | 3 | 1 | no data |
| | Carpus: outer distal SS | 1 | 0 | no data |
| | Propodus: outer SS | 3 | 0 | no data |
| Pereopod 4 | Merus: mid-ventral SS | 2 or 3 | 1 | 1 |
| | Propodus: ventral SS | 3 or 4 | 2 | 0 |

Figure legends

Figure 1. Live *Apseudes ranma* sp. nov., paratype ICHUM8629, dorsal view.

Figure 2. *Apseudes ranma* sp. nov., holotype; A body, dorsal view; B pleon and pleotelson, dorsal view; C body, left view; D left antennule, ventral view (setae on outer and inner flagella omitted); E left antennule, outer flagella, ventral view; F left antennule, inner flagella, ventral view; G left antenna, ventral view; H labrum; I, J mandible, left and right distal portions; K labium.

Figure 3. *Apseudes ranma* sp. nov. (A–D, I, H holotype; E, F paratype ICHUM8628); A outer and inner endites of right maxillule; B left maxilla (most setae on outer lobe of fixed endite omitted), anterior view; C same, outer lobe of fixed endite, anterior view; D bifurcate seta; E left maxillipedal endite; F bifurcate seta; G left maxilliped (endite omitted); H serrate seta; I right epignath; J left cheliped, outer view (cylindrical protrusion and knobby area on inner surface omitted).

Figure 4. *Apseudes ranma* sp. nov., (A, B paratype ICHUM8630; C–F paratype

ICHUM8635); SEM images; A ventral view of chelipeds, with box indicating region enlarged in B; B pair of cylindrical protrusions and knobbly areas; C right cheliped, inner view; D enlargement of mid-inner region of basis from C, showing cylindrical protrusion and knobbly area; E cylindrical protrusion from D; F part of knobbly area from D. Arrowheads, cylindrical protrusions; arrows, knobbly areas.

Figure 5. *Apseudes ranma* sp. nov., holotype; A–F left pereopods 1–6 (basis partly broken in B), G left pleopod 1 (setae on exopod and endopod omitted); H same, left exopod; I same, left endopod.

Figure 6. *Apseudes ranma* sp. nov., holotype; A merus, carpus, propodus, and dactylus of pereopod 4; B same, pereopod 5; C propodus and dactylus of pereopod 6; D left uropod, protopod; E same, overall view (setae on protopod omitted).

Figure 7. ML tree for Apseudoidea, based on 18S sequences. Numbers at nodes are SH-aLRT value / UFBoot value; only values of SH-aLRT greater than 60% and UFBoot greater than 70% are show

Captions for Supplementary Materials

Supplementary Material 1. List of species included in the molecular phylogenetic analysis and their INSD accession numbers.

Supplementary Material 2. Aligned 18S sequences before trimming the length and removing alignment-ambiguous sites.

Supplementary Material 3. Aligned 18S sequences used for the maximum-likelihood analysis, trimmed in MEGA10 to the shortest length among them, and reduced to 1960 positions by removing alignment-ambiguous sites with Gblocks under “relaxed” parameters.

Supplementary Material 4. Variation in characters among dissected specimens of *Apseudes ranma* sp. nov.













