

THE AMPHIPOD GENERA *EOBROLGUS* AND *EYAKIA* (CRUSTACEA: PHOXOCEPHALIDAE) IN THE PACIFIC OCEAN

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Abstract.—*Eobrolgus* now contains 3 species, *spinosus* (Holmes) (type), *chumasi* n. sp. and *pontarpioides* (Gurjanova); *E. spinosus* appears to be a west Atlantic species introduced into lagoons and estuaries of the north-eastern Pacific, whereas *E. chumasi* is a native eastern Pacific species and the possible ancestor of *spinosus*. Now that *spinosus* has returned to the Pacific, gene flow is perceived to occur with its parent *chumashi*.

Eyakia has 4 species, *robusta* (Holmes) (type) (? = *ochotica* (Gurjanova)), *calcarata* (Gurjanova), *uncigera* (Gurjanova) and *subuncigera* (Kudrjaschov). The first 2 are redescribed.

Introduction.—The genera *Eobrolgus* and *Eyakia* were recently carved out of the polytypic *Paraphoxus* Sars by J. L. Barnard (1979). The species of these genera are now presented and revised.

Of particular interest is the discovery of a new cryptic species of Phoxocephalidae near *Eobrolgus spinosus* (Holmes) (formerly *Paraphoxus spinosus*) which appears to be an endemic east Pacific species and which points to the possibility that east Pacific populations of *E. spinosus* are introductions from the Atlantic Ocean.

The taxonomy of American and North Pacific Phoxocephalidae is much more subtle than that found for Australian taxa by Barnard and Drummond (1978), so that generic distinctions are much finer and fewer.

The generic information of Barnard (1979) is not repeated here so as to save space for redescription of those species for which good material is available.

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Eobrolgus J. L. Barnard, 1979

This genus differs from Australian brolgins and *Paraphoxus* by the following factors: (1) proximal spines of article 4 on antenna 2 are thick and present (in brolgins they are thin or absent); (2) distal spines in the same

locality are few; (3) inner plate of maxilla 1 with 4 setae (2 in other mentioned groups); (4) mandibular molar with 4+ spines (3 or fewer in brolgins); (5) inner plate of maxilliped with one main apical spine (none in brolgins); (6) maxillipedal dactyl with apical spine fused (not fused in brolgins except in *Elpeddo*); (7) epimeron 3 with 3+ long setae (3 or fewer usually short setae in brolgins); (8) right lacinia mobilis apical branch narrow or absent.

Key to the Species of *Eobrolgus*

- 1. Each lobe of telson with 2 apical spines *E. pontarpioides*
- Each lobe of telson with one apical spine 2
- 2. Epimeron 3 naked ventrally, right lacinia mobilis simple in female, outer plate of maxilla 1 with 9 spines *E. spinosus*
- Epimeron 3 with 1–2 ventral setae, right lacinia mobilis bifid in female, outer plate of maxilla 1 with 11 spines *E. chumashi*

Eobrolgus spinosus (Holmes)

Fig. 1f

Paraphoxus spinosus Holmes, 1905:477–478, fig. [unnumbered]; Kunkel, 1918:76–78, fig. 13; Shoemaker, 1925:26–27; J. L. Barnard, 1959:18; 1960:243–249, pls. 29–31; 1961:178; 1964a:105; 1966a:89; 1969a:197–198; 1969b:224; Reish and Barnard, 1967:18; Bousfield, 1973:125, pl. 34.1.

Description of female ‘f’ of Atlantic Ocean.—Head about 18 percent of total body length, greatest width about 75 percent of length, rostrum unconstricted, broad, short, reaching middle of article 2 on antenna 1. Eyes large, mostly occluded with pigment, ommatidia ordinary. Article 1 on peduncle of antenna 1 about 1.35 times as long as wide, about 2.1 times as wide as article 2, ventral margin with about 9 setules, strongly produced dorsal apex with 2 setules, article 2 about 0.6 times as long as article 1, with 2 apicoventral rows of 4 and 2 setae and 3 lateral setae, primary flagellum with 7 articles, about 0.55 times as long as peduncle, bearing one short aesthetasc each on articles 3–6, accessory flagellum with 5 articles. Antenna 2 thin, not ensiform but article 1 enlarged, article 3 with one anterodorsal setule plus normal facial formula; spine formula on article 4 = 1-3-4, dorsal margin with notch bearing one seta and one spine, ventral margin with 5 groups of 2 long to medium setae, one ventrodiscal long spine, article 5 about 0.8 times as long as article 4, facial spine formula = 2, dorsal margin bearing one apical set of short setae, ventral margin with 4 sets of 2 long to short setae, 3 ventrodiscal long to medium spines set facially, flagellum as long as articles 4–5 of peduncle combined, with 8 articles.

Epistome with weak anterior knob. Mandibles with medium palpar hump, right incisor with 3 normal teeth, left incisor with 3 hump-teeth in 2 branch-

formula = 0. Each outer lobe of lower lip with one cone. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae, outer plate with 9 spines, palp thin, scarcely biarticulate, article 2 with one apical spine, one apicolateral and 2 medial setae. Plates of maxilla 2 extending equally, outer not broader than inner, outer with 2 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with one large thin apical spine, 2 apicofacial setae, 4 medial setae, outer plate with 8 medial and apical spines, no apicolateral setae, palp article 1 without apicolateral seta, article 2 without lateral setae, medial margin weakly setose, article 3 with 4 facial setae, 2 lateral setae, nail of article 4 fused, with 2 accessory setules.

Coxa 1 scarcely expanded apically, anterior margin straight, main ventral setae of coxae 1-4 = 8-8-8-5, posteriormost seta of coxae 1-4 slightly shortened, anterior and posterior margins almost parallel, posterior margin convex, posterodorsal corner rounded, posterodorsal margin short, V-shaped, width-length ratio = 18:19. Gnathopods generally ordinary, width ratios on articles 5-6 of gnathopods 1-2 = 25:36 and 27:39, length ratios = 65:73 and 53:71, palmar humps ordinary, palms strongly oblique, article 5 of gnathopod 1 elongate, ovate, posterior margin rounded-flat, long, article 5 of gnathopod 2 ovate, posterior margin rounded, short, almost produced.

Pereopods 3-4 similar to each other, facial setae formulas on article 4 = 4 and 3, almost parallel to apex, on article 5 = 4 and 3, main spine of article 5 extending to M. 100 on article 6, article 5 with no proximoposterior spines, spine formula of article 6 = 4 + 5 and 4 + 5 plus middistal seta, some spines especially long, acclivity on inner margin of dactyls of pereopods 3-4 absent, emergent setule short, almost fully immersed, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 2-1-1. Articles 4-5 of pereopods 5-6 narrow, facial spine rows sparse, facial ridge formula of article 2 on pereopods 5-7 = 0-1-1. Width ratios of articles 2, 4, 5, 6 on pereopod 5 = 53:33:30:13, of pereopod 6 = 68:26:16:9, of pereopod 7 = 80:17:16:8, length ratios of pereopod 5 = 78:32:40:38, of pereopod 6 = 90:56:45:43, of pereopod 7 = 100:23:22:27, article 2 of pereopod 7 reaching middle of article 4, posterior margin with 8 tiny serrations, only medial apex of article 6 finely and sparsely combed, bearing 1-2 weak digital processes.

Posteroventral corner of epimeron 1 rounded, posterior margin straight, naked, anteroventral margin with 2 medium setae, posteroventral face with one long seta. Posteroventral corner of epimeron 2 rounded, posterior margin weakly convex, naked, facial setae = 5, no pair set vertically. Posteroventral corner of epimeron 3 rounded, posterior margin straight, serrate, setose (4), with one dorsal setule notch, ventral margin naked.

Urosomite 1 with lateral setule at base of uropod 1, no ventral setae, articulation line short, urosomite 3 unprotuberant dorsally. Rami of uropods

1–2 with articulate but tightly fixed apical nails, outer ramus of uropod 1 with 3 dorsal spines, inner with 2, outer ramus of uropod 2 with 2 dorsal spines, inner with one dorsomedial spine, peduncle of uropod 1 with 4 basofacial setae and one apicolateral spine, medially with 4 marginal spines, apicalmost enlarged but not displaced. Peduncle of uropod 2 with 5 thin dorsal spines, medially with one medium apical spine, apicolateral corner of peduncles on uropods 1–2 with comb. Peduncle of uropod 3 with 4 ventral spines, dorsally with 2 lateral spines, one medial setule, rami feminine, inner extending to M. 50 on article 1 of outer ramus, apex with one long seta, medial and lateral margins naked, article 2 of outer ramus elongate, 0.25, bearing 2 short to medium setae, medial margin of article 1 with 4 setae, lateral margin with 3 acclivities, spine formula = 2-2-2-2, setal formula = 0. Telson especially long, length-width ratio = 35:29, almost fully cleft, each apex of medium width, rounded, scarcely protruding, lateral acclivity shallow, narrow, bearing ordinary lateral setule, spine next medial longer than setule; midlateral setules diverse, largest of medium size.

Young male "p" of Pacific Ocean (assumed transplant).—Like *Atlantic spinosus* in (1) presence of 9 spines on outer plate of maxilla 1; (2) simple right lacinia mobilis; (3) coxa 4 setose; (4) uropods 1–2 with comb; (5) rami of uropod 2 with one spine each; (6) apical setae on outer ramus of uropod 1 medium in length; (7) apical nails on rami of uropods 1–2 large; (8) no ventral setae on epimeron 3.

Female "u" of Pacific Ocean, possible hybrid.—Like *Atlantic spinosus* in items of paragraph above: 2, 3 (but coxa 4 with only 1 seta), 4, 5 (but only outer ramus with spine), 6, 7, 8; but outer plate of maxilla 1 with 11 spines like *chumashi*.

Male "b."—Article 2 of antenna 1 with 6–7 narrowly spread ventral setae, primary flagellum with 9 articles, one calceolus each on articles 1–5. Facial spine formula on article 4 of antenna 2 = 3-4-1, of article 5 = 2, latter with 4 dorsal sets of male setae and no calceoli, ventrodiscal apex with 2 thin spines, flagellar calceolus formula = 2,3,5,7,9 . . . n.

Basofacial setal formula of article 3 on mandibular palp = 0-1, article 2 with 4 apical setae. Outer plate of maxilla 1 with 9 spines.

Coxa 4 more elongate than in female, width-length ratio = 4:5. Pereopods 3–4 thinner than in female; article 2 of pereopods 5–7 narrower than in female; article 5 of pereopod 7 with 1–2 male setae.

Epimera 1–3 broadened, posterior margin of epimeron 3 not shortened, setal formulae, epimeron 1 anteroventral = 2, posteroventral = 1, epimeron 2 facial = 3-4, epimeron 3 posterior = 4, facial = 0, ventral = 0. Spine formulae of uropods, uropod 1 peduncle apicolateral = 1, basofacial = 4, uropod 2 peduncle dorsal = 5, dorsal spines on outer ramus of uropod 1 = 2, of uropod 2 = 2, inner ramus of uropod 1 = 1, of uropod 2 = 1, ventral

spines on peduncle of uropod 3 = 5, spine formula on article 1 of outer ramus = 1-2-2-2-2, setal formula = 1-1-1-1-1, setae on outer ramus of article 2 as in female.

Telson elongate, length-width ratio = 4:3, distal spines shortened, formula = setule, spine, setule, each lobe with long single denticle row.

Voucher material.—Male “b” 4.37 mm and male “c” 4.02 mm, Woods Hole, Massachusetts, USA, 9 July 1875, surface, A.E.V. [Verrill]; female “f” 4.58 mm, Amityville [Long Island, New York, USA], 6 July 1938, Acc. no. 149428; young male “p” 3.22 mm (no antenna 2), Friday Harbor, Washington, USA, 8896, 21 October 1920; female “u” 1.88 mm, Newport Bay, California, USA, station 50, 1964 January (see J. L. Barnard, 1959).

Remarks.—One presumes that this is an Atlantic species that has been introduced into estuaries, bays and lagoons of the northeastern Pacific Ocean, such as Friday Harbor and Newport Bay (and Morro Bay, San Francisco Bay, etc.) where it closely matches the endemic Pacific *E. chumashi*. Female “u” cited above is disturbing because it has 11 spines on the outer plate of maxilla 1 like *chumashi* yet has the *spinosus* morphology in other characters. Study on hybridization is warranted. The two morphs may have been separated by Pleistocene closure of the Panamic isthmus and now have been rejoined by mankind without complete genetic isolation. Other explanations can be visualized and need not be discussed until the morphs are explored further.

Barnard (1960) did not detect this problem because finely drawn characters as now used had not been introduced. Most of the Allan Hancock Foundation materials will require reidentification, a task we leave to someone who wants to pursue the introduction problem.

Despite the amazing superficial resemblance of this species to *Paraphoxus oculatus*, the two taxa cannot be congeneric because of (1) the mandibular molar spine counts; (2) the spine distribution on article 4 of antenna 2; (3) the short article 1 of the mandibular palp; (4) the oblique apex of palp article 3 on the mandibular palp; (5) the non-foliate right lacinia mobilis; (6) the presence of 4 setae on the inner plate of maxilla 1; (7) the stout apical spine on the inner plate of the maxilliped; (8) the presence of basal armaments on article 5 of pereopods 3–4; (9) the presence of long setae on epimeron 3; and, in addition, the lesser values of setae on article 2 of antenna 1 not being fully apicad and the dactylar nail of the maxilliped being fused.

This species is also confusable with *Foxiphalus obtusidens* but the following characters distinguish *spinosus* from *obtusidens*: (1) the apicad position of the setae on article 2 of antenna 1; (2) the short head; (3) the non-ensiform antenna 2; (4) the simple right lacinia mobilis; (5) the thin apex of the palp on maxilla 1; (6) the tightly fixed apical nail on the inner ramus of uropod 1; (8) the lack of ventral setae on the urosome.

A few west American samples of “*Paraphoxus spinosus*” have been reex-

amined and some found to be the new species, *Eobrolgus chumashi*, a cryptic species similar to *spinosus*. But most of the material in the Allan Hancock Foundation needs to be reidentified and we have not examined the material from the Gulf of California, Carmen Island, identified by Shoemaker (1925) which is presumably in the American Museum of Natural History.

The open-sea character of *chumashi* and the estuarine-lagoon-shallow open-sea character of *spinosus* suggest the latter has been introduced onto the Pacific Coast from the western Atlantic. But more investigation of the two species is required.

Distribution.—Western Atlantic Ocean from Vineyard Sound to North Florida (*fide* Bousfield, 1973), depths unknown, no samples in Smithsonian collections with stated depths; eastern Pacific Ocean, confirmed localities, Friday Harbor and Newport Bay (lagoon), shallow water; much material to be reidentified in Allan Hancock Foundation.

Eobrolgus chumashi, new species

Fig. 1e

Description of female "e."—Body dwarfed. Head about 21 percent of total body length, greatest width about 67 percent of length, rostrum unconstricted, broad, short, almost reaching apex of article 2 on antenna 1. Eyes large, mostly occluded with pigment, ommatidia especially large. Article 1 of peduncle on antenna 1 almost 1.5 times as long as wide, about twice as wide as article 2, ventral margin with 7–8 setules, produced dorsal apex with 2 setules, article 2 about 0.55 times as long as article 1, with 2 apicoventral rows of 4 and 1 setae and 2 lateral setae, primary flagellum with 7 articles, about 0.8 times as long as peduncle, bearing one short aesthetasc each on articles 3–6, accessory flagellum with 5 articles. Antenna 2 not ensiform, article 3 dorsally naked but with normal facial setules, spine formula of article 4 = 1-3-5, dorsal margin with notch bearing 2 setae and one spine, ventral margin with 5 groups of 2 long to medium setae, one ventrodiscal long spine, article 5 about 0.72 times as long as article 4, facial spine formula = 3, dorsal margin bearing one set of small setae apically, ventral margin with 4 sets of 1–2 long to short setae, 3 ventrodiscal long to medium spines set facially; flagellum about 0.95 times as long as articles 4–5 of peduncle combined, with 7 articles.

Epistome unproduced. Mandibles with weak to medium palpar hump, right incisor with 3 teeth, left incisor with 3 hump-teeth in 2 branches, right lacinia mobilis bifid, distal branch not shorter than proximal, distal branch broad, proximal branch narrow, both branches simple, pointed, left lacinia mobilis with 4 teeth, middle teeth shortened, right rakers 7 plus 2 rudimentaries, left rakers 7 plus 3 rudimentaries, molars composed of elongate bul-

bous plaques, right molar with 5 primarily medium spines plus one short spine strongly disjunct, left molar with 6 primarily medium spines, no spine disjunct, each molar with plume, palp article 1 short, article 2 with one short inner apical seta and 2 other short inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 9-7 spine-setae, basofacial formula = 0. Each outer lobe of lower lip with one cone. Inner plate of maxilla 1 ordinary, bearing one medium apical pluseta, one similar apicomедial seta, 2 apicolateral shorter setae, outer plate with 11 spines, no cusps, palp article 2 with one apical spine, one apicolateral, 2 apicomедial and 3 submarginal setae. Plates of maxilla 2 extending equally, outer broader than inner, outer with 3 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with one large thick apical spine, 2 apicofacial setae, 3 medial setae, outer plate with 3 medial spines set apicad tightly, no apicolateral setae or cusp, palp article 1 without apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 moderately setose, article 3 with 4 facial setae, one lateral seta, nail of article 4 fused, with 2 accessory setules.

Coxa 1 scarcely expanded apically, anterior margin straight, main ventral setae of coxae 1-4 = 7-8-7-0, posteriormost seta of coxae 1-3 shortened, anterior and posterior margins parallel, posterior margin almost straight, posterodorsal corner sharp-rounded, posterodorsal margin short, concave, V-shaped, width-length ratio of coxa 4 = 13:17. Gnathopods ordinary, width ratios on articles 5-6 of gnathopods 1-2 = 25:33 and 26:33, length ratios = 65:56 and 49:52, palmar humps small, palms oblique, article 5 of gnathopod 1 elongate, ovate, posterior margin rounded-flat, long, article 5 of gnathopod 2 ovate, posterior margin rounded, short, almost produced.

Pereopods 3-4 similar to each other, facial setae formula on article 4 = 3 and 3, slightly oblique to apex, on article 5 = 4 and 4, main spine of article 5 extending to M. 90-100 on article 6, article 5 with no proximoposterior spines, spine formula of article 6 = 4 + 4 and 4 + 5 plus middistal seta, some spines especially long, acclivity on inner margin of dactyls of pereopods 3-4 obsolescent but sharp, emergent setule short, almost fully immersed, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 5-6 narrow, facial spine rows sparse, facial ridge formula of article 2 on pereopods 5-7 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 5 = 51:40:35:13, of pereopod 6 = 69:30:18:9, of pereopod 7 = 80:18:16:8, length ratios of pereopod 5 = 76:34:40:39, of pereopod 6 = 89:51:40:49, of pereopod 7 = 100:21:21:28, article 2 of pereopod 7 almost reaching middle of article 5, posterior margin with 10-11 tiny serrations, medial and lateral apices of article 6 deeply combed, lacking digital processes.

Posteroventral corner of epimeron 1 rounded, posterior margin weakly convex, with 2 setule-notches, anteroventral margin with 4-5 short setae, paired or not, posteroventral face with one medium seta. Posteroventral

corner of epimeron 2 rounded, posterior margin weakly convex, with 2 setule notches, facial setae = 7, posteriormost seta disjunct posteriad. Posteroventral corner of epimeron 3 rounded, weakly protuberant, posterior margin straight, serrate, setose (2) and with 5 setule notches, ventral margin with 2 short spine-setae in posterior half.

Urosomite 1 with lateral setule at base of uropod 1, no ventral setae, articulation line short, urosomite 3 unprotuberant dorsally. Rami of uropods 1–2 with articulate but tightly fixed, deeply immersed and small apical nails, outer ramus of uropod 1 with one dorsal spine, inner with one, rami of uropod 2 naked, peduncle of uropod 1 with no basofacial setae and one small apicolateral spine, medially with 2 marginal spines, apicalmost enlarged but not displaced. Peduncle of uropod 2 with 4 dorsal spines, medially with one small apical spine, apicolateral corners of peduncles on uropods 1–2 without comb. Peduncle of uropod 3 with 4 ventral spines, dorsally with one lateral spine, one medial spine, rami feminine, inner extending to M. 65 on article 1 of outer ramus, apex with one tiny setule, medial and lateral margins naked, article 2 of outer ramus elongate, 0.40, bearing tiny immersed setule near pointed apex, apicomedial margin of article 1 naked, lateral margin with 2 acclivities, spine formula = 2-2-2, setal formula = 0. Telson especially long, length-width ratio = 42:33, almost fully cleft, each apex of medium width, rounded, scarcely protuberant, lateral acclivities shallow, narrow, bearing short lateral setule, spine next medial shorter than setule (thus very short), midlateral setules diverse, largest of medium size.

Male “*d.*”—Ommatidia large. Article 1 of antenna 1 and articles 2–3 of antenna 2 with medial pubescence; length ratio of articles 1–2 on antenna 1 = 5:3; article 2 with 4 + 1 ventral setae narrowly confined and set apically, primary flagellum with 6 articles, one calceolus each on articles 1–3, aesthetascs moderately developed, accessory flagellum very short, 4-articulate. Article 4 of antenna 2 lacking dorsal notch, no dorsal spines and setae, other setae shortened, facial formula = 3-4-1, article 5 with 3 dorsal sets of male setae and one calceolus, 3 facial spines, ventrodiscal apex with 2 thin spines; formula of calceoli on flagellum = 1,2,3,5,7,9 . . . n. Right lacinia mobilis broad and scarcely bifid, apices of lobes stubby and rounded, basofacial setal formula of article 3 on mandibular palp = 0-2.

Setae of coxae 1–3 shortened, coxa 4 not broadened, setae absent. Article 2 of only pereopod 7 narrower than in female. Epimera 1–3 broadened, posterior margin of epimeron 3 not shortened, setal formulae: epimeron 1 anteroventral = 4 (one set paired), posteroventral = 1, posterior = 3 setules, epimeron 2 facial = 6 (posterior one disjunct), posterior = 2 setules, epimeron 3 posterior = 3 + 3 setules, facial = 0, ventral = 2.

Spine formulae of uropods: uropod 1 peduncle apicolateral = 1, basofacial = 1 stout and short spine, medial peduncle = only one long apical spine not displaced, no others; uropod 2 peduncle dorsal = 4, not longer than in

female, dorsal spines on outer ramus of uropod 1 = 1, of uropod 2 = 0-1, inner ramus of uropod 1 = 1, of uropod 2 = 1, ventral spines of peduncle of uropod 3 = 4, spine formula on article 1 of outer ramus = 2-2-2-2, setal formula = 0-1-1-1, apex of article 2 with 2 diverse medium setae. Telson elongate, distal spines not more shortened than already in female, with long denticle row on each lobe.

Male "g."—Nails on rami of uropods 1-2 enlarged but epimeron 3 with 2 ventral setae, rami of uropod 2 lacking spines, right lacinia mobilis bifid and outer plate of maxilla 1 with 11 spines. Possible hybrid with *spinus*.

Holotype.—Allan Hancock Foundation No. 5746, female "e" 2.77 mm.

Type-locality.—Veleo IV 4870, southern California, 33°30'33"N, 117°45'17"W, 10.7 m, benthic orange peel grab.

Voucher material.—Type-locality, male "d" 2.71 mm; male "g" J. L. Barnard station 38-C-4, Cayucos, California, 1 July 1961, intertidal, *Phyllospadix-pelvetiid* community (see J. L. Barnard, 1969a).

This cryptic species is generally similar to *E. spinus* but differs in the following ways: (1) the ommatidia are enlarged; (2) the dorsal notch on article 4 of antenna 2 has one more seta; (3) the right lacinia mobilis is bifid; (4) the outer plate of maxilla 1 has 11 spines; (5) coxa 4 lacks setae; (6) epimeron 3 has 2 ventral setae; (7) uropods 1-2 lack peduncular comb; (8) the apical nails of uropods 1-2 are small; (9) uropod 1 has no basofacial setae; (10) the rami of uropods 1-2 lack dorsal or marginal spines; (11) article 2 on the outer ramus of uropod 3 is longer; and (12) has no significant setae in the female.

Just the sparse materials reexamined for this study indicate that characters 4, 5, 8 and possibly 10 are not very precise and that some hybridization or gene flow may be occurring between *chumashi* and *spinus*. Nevertheless, the species seem to be justified; they appear to be vicariants now rejoined by human interference, *chumashi* appearing to be the native Pacific species and *spinus* the Atlantic species that has been brought west.

Distribution.—Southern California, 0-11 m, probably more widespread (collections of *spinus* in Allan Hancock Foundation requiring reidentification).

Eobrolgus pontarpioides (Gurjanova), revived

Pararpinia [sic] *pontarpioides* Gurjanova, 1953:229-230, figs. 11-12.

This species was synonymized with *obtusidens* by J. L. Barnard (1960:249) but is now recognized to be near or in the genus *Eobrolgus*. It is distinguished in the key to *Eobrolgus* but needs extensive redescription. No materials are available.

In the original depiction, antenna 1 is drawn as if the setae are apical on article 2 but possibly because of the deeply folded condition of article 3 the true condition of article 2 is obscured. If interpreted as apical, those setae

suggest that *P. pontarpioides* belongs with *Eobrolgus*, but, if not, the species probably belongs to *Foxiphalus* or *Grandiphoxus*. Gurjanova drew only one seta on article 3 of antenna 2 suggesting that the species belongs with *Foxiphalus* and not with *Grandiphoxus* where at least 3 setae occur on article 3. The diversity in head of *Foxiphalus* and *Grandiphoxus* is intergraded by *Grandiphoxus robustus* Gurjanova so that the side view shown by Gurjanova for *P. pontarpioides* is useless for determination. J. L. Barnard (1960) considered *P. pontarpioides* to be a synonym of *Foxiphalus obtusidens* (Alderman) but now that *obtusidens* has been split into several species there may be cause to consider *P. pontarpioides* a good species. However, epimeron 3 as shown by Gurjanova is not typical of *obtusidens* nor of *Foxiphalus* in general. *Pontharpinia pontarpioides* must be reserved as a valid species of unknown genus until further study can be undertaken.

Eyakia J. L. Barnard, 1979

Four species are assigned to this genus; two of these are redescribed in the system of Barnard and Drummond (1978). These are *E. robusta* (Holmes) and *E. calcarata* (Gurjanova). The other two species, *E. uncigera* (Gurjanova) and *E. subuncigera* (Kudrjaschov) do not occur in Smithsonian collections.

The two analyzed species are alike in the extra spine on article 4 of antenna 2, the elongate spine on the molar, the taper on article 2 of pereopod 5, the facial setae on epimeron 3 and the widely spread basofacial setae on the peduncle of uropod 1.

Key to the Species of *Eyakia*

- 1. Epimeron 3 with large tooth *E. robusta* (= ?*ochotica*)
- Epimeron 3 lacking tooth 2
- 2. Pereopod 7 article 2 ordinary, lacking spike *E. calcarata*
- Pereopod 7 article 2 with large spike 3
- 3. Coxa 2 without posteroventral tooth, outer ramus of uropod 1 without marginal spines *E. uncigera*
- Coxa 2 with posteroventral tooth, outer ramus of uropod 1 with marginal spines *E. subuncigera*

Eyakia robusta (Holmes)

Fig. 1m, w, y

Paraphoxus robustus Holmes, 1908:518–521, fig. 27.—J. L. Barnard, 1960:235–236, pl. 25; 1964b:244; 1966a:89; 1966b:29.

Description of female “w.”—Head about 21 percent of total body length, greatest width about 70 percent of length, rostrum unconstricted, broad, elongate, almost reaching apex of article 2 on antenna 1. Eyes small, largely

occluded with pigment, ommatidia ordinary. Article 1 of peduncle on antenna 1 about 1.4 times as long as wide, about 2.6 times as wide as article 2, ventral margin with about 11 setules, weakly produced dorsal apex with 2 setules, article 2 about 0.7 times as long as article 1, with midventral row of 8 setae, primary flagellum with 8 articles, about 0.45 times as long as peduncle, bearing one short aesthetasc each on articles 2–7, accessory flagellum with 6 articles. Antenna 2 not ensiform, article 3 with thin anterodorsal spine and normal facial armament, spine formula on article 4 = 5-5 (tightly compressed) plus offset thin spine midapically, dorsal margin with notch bearing 5 setae and one spine, ventral margin with 15 groups of 1–3 long to medium setae, one ventrodiscal long spine, article 5 about 0.78 times as long as article 4, facial spine formula = 2-3, dorsal margin bearing one set of apical setae, ventral margin with 8 sets of one long seta each, 2 ventrodiscal long to medium spines set facially; flagellum almost 0.7 times as long as articles 4–5 of peduncle combined, with 8 articles.

Epistome unproduced. Mandibles with weak palpar hump, right incisor with 3 teeth, third tooth placed distad, left incisor with 3 humps on 2 branches plus 3–4 weak teeth between, right lacinia mobilis bifid, distal branch much shorter than proximal, flabellate, tridentate, proximal branch simple, pointed, with marginal denticles and facial humps, left lacinia mobilis with 4 teeth, middle teeth not shortened, right rakers 11 plus 2 rudimentaries, left rakers 11 plus one rudimentary, molars composed of short bulbous humps, each with huge serrate spine, right molar with 2 additional primarily medium spines, left molar with 3 primarily medium spines, no spine disjunct, each molar with dense elongate plume; palp article 1 short, article 2 with 3 long to medium inner apical setae and 4 other long to short inner setae, article 3 about 1.2 times as long as article 2, oblique apex with 8–10 spine-setae, basofacial formula = 2-4. Each outer lobe of lower lip with one cone. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one similar apicomedial seta, one shorter apicomedial seta and one apicolateral short seta, outer plate with 11 spines, palp article 2 with one apical spine, 2 apicolateral and 4–5 medial spines and 6 submarginal setae. Inner plate of maxilla 2 shorter than outer, outer not broader than inner, outer with 5 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 2 apicofacial setae, 4 medial setae, outer plate with 12–14 medial and apical spines plus 3 apical cusps, 4 apicolateral setae, palp article 1 with one apicolateral seta, article 2 with one group of 4 apicolateral setae, medial margin of article 2 moderately setose, article 3 with 4 facial setae, 2 lateral setae, nail of article 4 distinct, short, with 2 accessory setules.

Coxa 1 not expanded apically, anterior margin weakly convex, main ventral setae of coxae 1–4 = 23:19:18:29, widely spread, posteriormost seta of coxae 1–2 shortest, of 3–4 slightly shortened, anterior and posterior margins

of coxa 4 weakly divergent, posterior margin almost straight, posterodorsal corner rounded, posterodorsal margin ordinary, concave, width-length ratio = 15:18. Gnathopods generally ordinary but hands somewhat slender, width ratios on articles 5–6 of gnathopods 1–2 = 28:31 and 30:36, length ratios = 66:71 and 56:73, palmar humps ordinary, palms strongly oblique, article 5 of gnathopod 1 elongate, ovate, posterior margin flat, article 5 of gnathopod 2 ovate, posterior margin triangular.

Pereopods 3–4 similar to each other, facial setae formulas on article 4 = 12 and 12, parallel to apex, on article 5 = 13 and 12, main spine of article 5 extending to M. 100+ on article 6, article 5 with no proximoposterior spines but with numerous stout setae, spine formula of article 6 = 6 + 4 and 7 + 4 plus tiny middistal seta, one of spines in group of 4 really in middle, some spines especially long, acclivity on inner margin of dactyls of pereopods 3–4 absent, emergent setule short, midmarginal pluseta ordinary. Coxae 5–7 posteroventral seta formula = 11-6-1. Articles 4–5 of pereopods 5–6 narrow, facial spine rows sparse, facial ridge formula of article 2 on pereopods 5–7 = 0-1-1. Width ratios of articles 2, 4, 5, 6 of pereopod 5 = 42:23:21:11, of pereopod 6 = 69:22:17:10, of pereopod 7 = 84:23:17:8; length ratios of pereopod 5 = 74:28:35:37, of pereopod 6 = 92:50:60:53, of pereopod 7 = 100:25:22:33, article 2 of pereopod 7 not reaching middle of article 4, posterior margin with 6–8 medium serrations, anteroapical margins of articles 2–3 and anterior margins of articles 4–5 very densely setospinose, medial apex of article 6 smooth, bearing 6 digital processes; article 2 of pereopods 5–6 tapering distally, only setulose posteriorly, posteroventral lobe of pereopod 6 narrow, of pereopod 5 absent.

Posteroventral corner of epimeron 1 rounded, posterior margin weakly convex, with 4 widely spread setules, anteroventral margin densely setose, ventral face with 14+ long setae in irregular ranks (one row of 9 fairly uniform). Posteroventral corner of epimeron 2 rounded, posterior margin straight, with 4 widely spread setules, facial setae = horizontal rows of 16, 8 and 4. Posteroventral corner of epimeron 3 with large tooth, posterior margin straight, with 2 setule notches, ventral margin with 7 setae widely spread, face with almost horizontal row of 18 setae.

Urosomite 1 with lateral setule at base of uropod 1 and distoventral setae besides midventral setae, articulation line complete, urosomite 3 unprotuberant dorsally. Rami of uropods 1–2 with articulate but tightly fixed apical nails, outer ramus of uropod 1 with 3 tightly contiguous dorsal spines, inner with 2 also tight, outer ramus of uropod 2 with 3 dorsal spines also tight, inner with no dorsomedial spine, peduncle of uropod 1 with 10 basofacial setae extending along ventral margin and one apicoventral spine, medially with 10 thin marginal spines none displaced. Peduncle of uropod 2 with 17 thin dorsal spines, except apicalmost short and stout, medially with one small thin apical spine, apicolateral corners of peduncles on uropods 1–2

without comb. Uropod 3 shortened, peduncle with 8 ventral spines, dorsally with one lateral spine, one medial spine and one setule, rami feminine, inner extending to M. 50 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus short, 0.13, bearing 2 long setae, medial margin of article 1 with 5 spine-setae, lateral margin with 4 acclivities, short spine formula = 1-1-1-1-2, long spine formula = 0-1-1-1-1, setae = 0. Telson long, length-width ratio = 15:13, almost fully cleft, each apex wide, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, thin spine next medial much longer than setule, midlateral setules diverse or not, largest of medium size.

Female "y".—Article 2 of antenna 1 actually with 2 rows of setae, 6 medial long and 8 laterals (3 long, 5 short), flagella with 10 and 7 articles each. Article 4 of antenna 2 with 10 spines in one row plus one displaced spine, formula of spines on article 5 = 2 + 2-2, [flagellum broken]. Right lacinia mobilis with 7 teeth on distal branch; rakers 12 plus 2 rudimentaries; each molar with 3 spines; basofacial formula on mandibular palp article 3 = 3-3. Inner plate of maxilla 1 normal. Apicolateral setae on outer plate of maxilla 2 = 7. Outer plate of maxilliped with 5 spines, 3 cusps and 9 lateral setae.

Setal formula on coxae 1-4 = 29-24-22-34. Epimeron 3 with 10 ventral setae mostly anterior, main facial row = 13. Uropod 1 peduncle with 3 apicolateral spines, inner ramus with only 1. Uropod 2 peduncle with 18 spines, apical four spines short and stout. Outer ramus of uropod 3 spine formula lateral = 1-2-2 only, inner ramus only half length of outer ramus article 1, length of article 2 = 0.07. Lateral setule of telson described for female "w" of spinal dimensions on this specimen.

Another female.—Article 1 outer ramus of uropod 3 spine formula = 1-2-2-2-2.

Male "m."—Article 1 of antenna 1 with medial pubescence, article 2 with 4 lateral setae and ventral groups of 6 and 6. Articles 3-4 of antenna 2 with medial pubescence, article 4 lacking dorsal notch and spines, lateral formula on article 4 = 3-6-2, with one spine in group of 3 elongate and apparently representing displaced spine occurring on female; article 5 with 3 lateral spines, apex with only 2 spine-setules and one setule, dorsal margin with 8 sets of male setae and probably 7 calceoli [some broken], one flagellar calceolus each on articles 1,2,3,4,5,6,7,8 . . . n (generic character).

Spines on right mandibular molar = 2, shorter than in female, on left molar = 3, right lacinia mobilis illustrated.

Pereopods 5-6 like female, pereopod 7 illustrated, with odd article 5 as shown by Gurjanova (1938, 1951) for *calcarata*, article 2 narrower than in female.

Epimera 1-3 broadened, first 2 heavily setose as in female, ventral setae of epimeron 3 = 8, facial row = 11. Basofacial setae of uropod 1 = 11,

position as in female, but ventral side of peduncle near base with 2–3 large setae not occurring in female, apicolateral spines of peduncle = 4, outer ramus = 4, inner = 1. Peduncle of uropod 2 with 25 dorsal spines, basals shorter than in female, 3 apicalmost short, outer ramus with 6 crowded spines. Peduncle of uropod 3 with 7 ventral spines, setal formula on article 1 of outer ramus (long and short together) = 1-1-2-2-1-2-1-1-2-2-2-3-3-3-3, length of article 2 = 0.025!!, with 2 long setae. Telson broadened, length-width ratio = 8:7, apical elements shortened, composed of one setule and one spine, each lobe with long row of denticles very densely packed.

Male "n."—Spine formula on article 4 of antenna 2 = 3-7-2.

Voucher material.—Female "w" 9.12 mm, Allan Hancock Foundation *Velero IV* 4772, southern California, 80.5 m; male "m" 12.0 mm and female "y" 15.0 mm, *Albatross*, Adakh Island [Alaska], July 1893, surface.

Other material.—Giant female, Port Etches, Alaska, 12–18 fm, 1874, W. H. Dall 669 (1140), mud; 2 males, Mitrofan Bay, Alaska, Acc. No. 157371, M.S. [Motorship] *Dorothy*, light shown over side [of vessel at] 7:30 P.M., from surface; giant male, Akun Island, Alaska, surface electric light, *Albatross*, 189?; one male, Old Harbor, Kodiak Island, Alaska, 11 August 1887–1888, *Albatross*; 2 males, Friday Harbor, Washington, USA, 9 August 1950, L. Piternick, light off Oceanographic Lab.

Distribution.—Inner Aleutian Islands southward to Bahia de San Quintin, Baja California, Mexico, 4–221 m (bottom) and swimming at surface in neritic zone.

Eyakia calcarata (Gurjanova)

Parharpinia calcarata Gurjanova, 1938:271–272, 385, figs. 9, 9a, 9b.

Pararpinia [sic] *calcarata*.—Gurjanova, 1951:388–392, fig. 237.

Parphoxus calcaratus.—J. L. Barnard, 1960:238–240, pl. 26; 1966a:88.

Description of female "n."—Head about 20 percent of total body length, greatest width about 70 percent of length, rostrum unstricted, broad, elongate, exceeding middle of article 2 on antenna 1. Eyes medium to large, clear of pigment (aged in alcohol), ommatidia ordinary. Article 1 of peduncle on antenna 1 about 1.3 times as long as wide, about 2.3 times as wide as article 2, ventral margin with about 9 setules, unproduced dorsal apex with 2 setules, article 2 about 0.6 times as long as article 1, with 2 ventral rows of 5 and 4 setae, primary flagellum with 12 articles, about as long as peduncle, bearing one short aesthetasc each on articles 5–11, accessory flagellum with 10 articles. Antenna 2 not ensiform, article 3 with one anterodorsal spine (besides normal facial setules), spine formula on article 4 = 2-4 plus one long displaced midapical spine, dorsal margin with notch bearing 2 setae and 2 spines, ventral margin with 6 groups of 2–3 long to medium setae, one ventrodorsal long spine, article 5 about 0.8 times as long as article 4, facial spine formula = 2-2, dorsal margin bearing one set of small apical setae,

ventral margin with 4 sets of 1–2 long to short setae, 2 ventrodiscal long spines set facially, flagellum proliferating.

Epistome unproduced. Mandibles with weak palpar hump, right incisor with 3 teeth, third set distad, left incisor with 3 humps on 2 branches and serrate between, right lacinia mobilis bifid, distal branch much shorter than proximal, flabellate, quadridentate, proximal branch simple, pointed, with marginal denticles and facial humps, left lacinia mobilis with 4 teeth plus one accessory tooth, middle teeth shortened, right rakers 9, left rakers 9 plus 2 rudimentaries, molars composed of bulbous humps, each with huge serrate spine, right molar with 3 additional medium spines, left with 2 additional medium spines, no spines disjunct, each molar with plume; palp article 1 short, article 2 with one long inner apical seta and 3–4 other long and short inner setae, article 3 about 1.2 times as long as article 2, oblique and narrow apex with 8 spine-setae, basofacial formula = 1-1. Each outer lobe of lower lip with one cone. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae, outer plate with 11 spines, palp article 2 with one apical spine, one lateral and 2 medial spines, 3–4 submarginal setae. Plates of maxilla 2 extending equally, outer not broader than inner, outer with 3 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 2 apicofacial setae, 5 medial setae, outer plate with 8 medial and apical spines, 4 apicolateral setae, palp article 1 with one apicolateral seta, article 2 with one group of 2 apicolateral setae, medial margin of article 2 moderately setose, article 3 with 7 facial setae, 2 lateral setae, nail of article 4 distinct, short, with 2 accessory setules.

Coxa 1 expanded apically, anterior margin convex, main ventral setae of coxae 1–4 = 14-9-9-12, posteriormost seta of coxae 1, 2, 4 shortest, of coxa 3 slightly shortened, anterior and posterior margins of coxa 4 parallel, posterior margin slightly convex, posterodorsal corner sharp-rounded, posterodorsal margin ordinary, concave, width-length ratio = 9:10. Gnathopods generally ordinary but gnathopod 2 significantly stouter than gnathopod 1. Width ratios on articles 5–6 of gnathopods 1–2 = 28:36 and 28:42, length ratios = 65:70 and 49:79, palmar humps ordinary, palms strongly oblique, article 5 of gnathopod 1 elongate, ovate, posterior margin flat, long, article 5 of gnathopod 2 subtriangular, posterior margin triangular, almost lobate.

Pereopods 3–4 similar to each other, facial setae formula on article 4 = 4 and 5, parallel to apex, on article 5 = 4 and 5, main spine of article 5 extending to M. 85–100 on article 6, article 5 with no proximoposterior spines, spine formula of article 6 = 4 + 3 and 5 + 3 plus middistal seta, one of spines in group of 3 situated in middle of posterior articular axis (not in the normal bilateral fashion), some spines especially long, acclivity on inner margin of dactyls of pereopods 3–4 absent, emergent setule short, midfacial pluseta ordinary. Coxae 5–7 posteroventral seta formula = 4-5-1. Articles

4–5 of pereopods 5–6 narrow, facial spine rows sparse. Facial ridge formula of article 2 on pereopods 5–7 = 0-1-1. Width ratios of articles 2, 4, 5, 6 of pereopod 5 = 45:22:22:13, of pereopod 6 = 75:27:21:11, of pereopod 7 = 88:22:21:11, length ratios of pereopod 5 = 74:28:41:49, of pereopod 6 = 95:58:55:70, of pereopod 7 = 100:25:28:40, article 2 of pereopod 7 reaching middle of article 4, posterior margin with 8 small serrations, articles moderately setose anteriorly, medial apex of article 6 sparsely and scarcely combed, bearing 3–4 short digital processes; article 2 of pereopods 5–6 tapering distally, only setulose posteriorly, posteroventral lobe of pereopod 6 broad, of pereopod 5 absent.

Posteroventral corner of epimeron 1 rounded, weakly protuberant, posterior margin deeply convex, with 3 setule notches, anteroventral margin with 9 short to medium setae, ventral face with 6 long setae in row running fully to posterior corner. Posteroventral corner of epimeron 2 rounded, weakly protuberant, posterior margin barely convex, with 4 setule notches, facial setae = 9, 2 middle pairs set vertically (setae scattered). Posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin straight, with 2 setule notches, ventral margin with one anterior seta, face with oblique row of 6 setae.

Urosomite 1 with lateral setule at base of uropod 1, scarcely any mid-ventral setae, no ventrodiscal setae, articulation line complete, urosomite 3 unprotuberant dorsally. Rami of uropods 1–2 with articulate but tightly fixed apical nails, outer ramus of uropod 1 with 3 dorsal spines, not crowded, inner with 2, outer ramus of uropod 2 with 2 dorsal spines, inner with none, peduncle of uropod 1 with 5 basofacial setae extending along ventral margin and 5 small apicolateral spines, medially with 6 marginal spines, apicalmost an ordinary spine, none displaced. Peduncle of uropod 2 with 8 dorsal spines, medially with one small apical spine, apicolateral corners of peduncles on uropods 1–2 without comb. Peduncle of uropod 3 with 4 short ventral spines, dorsally with one lateral spine, one medial spine and setule, rami submasculine, inner extending to M. 100+ on article 1 of outer ramus, apex with 2 small setae, medial and lateral margins with 7 and one setules, article 2 of outer ramus ordinary, 0.17, bearing 2 medium setae, medial margin of article 1 with one apical spine and 4–5 medial setules, lateral margin with 3 acclivities, spine formula = 1-1-1-1, short setal formula = 0-1-1-1. Telson long, length width ratio = 22:19, almost fully cleft, each apex wide, rounded, lateral acclivity broad, shallow, with very short lateral and short medial spine separated by setule, midlateral setules diverse, larger of medium size.

Voucher material.—Female “n” 6.41 mm, Allan Hancock Foundation *Velero III* 171-34, Islas Galapagos, east of Wreck Bay, Chatham Island, 32 fm, 21 January 1934.

Other material.—*Velero III* 224-34, Colombia, off Gorgona Island, 10 fm, 12 February 1934.

Distribution.—Japan Sea, 75 m; California, 324–695 m; Galapagos Islands, 46–73 m; Colombia, Gorgona Island, 18 m.

Eyakia ochotica (Gurjanova)

Pararparinia [sic] *ochotica* Gurjanova, 1953:225–229, figs. 9, 10.

Paraphoxus ochoticus.—J. L. Barnard, 1960:274.

A possible synonym of *E. robusta* but see J. L. Barnard (1960).

Distribution.—Okhotsk Sea.

Eyakia subuncigera (Kudrjaschov)

Paraphoxus subuncigerus Kudrjaschov, 1965:1776–1779, figs. 1, 2.

Article 5 of gnathopod 2 very short.

Distribution.—Okhotsk Sea, 207 m.

Eyakia uncigera (Gurjanova)

Parharparinia uncigera Gurjanova, 1938:267–269, 385, fig. 8.

Pararparinia [sic] *uncigera*.—Gurjanova, 1951:388, fig. 236.

Paraphoxus uncigerus.—J. L. Barnard, 1960:282.

Distribution.—Japan Sea; Okhotsk Sea.

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