Elthusa poutassouiensis (Penso, 1939), comb, nov. (Isopoda, Cymothoidae) for Meinertia (Ceratothoa) poutassouiensis, parasite of the blue whiting, Micromesistius poutassou

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Elthusa poutassouiensis (Penso, 1939), comb. nov. (Isopoda, Cymothoidae) for *Meinertia* (*Ceratothoa*) *poutassouiensis*, parasite of the blue whiting, *Micromesistius poutassou*

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Abstract

The parasite was obtained on the gill cavity of the blue whiting, *Micromesistius poutassou* (Risso), from the Aegean Sea Coast, Turkey. This cymothoid is a typical parasite of the blue whiting, but it is poorly known. It was reported from the same host as *Meinertia* (*Ceratothoa*) *potassoniensis* and *Meinertia poutassouiensis* with an inadequate description. The specimens examined in this study show the diagnostic characters of *Elthusa* Schioedte & Meinert, 1884. The previous two species are proposed to be transferred to the genus *Elthusa*. The ovigerous female, non-ovigerous female and male species are redescribed by drawings for the first time. The Mediterranean Sea is a new geographical record for the genus *Elthusa*.

Introduction

Cymothoids (Crustacea, Isopoda) typically infect marine, freshwater or brackish water teleost fish. Cymothoidae species settle in the buccal cavity (*Ceratothoa* Dana, 1852, *Cymothoa* Fabricius, 1793 etc.) (Hadfield et al., 2013; Martin et al., 2015), the branchial cavity (*Mothocya* Costa in Hope, 1851) (Hadfield et al., 2015), on the external surface (*Anilocra* Leach, 1818, *Nerocila* Leach, 1818 etc.), (Bruce, 1987), or in the body cavity (*Ichthyoxenos* Herklots, 1870, *Riggia* Szidat, 1948 etc.) (Tsai and Dai, 1999; Thatcher et al., 2002).

Although the Cymothoidae family is known, there are some deficiencies taxonomically. According to some researchers, more detailed studies must be done for this family (Bruce et al., 2002; Martin et al., 2015; Hadfield et al., 2016a). Fifteen species [*Ceratothoa oestroides* (Risso, 1816), *Ceratothoa parallela* (Otto, 1828), *Ceratothoa italica* Schiödte & Meinert, 1883, *Ceratothoa steindachneri* Koelbel, 1879, *Ceratothoa capri* (Trilles, 1964), *Nerocila bivittata* (Risso, 1816), *Nerocila orbignyi* (Guérin-Méneville, 1832) , *Emetha audouini* (H. Milne Edwards, 1840), *Mothocya belonae* Bruce, 1986, *Mothocya taurica* (Czerniavsky, 1868), *Mothocya epimerica* Costa,

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1851, *Anilocra physodes* (Linnaeus, 1758), *Anilocra frontalis* H. Milne Edwards, 1840, *Livoneca sinuata* Koelbel, 1878, *Livoneca pomatoi* Gaillat Airoldi, 1940] of the Cymothoidae family are reported in Turkish waters (Öktener and Trilles, 2004; Trilles and Öktener, 2004; Ateş et al., 2006).

The genus *Elthusa* Schioedte & Meinert, 1884 was redefined and revised by Bruce (1990). Twenty eight nominal species were accepted by Smit et al. (2014). Since then, Hadfield et al. (2016b) proposed *Elthusa nierstraszi* Hadfield, Bruce & Smit, 2016 as the new replacement name for the junior secondary homonym *Elthusa parva* (Nierstrasz, 1915). Saito and Yamauchi (2016) described *Elthusa moritakii* Saito & Yamauchi, 2016 on *Ereunias grallator* from East China Sea. Hadfield et al. (2017a) described *Elthusa winstoni* Hadfield, Tuttle & Smit, 2017 on *Ctenochaetus strigosus* from Hawaii. The last two records increase the number of known *Elthusa* genus to thirty one (Hadfield et al., 2017b).

Members of *Elthusa* attach to the gills of their hosts (Bruce, 1990). They have a wide distribution in the world and are reported from the Pacific Ocean, the Indian Ocean and the Atlantic Ocean (Bruce, 1990; Trilles, 1994; Trilles and Justine, 2004; Rocha-Ramírez et al., 2005; Trilles and Justine, 2006, 2010; Hadfield et al., 2016b; 2017a).

The purpose of this paper is to propose the transfer the *Meinertia* (*Ceratothoa*) *potassoniensis* Penso (1939) and *Meinertia poutassouiensis* Brian (1939) to the genus *Elthusa* and to redescribe *Elthusa poutassouiensis* (Penso, 1939) comb. nov. from Turkey, including morphological characters with drawings.

Material and methods

The blue whiting was collected by commercial fisherman from the Northern Aegean Sea (off Babakale Port, 39°25′32″N, 26°30′46″E) in May 2008, June 2015 and March 2017. Isopods were removed from the gill cavities of host fish, and preserved in vials containing 70% ethanol. The scientific and common names of the host are those verified in FishBase (Froese and Pauly, 2017). Mouthparts and appendages were dissected using a Wild M5 stereo microscope. Dissected parts were mounted on slides in the glycerin-gelatine mounting medium. Pleopods of isopods were stained with methylene blue. Measurements, all in micrometers, were obtained using a micrometric program (Pro-way). The appendages were drawn with the aid of a camera lucida (Olympus BH-DA). The photos were performed using a Canon EOS 1100D camera attached to a microscope.

Results

Order Isopoda Latreille, 1817
Suborder Cymothoida Wägele, 1989
Superfamily Cymothooidea Leach, 1814
Family Cymothoidae Leach, 1814
Elthusa Schioedte and Meinert, 1884
Elthusa poutassouiensis Penso, 1939 comb.nov. (Figures 1 to 10)

Meinertia poutassouiensis.—Brian (1939): 3–11 [*nomen nudum*].
Meinertia (*Ceratothoa*) *potassoniensis.*—Penso (1939): 1, Figures 1 to 2 [*lapsus*].
Ceratothoa poutassouiensis (Brian, 1939).—Trilles (1994):127.—Horton (2000):1042. [*nomen nudum*].
Ceratothoa poutassouiensis (Penso, 1939) .—Hadfield et al. (2016a):73 [*nomen dubium*].

Material examined:

Type–host: the blue whiting, *Micromesistius poutassou* (Risso) (Gadiformes: Gadidae)

Type–locality: Babakale Port, Aegean Sea Coasts of Turkey

Site on host: Gill cavity

Prevalence: 5.4% (26 of 480 blue whiting infected)

Total parasite: 14 non-ovigerous female, 12 ovigerous female, 2 male;

Dissected material: 4 ovigerous female, 4 non-ovigerous female, 2 male

Museum Number: Museum National d'Histoire Naturelle (MNHN), Paris, France MNHN-IU-2014-12864, MNHN-IU-2017-316 (ovigerous female), MNHN-IU-2014-12865, MNHN-IU-2017-317 (non-ovigerous female)

Description of ovigerous female: Body length varies from 18 to 21 mm (Figure 1A). Cephalon 0.6 times longer than wide, visible from dorsal view, immersed in pereonite 1. Body 2 times as long as greatest width, dorsal surfaces smooth and polished in appearance, widest at pereonite 5, most narrow at pereonite 1. Pereonite 1 longest, 2–4 progressively increasing in length, 5–7 progressively decreasing towards posterior in length. Posterior margin of pereonite 7 deeply curved. Eyes trapezoid (well-developed), 0.3–0.35 times width of head. Coxal plates of pereonites 2–7 visible in dorsal view. Coxae 1–2 posteroventral margins straight; 3–7 posteroventral margins rounded. All pleonites similar length, visible in dorsal view; pleonites 2–5 similar in width; first pleonite distinctly narrow than other. Pleonite 1 partially overlapped by pereonite 7. Pleotelson 0.57–0.62 times as long as anterior width, dorsal surface with 2 submedial depressions, lateral margins and posterior margin rounded. Pleotelson not wider than pleonite 7. Pleotelson wider than long.

Antenna (Figure 2B) comprising 10 articles, extending to anterior margin of pereonite 1.

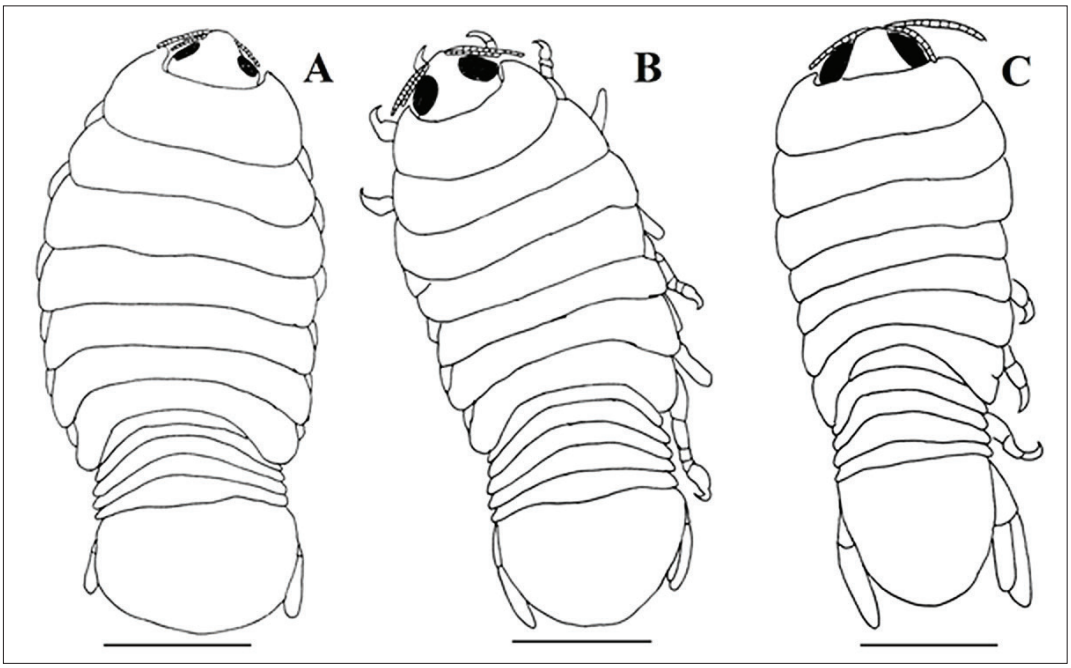

Figure 1. *Elthusa poutassouiensis* comb.nov. **(A)** Ovigerous female, dorsal view, Bar=0.5 mm. **(B)** Non-ovigerous female, Bar=0.25 mm. **(C)** Male, Bar=0.20 mm.

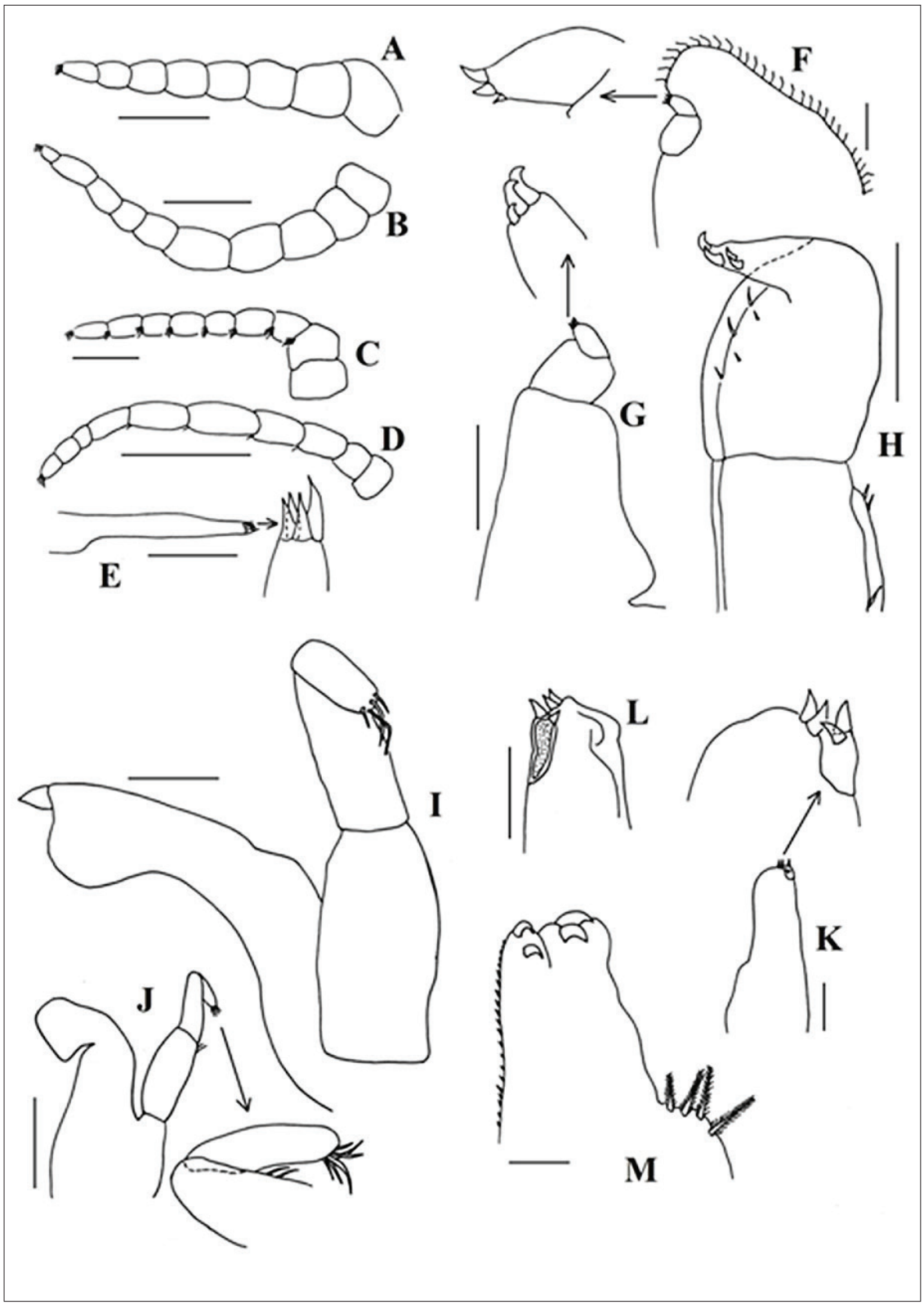

Figure 2. *E. poutassouiensis* comb.nov., **(A)** Antennula, ovigerous female, Bar=0.46mm. **(B)** Antenna, ovigerous female, Bar=0.49mm. **(C)** Antennula, male, Bar=0.36mm. **(D)** Antenna, male, Bar=0.65mm. **(E)** Maxillula, Bar=0.40mm. **(F)** Maxilliped, ovigerous female, Bar=0.24mm. **(G)** Maxilliped, non-vigerous female, Bar=0.51mm. **(H)** Maxilliped, male, Bar=0.19mm. **(I)** Mandible, non-vigerous female, Bar=0.16mm. **(J)** Mandible, ovigerous female, Bar=0.45mm. **(K)** Maxilla, ovigerous female, Bar=0.21mm. **(L)** Maxilla, male, Bar=0.11mm. **(M)** Maxilla, non-vigerous female, Bar=0.21mm.

Antennula (Figure 2A) comprising 8 articles; extending to posterior margin of eye. Labrum lateral margins concave, anterior margin rounded. Mandibular (Figure 2J) process without simple setae. Mandible palp third article distinctly shorter than others, article 2 with 2 setae, article 3 with 5–8 setae on lateral margin. Maxillula (Figure 2E) simple, with 4 terminal robust spines, one long and three short. Maxilla (Figure 2K) mesial lobe with 2 recurved robust spines, lateral lobe with 2-3 recurved spines. Maxilliped (Figure 2F) comprising 3 articles, article 3 with 2–4 recurved robust spines.

Pereopods (Figures 3A-G) gradually increasing in length. Pereopods 1–3 slightly smaller than 4–7. Merus expansions on 4–7 pereopods slightly distinct than 1–3. Basis of 4–7 pereopods longer than 1–3 pereopods. Pereopod 1 basis 1.3 times as long as greatest width; ischium 0.6 times as long as basis; merus proximal margin without bulbous protrusion; carpus with straight proximal margin; propodus 1.3 times as long as wide; dactylus slender, 1.2 times as long as propodus, 1.14 times as long as basal width. Pereopod 7 basis 1.6–1.7 times as long as greatest width; ischium 1.3–1.4 as long as basis, without protrusions; merus proximal margin with bulbous protrusion, merus 0.4 as long as ischium, 0.5 times as long as wide; carpus 0.3 as long as ischium, 0.5 times as long as wide; propodus 0.7 as long as ischium, 1.4

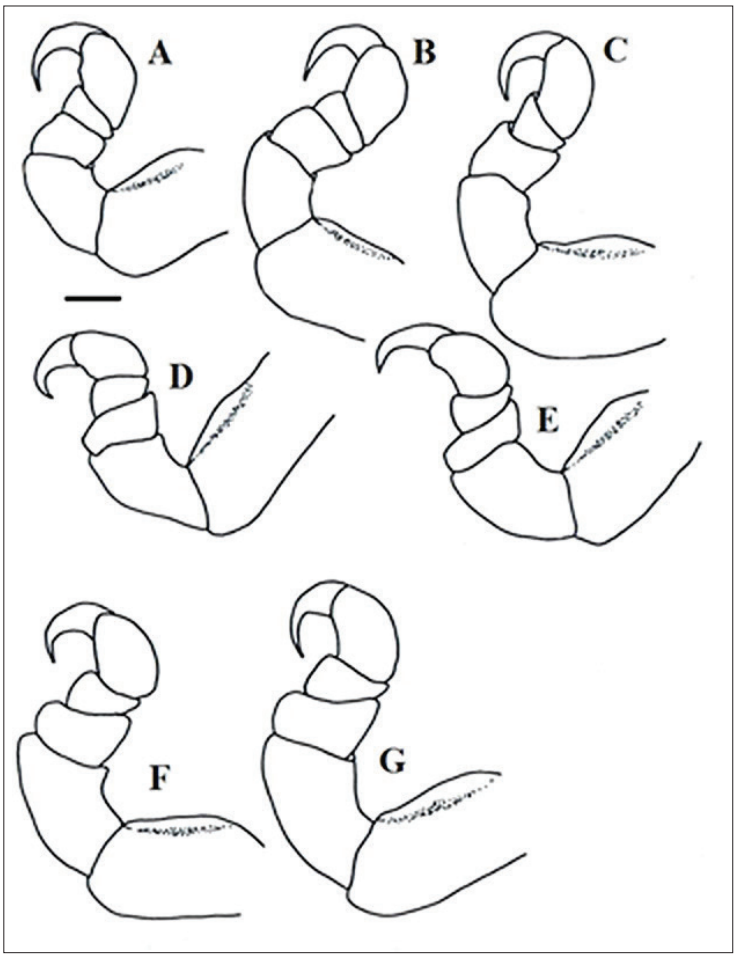

Figure 3. *E. poutassouiensis* comb.nov., ovigerous female, **(A-G)** Pereopods 1–7, Bar=0.72mm.

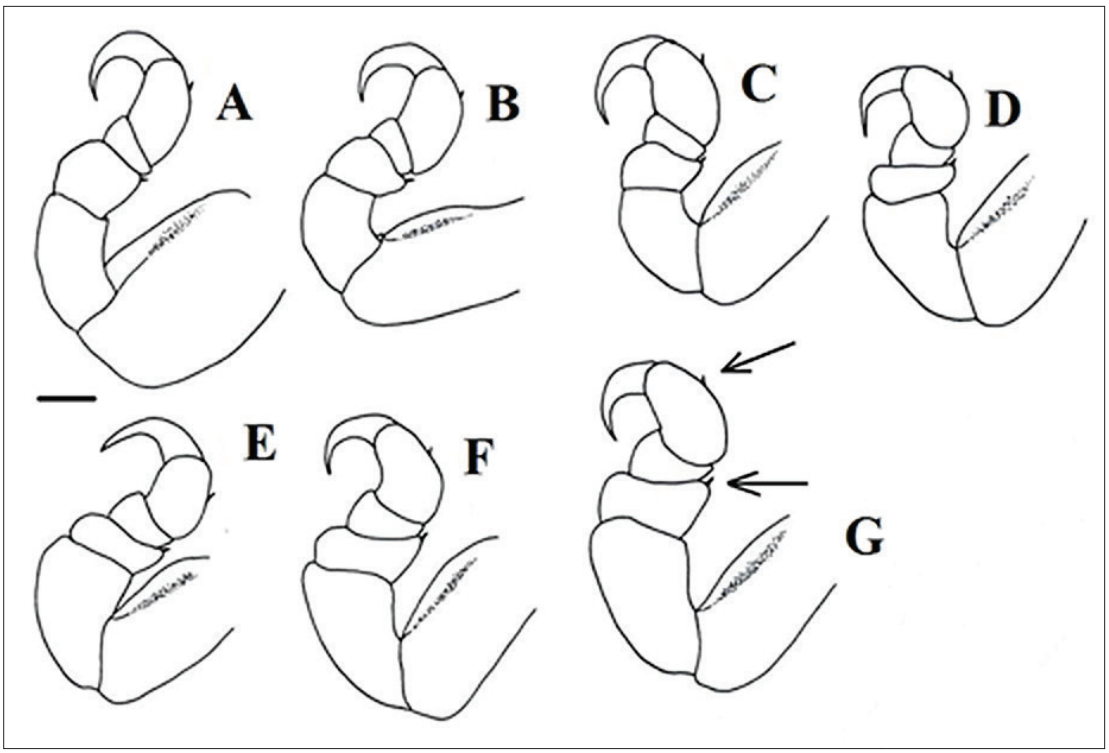

Figure 4. *E. poutassouiensis* comb.nov, non-ovigerous female, **(A-G)** Pereopods 1–7, Bar=0.49mm.

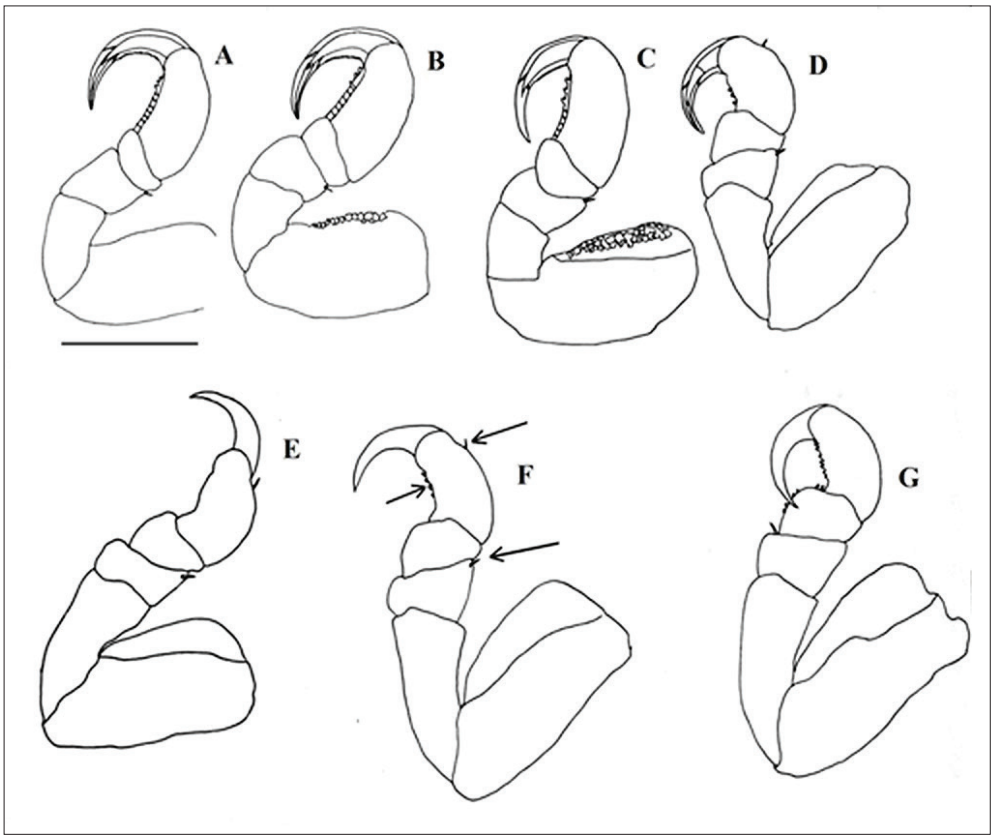

Figure 5. *E. poutassouiensis* comb. nov., male, **(A-G)** Pereopods 1–7, Bar=0.5mm.

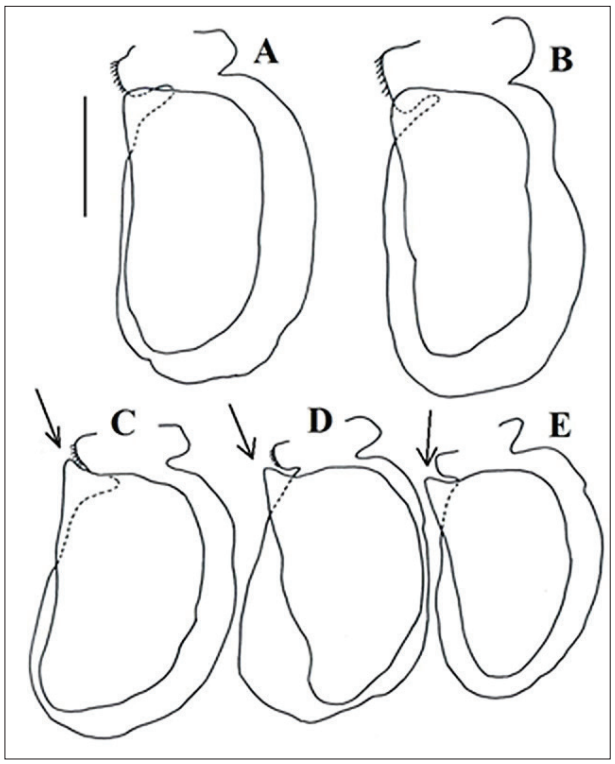

Figure 6. *E. poutassouiensis* comb.nov., ovigerous female, **(A-E)** Pleopods 1–5, Bar=2.00mm.

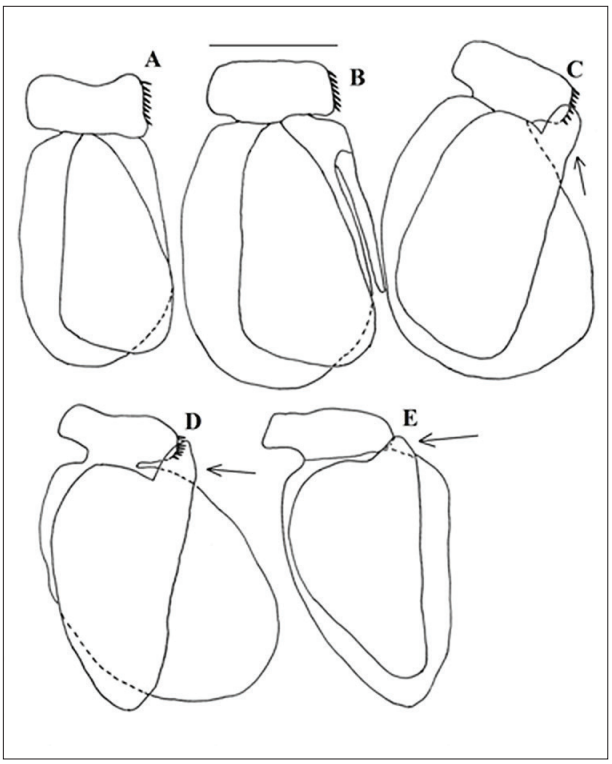

Figure 7. *E. poutassouiensis* comb. nov., male, **(A-E)** Pleopods 1–5, Bar=0.82mm.

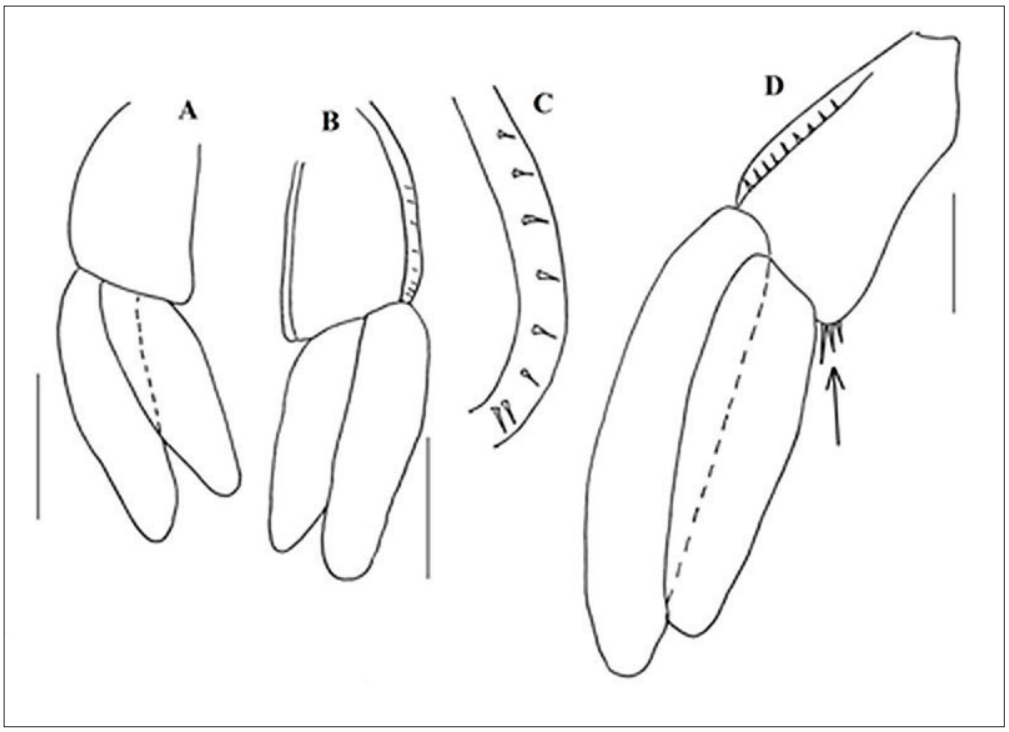

Figure 8. *E. poutassouiensis* comb.nov., **(A)** Uropod, ovigerous female, Bar=0.95mm. **(B)** Uropod, non-ovigerous female, Bar=0.55mm. **(C)** Uropod peduncle, non-ovigerous female. **(D)** Uropod, male, Bar=0.7mm.

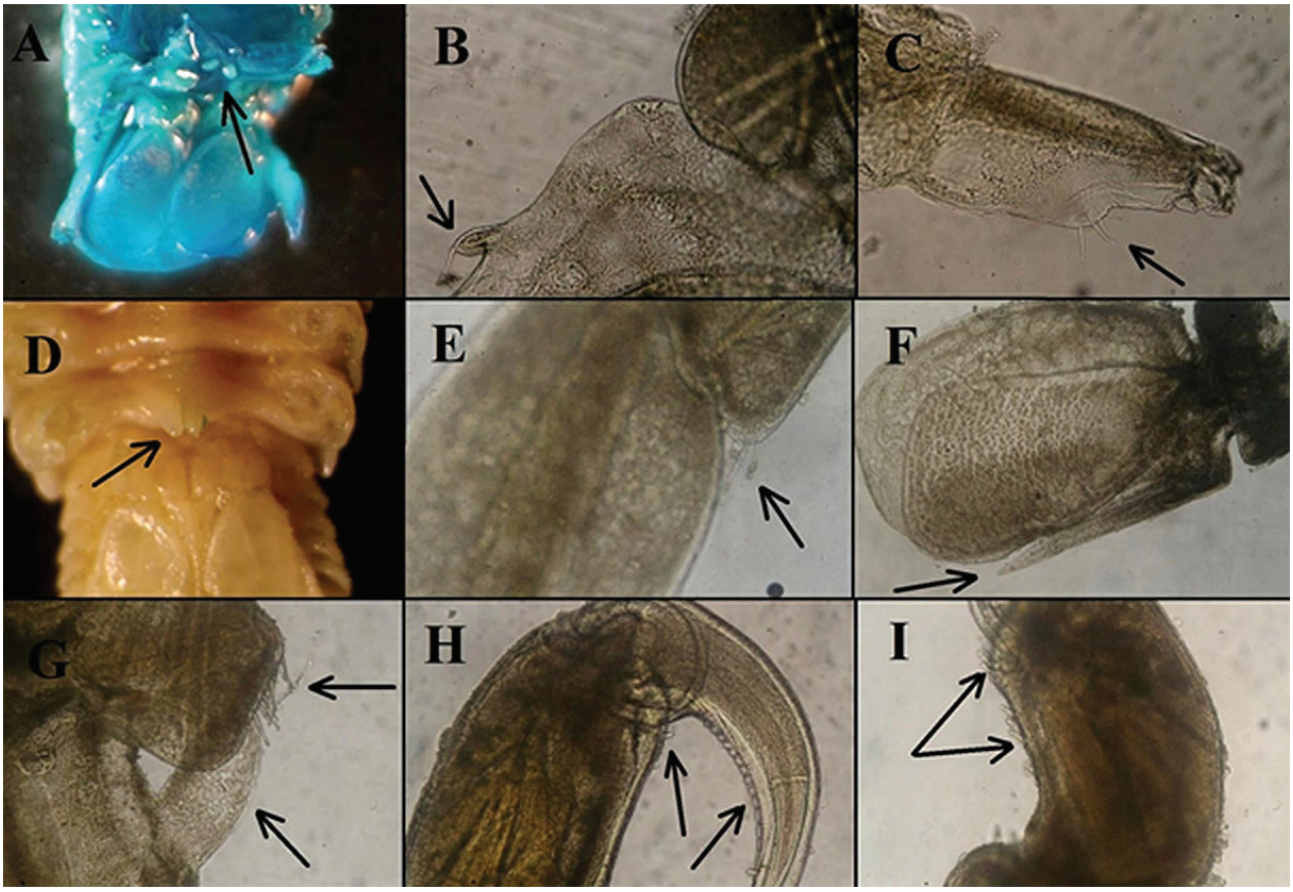

Figure 9. *E. poutassouiensis* comb.nov., **(A)** Penes, non-ovigerous female. **(B)** Remainder appendix masculinum, non-ovigerous female. **(C)** Spines on maxilla, non-ovigerous female. **(D)** Penes, male. **(E)** Spines on uropod peduncle, male. **(F)** Appendix masculinum, male. **(G)** Coupling hooks and proximomedial lobe on pleopod, male. **(H)** Teeth and spine on pereopod, male. **(I)** Spines on pereopod 7, male.

times as long as wide; dactylus slender, 1.2 as long as propodus.

Pleopods (Figures 6A-E) gradually decreasing in length. Peduncles of pleopods 1–4 with 4–9 coupling hooks irregularly. Endopod of pleopods 3–5 with proximomedial lobe. Pleopod 1 exopod 1.5 times as long as wide, lateral margin strongly convex, distally broadly rounded, mesial margin straight; endopod 2 times as long as wide, lateral margin convex, distally broadly rounded, mesial margin straight; peduncle 3.5 times as wide as long, without retinaculae. Uropods not extending beyond margin of pleotelson. Exopod slightly longer than endopod. Uropod peduncle lateral margin without spines (Figure 8A).

Description of non-ovigerous female: Body length varies from 10 to 13 mm (Figure 1B). Mouthparts similar to female except for the following: Maxilla (Figure 2M, 9C) medial lobe with 2 spines, lateral lobe with 2 spines. Maxilla with 4–5 spines on base side and more small spines on lateral side. Maxilliped (Figure 2G) comprising 3 articles, article 3 with 3 recurved robust spines. Mandible palp (Figure 2I) third article distinctly shorter than others, with 5–8 setae on lateral margin. Pereopods (Figures 4A-G) with one seta on propodus and merus. Pleopods 3-5 endopods with much larger proximomedial lobes. Uropods not extending beyond margin of pleotelson. Exopod (Figure 8B) longer than endopod in length. Uropod peduncle with

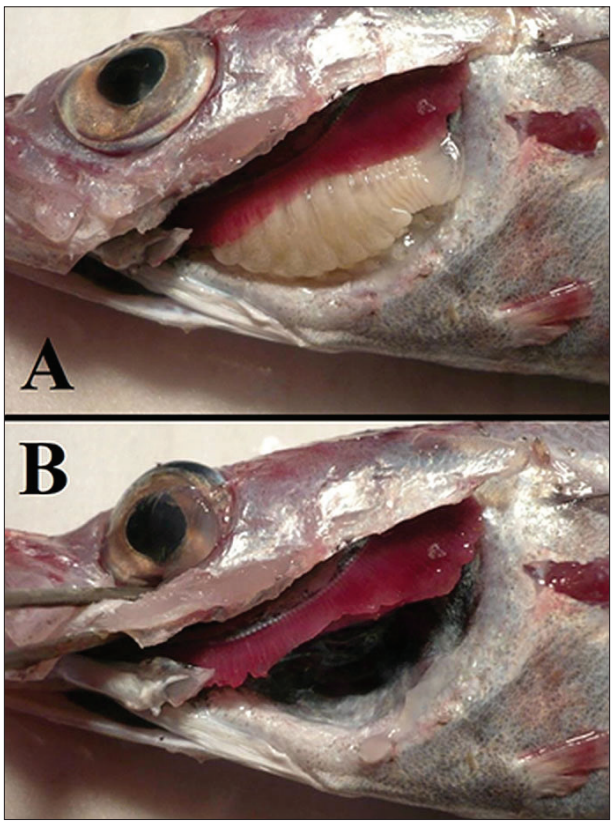

Figure 10. (A) *E. poutassouiensis* comb.nov. on the gill chamber of fish. **(B)** Atrophy on the gill filaments after removed parasite.

spines (Figure 8C). Pereonite 7 with remainder penes (Figure 9A). Pleopod 2 with remainder appendix masculina (Figure 9B).

Description of male: Body length varies from 8 to 8.5 mm (Figure 1C). Body bilaterally symmetrical and smaller than the female. Body 2.7 times as long as greatest width, widest at pereonite 2-3, other pereonites similar, most narrow at pereonite 7 slightly. Cephalon 0.4 times longer than wide, visible from dorsal view. Pereonite 1 longest, other pereopods similar in length. Posterior margin of pereonite 7 deeply curved. Eyes well-developed, 0.4 times width of head. Coxal plates of pereonites invisible in dorsal view. All pleonites similar in length, visible in dorsal view; pleonites 2–5 similar in width; first pleonite distinctly narrow than other. Pleonite 1 partially overlapped by pereonite 7. Pleotelson 1 times as long as anterior width, posterior margin rounded. Pleotelson not wider than pleonite 7.

Antennula (Figure 2C), antenna (Figure 2D), mandible (Figure 2J), maxillula (Figure 2E), maxilla (Figure 2L) similar to ovigerous female. Maxilliped (Figure 2H) comprising 3 articles, article 3 with 4 recurved robust spines. Antenna with some very little setae on distal margin of articles 1–8 (Figure 2D).

Pereopods 1–3 (Figure 5A-G) slightly smaller than 4–7. Basis, ischium of 4–7 pereopods longer than 1–3 pereopods. Pereopods 1-6 with one setae on posterior margin of merus. Pereopods with 2-9 spines on anterior margin of propodus, except of sixth. Pereopods 4-6, with one setae on posterior margin of propodus. Pereopod 7, with six spines on anterior margin of carpus (Figure 9I). Pereopods 1-3, with teeth on posterior margin of dactylus (Figure 9H).

Pleopod 1 (Figure 7A-E) smaller than pleopod 2, pleopods 2-5 similar in length. Peduncles of pleopods 1–4 with 4–9 coupling hooks irregularly, except of pleopod 5 (Figure 9G). Pleopods 3-5 endopods with much larger proximomedial lobes (Figure 9G). Uropods extend beyond margin of pleotelson. Exopod (Figure 8D) longer than endopod in length. Uropod peduncle with spines on outside. Uropod peduncle with three spines on inside corner (Figure 9E). Pereonite 7 with penes (Figure 9D). Pleopod 2 with appendix masculina (Figure 9F).

The atrophy of the lamellar epithelium in the gill filaments resulting from the attachment of pereopods is clearly visible when the parasite is removed from the branchial cavity (Figure 10A,B).

Discussion

The parasitic isopod mentioned in this article was firstly collected on the blue whiting, *Micromesistius poutassou* (syn. *Gadus potassou*) in Genova Gulf, Italy (Ligurian Sea) by Brian (1939). Brian (1939) gave no drawing or description about this species and measured the length of parasites about 2cm. Brian (1939) named this isopod *Meinertia poutassouiensis.* The same isopod was found on the same host as *Micromesistius poutassou* (syn. *Gadus potassou*) by Penso in 1939. Penso (1939) named this isopod as *Meinertia potassoniensis* without a detailed description and provided only two photos of it from anterior and lateral sides.

Horton (2000) placed *Meinertia poutassouiensis* as *Ceratothoa poutassouiensis* (Brian, 1939) *nomen nudum*, due to the lack of type material, type locality and description. Hadfield et al. (2016a) also placed this species as *Ceratothoa poutassouiensis* (Penso, 1939) *nomen dubium* due to the lack of type material, type locality and description.

Brian (1939) and Penso (1939) found this parasite from the gill cavity of blue whiting. They named this species as *Ceratothoa* (syn *Meinertia*). All members of *Ceratothoa* occurr on the buccal cavity of fish (Hadfield et al., 2016a). A total of 480 fish samples were examined in this study, with all isopods found only in the gill cavity of these fish. Those isopods collected matched host and infestation sites mentioned in Penso (1939) and Brian (1939). Bruce (1990) noted *Elthusa* (except two species) only from the gill and operculum of the fish. The selection of infestation sites on the host of *Elthusa* verified the finding in this study.

The morphological characters of the gill-inhabiting *Elthusa* genus were summarised by Bruce (1990), Trilles and Randall (2011), Hadfield et al. (2017a). *Elthusa* contains a weakly vaulted body, symmetrical or weakly twisted; antennula shorter than antenna; bases never in contact, varying from close set to wide apart; posterior margin of cephalon not trilobed; pleonite 1 as wide, or only a little narrower than pleonite 2; mandible palp slender; article 3, or 2 and 3 with setae; maxilliped with oostegital lobe; pleopods all lamellar, without lobes or folding, progressively decreasing in size from pleopod 1 to 5; pleopod 5 endopod rounded, or with straight medial margin, never indented. *Elthusa poutassouiensis* Penso, 1939 comb. nov. shares *Elthusa* characters summarised by Bruce (1990), Trilles and Randall (2011) and Hadfield et al. (2017a) and is hereby placed into the genus *Elthusa*.

Although *Elthusa raynaudii* and *Elthusa epinepheli* are two species reported from very distant regions and other very different hosts, they show some similarity to *Elthusa poutassouiensis* Penso, 1939 comb. nov. morphologically. It can be separated from *Elthusa raynaudii* redescribed by Bruce (1990), by a number of characters, including female body slightly twisted to one side; pleonites from 1 to 5 increasing distinctly in width; antenna composed of 10 articles (11 in *E. raynaudii*); mandible palp second article with 2 setae and third article with 5–8 setae (5 and 2 setae on distolateral margin of articles 2 and 3 respectively in *E. raynaudii*); pleopods 1–4 with coupling hooks on medial peduncle margin and endopods 3–5 with proximomedial lobe (with coupling hooks and without proximomedial lobe in *E. raynaudii*); maxilliped third article 3 with 2–4 recurved robust spines (2 spines on third article of maxilliped in *E. raynaudii*).

E. poutassouiensis can be separated from *E. epinepheli* described by Trilles and Justine (2010) by a number of characters, including female mandible palp second article with 2 setae and third article with 5–8 setae (without setae in *E. epinepheli*); maxillula with 4 spines (3 spines in *E. epinepheli*); pereopods 5–7 without carina (present in *E. epinepheli*); pleopods 1–4 with coupling hooks on medial peduncle margin (without coupling hooks in *E. epinepheli*); maxilliped third article 3 with 2–4 recurved robust spines (2 spines in *E. epinepheli*).

The discovery of *E. poutassouiensis* in Turkish waters brings the total number of the valid genus of cymothoids recorded in that region to seven. *E. poutassouiensis* is the first species of *Elthusa* genus reported from the Mediterranean Sea. In addition, the controversy regarding findings of Brian (1939) and Penso (1939) is clarified in this study.

Acknowledgements

The authors gratefully acknowledge the following individuals for technical and facility support: Dr. Kerry Hadfield Malherbe verified *Elthusa* genus; Dr. Mike Robertson purveyed scientificial support; Dr. Deniz Soysal provided laboratory space for the examination; Enrico Muzio provided Brian's (1939) article from Biblioteca del Museo Civico di Storia Naturale; Michele Losacco provided Penso (1939)'s artişle from Biblioteca Nazionale Braidense. The first author dedicates this paper to the memory of Professor Murat Sezgin, who passed away in a traffic accident.

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