



## First Record of *Epactophanes richardi* Mrázek, 1893 (Copepoda, Harpacticoida, Camptocamptidae) for Turkish Inland Waters

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### Abstract

The harpacticoid copepod, *Epactophanes richardi* collected from Sariseki Stream (İskenderun, Hatay) and Dragon River (Anamur, Antalya) was reported for the first time from Turkish inland waters. In addition, 14 other species of copepods were found in three localities. On the other hand, *Phyllognathopus viguieri* and *Kinnecaris xanthi* are second record from inland waters of Turkey.

**Keywords:** *Epactophanes richardi*, first record, Sariseki Stream, Dragon River.

### Introduction

Harpacticoid copepods from Turkish inland waters have been little studied compared to calanoid and cyclopoid copepods. To date, 37 species of harpacticoids belonging to 11 families have been reported. *Harpacticus littoralis* Sars 1910 was reported within the Harpacticidae, *Heterolaophonte stroemii* (Baird, 1837) was reported within the Laophontidae, *Phyllognathopus viguieri* (Maupas, 1892) was reported within the Phyllognathopodidae, *P. spinicauda trisetata* Noodt, 1954 was reported within the Leptastacidae, *Onychocamptus mohammed* (Blanchard and Richard, 1891) was reported within the Laophontidae, *Leptocaris brevicornis* (Van Douwe, 1904) and *Leptocaris trisetosus* (Kurz, 1935) were reported within the Darcythompsoniidae, *Kinnecaris draconis* Bruno and Cottarelli, 2015 and *Kinnecaris xanthi* Bruno and Cottarelli, 2015 were reported within the Parastenocarididae, *Metis ignea ignea* Philippi, 1843, *M. aestuarii* Gurney, 1921 and *E. gracilis* (Sars, 1863) were reported within the Metidae, *P. phyllophora* Noodt, 1954, *C. retrogressus* Schmankevitch, 1875, *L. behningi* Borutzky, 1926 and *N. palustris* Brady, 1880 were reported within the Cletodidae, *N. hibernica* (Brady, 1880), *N. incerta* (Richard, 1893), *N. lacustris* (Schmankevitch, 1875), *Nitokrella stammeri* Chappius, 1938 and *N. kosswigi* Noodt, 1954 were reported within the Ameiridae, and 16 taxon within the Canthocamptidae (Ustaoğlu, 2004; 2015).

The genus *Epactophanes* is distributed on every continent. It was reported that the genus has wide ecological valence (Reid and Williamson, 2010; Smith, 2001; Reid, 2001; Harding, 1953; Fiasca *et al.* 2005). Recently Bruno and Cottarelli (1999) described the second species in the genus, *E. philippinus*, from ground waters of Philippines. A third, new species was detected on Taveuni, Fiji (Schabetsberger *et al.*, 2009).

*E. richardi* is cosmopolitan, coldstenothermic and capable of parthenogenetic reproduction (Dole-Olivier *et al.*, 2000). It is typically found in semiterrestrial habitats. In the Great Smoky Mountains, it occurs occasionally and in low numbers in wet moss, seeps, and springs (Rundle *et al.*, 2000).

*Epactophanes* is a controversial genus, and its definition is to some extent still circumstantial. According to some authors (Lang, 1948; Dussart, 1967; Shen *et al.*, 1979), the only species belonging to the genus, *E. richardi* is a cosmopolitan species with wide variability. For this reason, these authors have attributed all the several varieties and subspecies that have been described later to the nominal species.

*E. richardi* has been recorded from many countries. However, from Turkey this species has not been reported until now. As their cosmopolitan distribution leads us to suspect that more than one species may be involved under the names of *E. richardi*, some supplementary drawings and descriptions was provided of the species, in order to provide a basis for future comparison.

## Materials and Methods

Zooplankton samples were collected by horizontal hauls of a standard net (60 µm mesh size), on 26 November and 28 December 2011, as well as on 30 January, 26 February, 21 March and 16 April 2012 during routine survey cruises in Sariseki stream (36° 40/ 15.47// N; 36° 13/ 17.25// E and Sariseki Marshes (36° 40/ 56.29// N, 36° 12/ 30.81// E) (Iskenderun, Hatay). Furthermore, third sampling locality was Dragon River (Anamur River) (36° 03/ 31.57// N, 32° 49/ 15.73// E) (Mersin). Samples were taken on 15 June and 14 November 2015 from third sampling location. At the same time, various moss species were collected from the same localities and they washed and filtered from the plankton net and holes were dug in the coarse sand and water was collected. Sariseki Stream and marshes are situated at the East Mediterranean part of Turkey, the stream falling into Iskenderun Bay with a length of 15-20 km. It is fed by several small streams and drains to Iskenderun Bay with 4-5 m<sup>3</sup> /s in winter, about 2 m<sup>3</sup> /s in summer rate of flow. Dragon River in Mersin Province, runs underground from its source in the Taurus Mountains near the village of Sugözü as a subterranean river, and surfaces for 35 km to its mouth into the Mediterranean Sea. River bed is sandy and gravelly in near the downstream. The sampling station is located 2 km from the river mouth on the right bank. After sampling, the zooplankton was fixed and preserved in 4% formaldehyde. Specimens were examined in a distilled water and glycerol mixture. Drawings and measurements were made using an Olympus microscope with drawing-tube. The species were identified with the aid of Borutsky (1964), Dussart (1969), Damian-Georgescu (1970), and Kiefer and Fryer (1978).

## Results

Fifteen species of copepods were identified in all sampling fields: Copepod *Eucyclops serrulatus* (Fischer, 1851), *Macrocyclus albidus* (Jurine, 1820), *Mesocyclus leuckarti* (Claus, 1857), *Paracyclus fimbriatus* (Fischer, 1853), *Nitocra hibernica* (Brady, 1880) and *Kinnecaris xanthi* Bruno and Cottarelli, 2015 were found in Sariseki Marshes. *Diacyclops bicuspidatus* (Claus, 1857), *Acanthocyclops robustus* (Sars, 1863) *Bryocamptus zschokkei* (Schmeil, 1893), *Bryocamptus minutus* (Claus, 1863), *Attheyella crassa* (Sars, 1863), *Phyllognathopus viguieri* (Maupas, 1892) and *Epactophanes richardi* Mrázek, 1893 were found in Sariseki Stream; and *Acanthocyclops robustus*, *Epactophanes richardi*, *Nitocrella kosswigi* Noodt, 1954 and *Nitocrella stammeri* Chappuis, 1938 were found in Dragon River (Table 1).

The abundance of copepods was not determined numerically but it was observed visually under the microscope. The most abundant copepods were *Mesocyclus leuckarti* and *Bryocamptus zschokkei* followed by *Eucyclops serrulatus*, *Macrocyclus albidus*, *Acanthocyclops robustus*, *Diacyclops bicuspidatus*, *Nitocra hibernica*, *Phyllognathopus viguieri*, *Nitocrella kosswigi*, *Attheyella crassa*, *Nitocrella stammeri*, *Paracyclus fimbriatus*, *Bryocamptus minutus*, *Kinnecaris xanthi* and *Epactophanes richardi*. Male specimen of *E. richardi* was not found in samples and therefore drawings of male cannot be made.

Harpacticoid copepod *E. richardi* is new record and *K. xanthi* and *P. viguieri* are second record for Turkish inland waters.

**Table 1.** Copepod species found in three sampling localities

(Suborder)	Copepods found in Sariseki Marshes
(C)	<i>Eucyclops serrulatus</i> (Fischer, 1851)
(C)	<i>Macrocyclus albidus</i> (Jurine, 1820)
(C)	<i>Mesocyclus leuckarti</i> (Claus, 1857)
(C)	<i>Paracyclus fimbriatus</i> (Fischer, 1853)
(H)	<i>Kinnecaris xanthi</i> Bruno & Cottarelli, 2015
(H)	<i>Nitocra hibernica</i> (Brady, 1880)
	Copepods found in Sariseki Stream
(C)	<i>Acanthocyclops robustus</i> (Sars, 1863)
(C)	<i>Diacyclops bicuspidatus</i> (Claus, 1857)
(H)	<i>Attheyella crassa</i> (Sars, 1863)
(H)	<i>Bryocamptus minutus</i> (Claus, 1863)
(H)	<i>Bryocamptus zschokkei</i> (Schmeil, 1893)
(H)	<i>Epactophanes richardi</i> Mrázek, 1893
(H)	<i>Phyllognathopus viguieri</i> (Maupas, 1892)
	Copepods found in Dragon River
(C)	<i>Acanthocyclops robustus</i> (Sars, 1863)
(H)	<i>Epactophanes richardi</i> Mrázek, 1893
(H)	<i>Nitocrella kosswigi</i> Noodt, 1954
(H)	<i>Nitocrella stammeri</i> Chappuis, 1938

(C), Cyclopoida; (H), Harpacticoida

### Description of Female.

Body cylindrical, long, unpigmented; length from rostrum to distal apex of caudal rami=0.575 mm and 0.560 mm (Figure 1A). Cephalosome with nuchal organ of characteristic shape with sensilla. Abdominal somites 2-5 with ventral row of spinules along distal margin. Second abdominal somite with proximal row of smaller spinules. Last abdominal somite with additional ventral row of strong spinules along distal margin, extending laterally. Integumental ornamentation slightly variolated. Antenna (Figure 1G) with 1 segmented exopodite with 2 apical seta; allobasipodite with 2 spine. Endopodite with 4 inner spines near its origin, followed by 3 strong spines. Genital field as in Figure 1C. Anal operculum (Figure 1D) with convex distal margin with four strong pointed processes. Furcal rami (Figure 1D) shorter than last abdominal somite.

Antennule (Figure 2C) 7-segmented. First segment bare, second segment with 1 distal seta, third segment with 9 setae. Fourth segment with 4 lateral setae. Fifth segment with distal tubercle bearing 1 long seta and 1 long aesthetasc. Sixth segment with 1 apical seta, last segment with 7 setae and 1 aesthetasc.

P1 (Figure 1E) with basipodite bearing row of spinules and 1 seta near insertion of each ramus. Exopodite 3-segmented, each segment with strong pinnate seta on distal outer corner, spines on distal

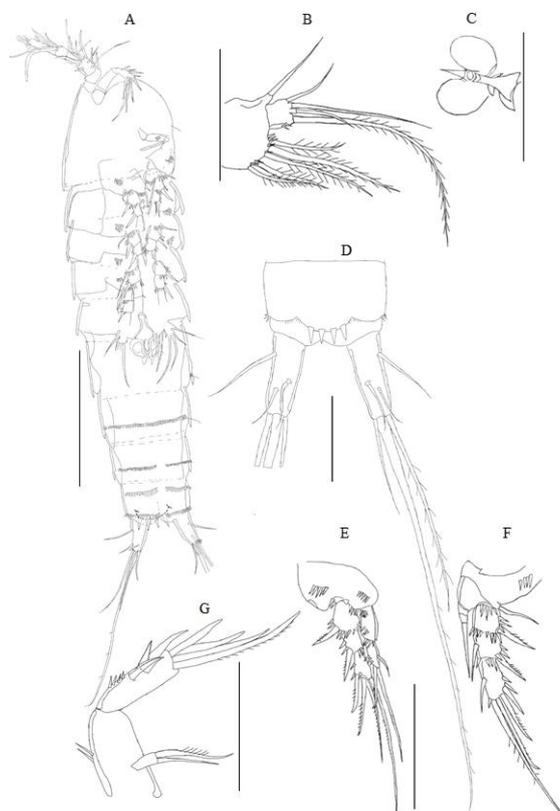
margin. Apically, 1 pinnate seta and 2 long geniculate pinnate setae of different lengths. Endopodite 2-segmented, reaching length of exp-3; first segment bare, second segment with 1 short lateral seta and, apically, 2 geniculate setae, longest seta unilaterally pinnate.

P2 (Figure 1F) with coxa and basipodite bearing seta near insertion of exopodite, and 1 seta near insertion of endopodite. Exopodite 3-segmented, second segment with lateral inner seta. Third segment longer than previous 2 segments, with 1 lateral inner pinnate seta, and 2 subapical and 2 apical pinnate seta. Endopodite 1-segmented, with trace of primitive 2-segmentation, small, with distal pinnate seta.

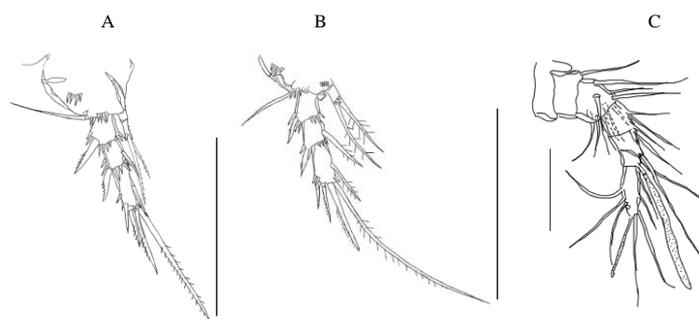
P3 (Figure 2A) with exopodite 3-segmented, second segment with lateral inner seta. Third segment longer than previous 2 segments, with 1 lateral inner seta, 2 subapical and 2 apical pinnate setae. Endopodite 1-segmented, with trace of primitive 2-segmentation, as long as exp-1, with 2 long pinnate apical seta.

P4 (Figure 2B) with exopodite 3-segmented. Second segment with lateral pinnate seta, third segment with transformed seta at about two-thirds of inner margin, 2 subapical and 2 apical pinnate setae. Endopodite 1-segmented, very small, bearing apically pinnate seta and spinules.

P5 (Figure 1B) with baseopodite having five pinnate setae of different lengths; exopodite



**Figure 1.** *Epactophanes richardi* adult female. A) Habitus, ventral view; B) fifth leg; C) genital field; D) caudal rami and anal somite, dorsal; E) first swimming leg; F) second swimming leg; G) Antenna. Scale bars A, G 100 µm, B, C, D, E, F 50 µm.



**Figure 2.** *Epactophanes richardi* adult female. A) third swimming leg; B) fourth swimming leg; C) antennule. Scale bars A, B, C 50  $\mu$ m.

small, with 1 normal seta and 3 pinnate setae of different lengths, 1 very long (Bruno and Cottarelli, 1999).

**Distribution.** — *Epactophanes richardi* is cosmopolitan in fresh waters, widely distributed throughout Europe, Brazil, Hokkaido, Philippines, throughout North America (Czaika 1978; Horvath *et al.* 2001). The eurytopic species is found in seeps, springs, moist soils, among mosses, in addition to the benthos of streams and rivers (Reid 2001; Dussart 1969; Rundle *et al.*, 2000; Ishida, 1987; Fiers and Ghenne, 2000).

## Discussion

Several studies have carried out fresh water zooplankton of Turkey. According to the results of these studies, copepod fauna of Turkey has 141 taxa which include 65 cyclopoid, 39 calanoid, and 37 harpacticoid species (Ustaoğlu, 2015). All species determined in this study except *E. richardi* were reported in previous studies (Ustaoğlu, 2015).

The genus *Epactophanes* found on every continent is a questionable genus, and its definition is still debated. According to most authors it should include a single species, *E. richardi*, which shows a wide distribution and variability, with numerous questionable subspecies (Dussart and Defaye 1990). Recently Bruno and Cottarelli (1999) described the second species in the genus, *E. philippinus*, from ground waters of Philippines.

*P. viguieri* and *K. xanthi* are recorded second time from Turkish inland waters. *P. viguieri* was recorded firstly by Bozkurt (2007) from Gölbaşı Lake and *K. xanthi* was recorded firstly by Bruno and Cottarelli (2015) from Karamenderes River (Çanakkale Province). On the other hand, Bruno and Cottarelli (2015) was reported *Kinnecaris dragonis* from Dragon River (Anamur, Antalya) but it was not found in our samples in Dragon River.

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