

— SHORT COMMUNICATION —

On the occurrence of *Lepidurus apus* (Linnaeus, 1758) (Crustacea, Notostraca) from Iran

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The occurrence of *Lepidurus apus* in Iran is reported for the first time. This species was found in Aigher Goli located in the mountains area, East Azerbaijan province (North East, Iran). Details on biogeography, ecology and morphology of this species are provided.

Key words: *Lepidurus apus*, Aigher Goli, East Azerbaijan, Iran.

INTRODUCTION

Notostracan records date back to the Carboniferous and possibly up to the Devonian period (Wallosek, 1993, 1995; Kelber, 1998). In fact, there are Upper Triassic *Triops* fossils from Germany which are almost indistinguishable from the extant *Triops cancriformis* (Tröger *et al.*, 1984; Kelber, 1999) and thus *Triops* is considered to be one of the best examples of evolutionary stasis or 'living fossils' (Fisher, 1990; King & Hanner, 1998; Kleesattel, 2001). The Notostraca exhibit plasticity in external morphology, making the demarcation of species on this basis a difficult task (Rogers, 2001). The absence of well-defined criteria allowed taxonomists to describe many "new species" in such a way that the nominal species of *Triops* and *Lepidurus* amounted to more than 70 in the 1950s (Longhurst, 1955; Brendonck *et al.*, 2008). The most salient distinguishing character between the two genera is the large supra-anal plate seen in species of *Lepidurus* (Longhurst, 1955; Rogers, 2001). Recently, two new genera, *Chenops* and *Jeholops* have been described through the fossil studies from the north-eastern of China (Hegna & Dong, 2010).

Their world-wide distribution is due to their antiquity, but possibly also to their passive transport: geographical barriers are more effective for non-passively distributed animals. From an ecological point of view, notostracans, like most branchiopods, are restricted to temporary pools (Longhurst, 1955; Kerfoot & Lynch, 1987). Their ability to adapt to the temporary habitats has enabled their drought-resistant eggs to become efficient agents of passive dispersal, so that populations occur on remote oceanic islands and are apparently found wherever there are suitable pools (Longhurst, 1955).

Brendonck *et al.* (2008) reported about 500 species of large branchiopods world-wide, 351 species from Palaearctic zoogeographic region including Iran. The Middle East Notostracans are represented by four species from two genera and one family; *Triops granarius* from Iraq (Longhurst, 1955), *Triops cancriformis* from Yemen, *Triops numidicus* from Saudi Arabia and Oman, *Lepidurus couesii* from Syria (Thiéry, 1996), *Triops cancriformis* and *Lepidurus apus lubbocki* from Israel (Kuller & Gasith, 1996). Lately, *Triops cancriformis* is the only species that has been reported from Iranian territory (Golzari *et al.*, 2009).

Lepidurus apus has one of the greatest ranges of distribution than any of the *Triops* species being found

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throughout continental Europe, Northern Africa, Asia, Australia (Longhurst, 1955).

In this paper we report for the first time the occurrence of *Lepidurus apus* from Iran and provide morphometrical characteristics of the Iranian population.

MATERIALS AND METHODS

Study site

Aigher Goli is a fresh water pool situated in the highlands of Sahand mountain (N 37°46', E 46° 35') in North West of Iran. A plain of 2560 m above sea level, surrounded by mountains of varying heights, about 43 km from Tabriz city at East Azerbaijan province, close to the borders of three neighboring countries, Turkey, Armenia and Azerbaijan Republic (Fig. 1).

It sets in steppic and cultivated hills with its bottom composed of clay and volcanic stone and ashes. The northern air current carrying cold and dry winds arrives in the country from heavy pressure centers in Armenia, resulting in very cold winters in this mountainous area. This cold northern wind severely affects the upland areas in North Western provinces of Iran from late October to late March, reducing the temperature to as low as -30°C causing heavy snowfalls. Local rainfall (300 mm y^{-1}) and melting snow during

the spring, continually supply the pool until early summer. The pool is generally frozen from late December, often remaining under deep snow cover throughout the winter. Most of the aquatic animals emerge after the long cold period. The pool is dominated by some typical algal genera such as *Scenedesmus*, *Nitzschia*, *Anabaena*, *Chlorella* and *Oocystis* throughout spring. This biotope is important primarily as a breeding area for waterfowl including *Tadorna tadorna* and *Tadorna ferruginea*.

Sampling

Lepidurus apus samples were collected from the habitat using a $250\text{ }\mu\text{m}$ mesh plankton net three times during spring. Some individuals were immediately transferred into 4% formalin and transferred to laboratory. Specimens were identified using appropriate taxonomic references (Longhurst, 1955; Cottarelli & Mura, 1983; Alonso, 1985, 1996; Thiéry, 1987; Kuller & Gasith, 1996). One hundred adult individuals were used for examination of sexuality and only females were found. Twenty five individuals were examined for morphometrical characteristics using a stereomicroscope. Main co-existing animals were identified. A number of physical and chemical parameters (pH, dissolved oxygen, temperature, conductivity, suspended materials, transparency, surface area and average

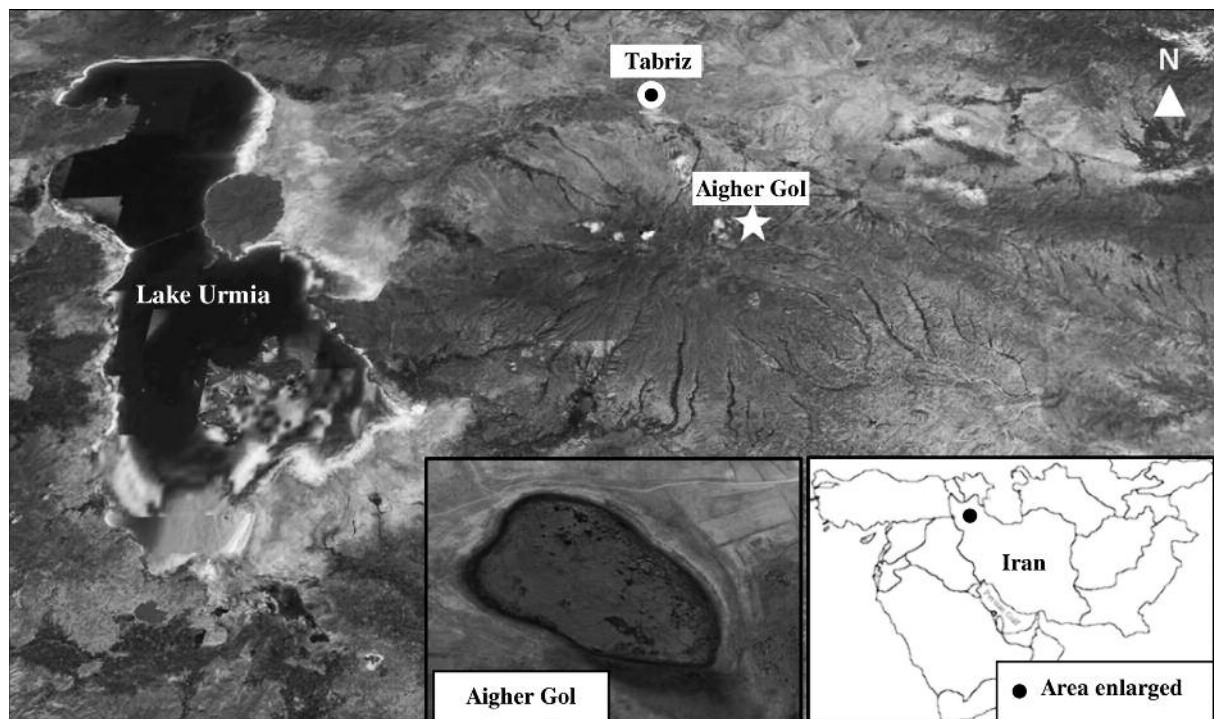


FIG. 1. Geographical location of the Aigher Goli.

depth) were measured in the field according to standard methods. The concentration of nitrate, phosphate and chlorophyll *a* were measured in the laboratory.

RESULTS

Ecological features of the pool

The pool covers an area of about 5-6 hectares and its average depth is 55 cm. It completely dries up during summer time. The presence of suspended clay particles generates a high turbidity in the pool (12 cm). Conditions at the pool were studied in detail. The pool is visited by livestock and their dung is deposited in the water affecting the water chemistry. The morphometric and physico-chemical characteristics of the pool are presented in Table 1.

Lepidurus apus was found to co-occur with the Anostracan species *Branchinecta orientalis* Sars 1901, *Chirocephalus skorikowi* Daday 1913, (Daday, 1910; Mura & Takami, 2000) and one species from Spinicaudatan, Ostracoda and Copepoda.

Morphological characteristics

The preserved individuals were scored for the characteristics indicated in Table 2 (only female). The adult length ranged from 42.50-59.17 mm (average 50.90 mm) from anterior margin of carapace to tip of the furca. Nuchal organ is located behind the eyes, intersected by a line drawn between posterior apices of the eyes. Endites 3, 4 and 5 of the second thoracic appendages project beyond carapace margin. 26 to 28 body rings, 41 to 46 pairs of legs, 4-5 apodous rings. Caudal lamina may be constricted at base, subqua-

TABLE 1. Physico-chemical characteristics of the studied pool

Variable	Value
Surface area (m ²)	5-6 × 10 ⁵
Perimeter (m)	750
Average depth (cm)	55
Temperature (°C)	27
pH	7.9
Conductivity (µS cm ⁻¹)	106
Dissolved oxygen (mg l ⁻¹)	8.4
Total nitrate (mg l ⁻¹)	1
Total phosphate (mg l ⁻¹)	0.1
Chlorophyll <i>a</i> (µg l ⁻¹)	9
Suspended matter (mg l ⁻¹)	120
Transparency (cm)	12

drate in very mature specimens, measures 0.35 to 0.4 times the length of carapace. A median series of spines is found on dorsal part of caudal lamina with few spines bigger compared to others. Prominent spines are found on the terminal margins of telson, lateral spines on telson, triangular sulcus spines of various sizes, generally as long as broad, a rough spine at the end of carina. A row of marginal spines are seen at the end of carapace (Fig. 2).

DISCUSSION

This paper provides some ecological, biogeographical, and morphological information about Iranian *Lepidurus apus*. This species was found in Aigher Goli in very high density by late spring, co-existing with few freshwater large branchiopods, Ostracods and Copepods who have adapted to similar conditions. They are found in close competition for food; however,

TABLE 2. Morphometric parameters measured in *Lepidurus apus*

Characteristics	Mean	s.d.	Range
Total length (mm)	50.90	4.31	42.50-59.17
Carapace length (mm)	19.05	1.04	17.17-20.83
Carina length (mm)	14.32	0.78	12.9-15.65
Telson length (mm)	1.20	0.04	1.17-1.25
Telson width (mm)	2.55	0.09	2.33-2.67
Length of caudal lamina (mm)	5.01	0.20	4.5-5.5
Eye diameter (mm)	2.57	0.15	2.17-3
Number of apodous rings	4.84	0.44	4-5
Number of body rings	27.20	0.71	26-28
Number of exposed rings	8.60	0.96	7-10
Number of leg pairs	44.40	1.35	41-46
Number of spines on caudal lamina	31.00	2.74	27-35

s.d. = standard deviation

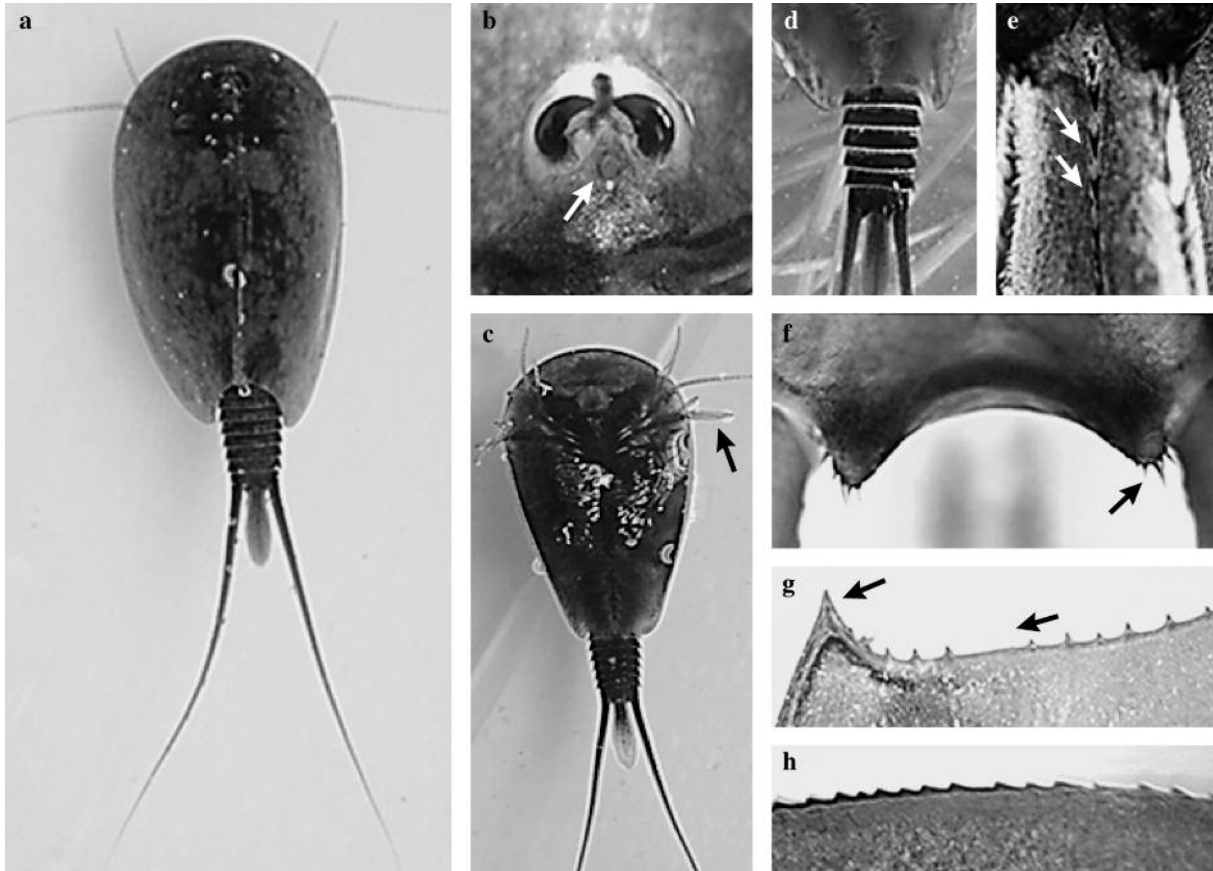


FIG. 2. a) Adult *Lepidurus apus*, b) nuchal organ, c) ventral view of the endites of the first and second trunk appendages projecting, d) apodous rings, e) series of spines on caudal lamina, f) telson terminal projections, g) row of sulcus spines and carina terminal spine, h) row of spines on carapace margin.

most of them continue living until the pool is dried in summer.

The pool is geographically isolated and there are no water connections with any other aquatic habitat. The colonization of the habitat probably has resulted from dispersal through other vectors. Figuerola *et al.* (2003) and Green & Figuerola (2005) reported on dispersal of the diapausing cysts of large branchiopods by wind, water or visiting birds. Having in mind the occurrence of this species at the altitude of 2560 m, we believe that the migrating waterfowls, who visit the area annually for breeding, could have played a major role in its dispersal to such a remote and isolated biotope.

Large freshwater branchiopods serve as an important source of protein and energy for migratory waterfowls (Eriksen & Belk, 1999). Many vernal pools occur along the Pacific flyway; the use of these pools as resting and feeding grounds by migratory birds is well documented (Silveira, 1998). It seems that the large branchiopods including *L. apus* existing in the target pond serve as suitable source of food for the

visiting birds providing the basic ground for their breeding.

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