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OCCURRENCE OF A TUMOUR-LIKE ABNORMALITY IN THE TELSON SKELETON OF THE BRINE SHRIMP *ARTEMIA* (BRANCHIOPODA, ANOSTRACA)

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ABSTRACT

Malformations of crustaceans have been observed in their natural habitats as well as in laboratory studies. Two patterns of morphological abnormalities have been recorded in species of the brine shrimp genus *Artemia*, including a gynandromorphic pattern and a specimen with three compound eyes. Here we report a hitherto unknown pattern of morphological deformation, viz., a tumour-like abnormality that occurred in the telson skeleton of a specimen of *Artemia* from China.

Key words. — *Artemia*, skeletal malformations, telson, tumour-like

RÉSUMÉ

Des malformations chez les crustacés ont été observées dans leurs habitats naturels comme dans des études en laboratoire. Deux types d'anomalies morphologiques ont été observés chez les espèces du genre de Branchiopode Anostracé *Artemia*, incluant une forme gynandromorphe et un spécimen avec trois yeux composés. Ici, nous rapportons un modèle de malformation morphologique jusqu'alors inconnue, à savoir une anomalie ressemblant à une tumeur apparue dans le squelette du telson d'un spécimen d'*Artemia* de Chine.

Mots clés. — *Artemia*, malformations squelettiques, telson, pseudo-tumeur

INTRODUCTION

The existence of morphological abnormalities in crustaceans has been recorded at irregular intervals and those reported include skeletal malformations (Pan-

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dourski & Evtimova, 2005), abnormalities in sexual characters (Brylinski, 1984; Martinelli-Filho et al., 2009; Long et al., 2010; Asem & Sun, 2013), and tumour-like anomalies (Skovgaard, 2004; Bhandare & Ingole, 2008). These malformations have been observed in the species' natural habitats as well as in laboratory studies (McKenney, 2005; Asem & Sun, 2013; Zambrano, 2017).

The brine shrimp *Artemia* is the most numerous crustacean inhabiting saline environments worldwide. It is an ecologically important organism in the food chain, which links microscopic algae on the lower end, to water birds on the higher end (Asem et al., 2014, 2016). Two patterns of morphological abnormalities have been recorded in *Artemia* until now, including a gynandromorphic pattern (see Asem & Sun, 2013) and a specimen with three compound eyes instead of the usual two (Chang et al., 2018).

This study presents herein the first record of an abnormality in the external skeleton of a species of *Artemia*.

MATERIAL AND METHODS

A tetraploid parthenogenetic *Artemia* clone from Barkol salt lake (China) was cultured under laboratory conditions (light regime 16 h light : 8 h dark, salinity 70 ppt, and constant temperature 25°C) for biological studies. During the period December 2017 to August 2018, five specimens were observed with abnormal patterns in the telson. Two samples died before producing offspring. Three adult abnormal specimens were photographed alive under a Nikon SMZ800 stereomicroscope using a Nikon DS-5M digital camera. These specimens have been separately cultured to check the morphological structure in the next generations, i.e., F1 and F2.

RESULTS AND DISCUSSION

All five specimens of *Artemia* revealed an abnormality in the skeleton of the telson, which appeared after the maturation stage. The telson, normally having the structure of the final body segment and being straight, presented a marked curvature in its structure that was best observed in the abnormal specimens when they were swimming. The skeletal malformations were all similar and showed a knee-shaped bend, where a tubercle-like deformation can be seen, much as some tumour-like abnormality. Under the stereomicroscope, several small lumps were observed on the surface of what might be characterized as the "main tumour" (fig. 1). Three of the abnormal examples survived, between 15 and 34 days after maturation. The results further showed that all three abnormal specimens produced normal offspring in the first as well as in the second generations (table I).

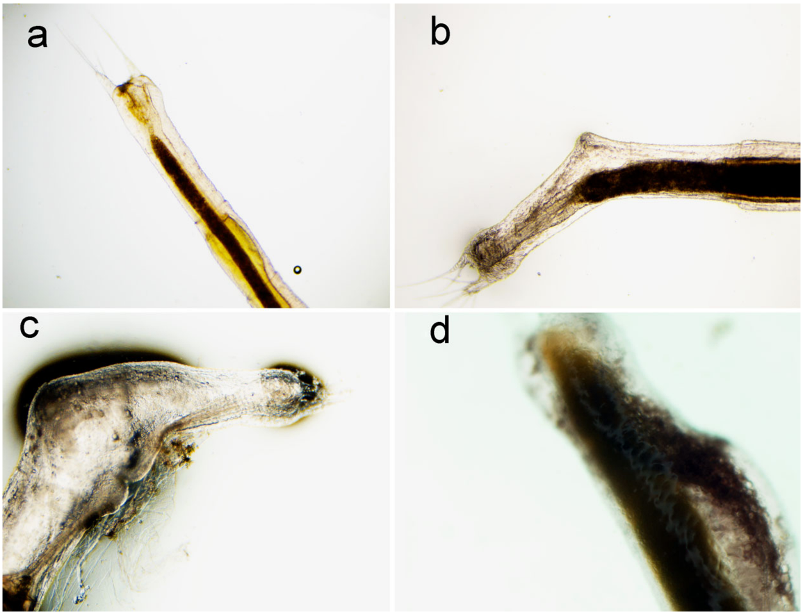

Fig. 1. Details of the telsons of specimens of *Artemia*, originating from a tetraploid parthenogenetic clone from Barkol salt lake (China), cultured in the laboratory: a, a normal specimen, with straight telson; b-d, telsons of three specimens, each with a similar anomaly in the skeleton of the telson, i.e., a distinct bend in the telson at which site a tumour-like abnormality seems to be present; b, detail of abnormal telson in pre-adult specimen; c, similar abnormality in adult specimen, showing small lumps on the tumour-like structure; d, detail of the third specimen, showing small lumps on the exoskeleton of the telson.

Different biological and non-biological reasons have been discussed as possible causes to explain morphological malformations. Besides genetic origins, part of the deformities recognized was referred to ecological factors, in particular contaminations of the environment (Lopez Greco et al., 2000; Sousa et al., 2011). Some occurrences of abnormalities in copepods such as damage to the exoskeleton, leading to breakage of body parts, or such as intestinal prolapse, were referred

TABLE I

Abnormality characteristics of the offspring of the three abnormal, parthenogenetic specimens of *Artemia* in their F1 and F2

Specimen no.	Telson abnormality			
	F1		F2	
	No. of offspring	No. with abnormality	No. of offspring	No. with abnormality
1	58	0	120	0
2	53	0	180	0
3	132	0	321	0

to unfavourable physico-chemical conditions in the natural habitat (Crisafi, 1974; Montú & Gloeden, 1982), or to environmental stress, injuries, pollution (Lopez Greco et al., 2000), as well as to parasites and predators (Peltzer et al., 2011). But it was also plausibly argued that those can be attributed to random occurrences, as in the case of malformations in ocypodid crabs (Zambrano, 2017).

Our results strongly confirmed that there is no genetic reason for the present abnormality in *Artemia*, because all offspring of the abnormal specimens, both in F1 and F2, were found to be in normal condition. There is, on the other hand, also no evidence that reveals whether or not any ecological problems could have caused the tumour-like abnormality in the skeleton of those specimens. Regardless the reasons of the occurred deformations, it is notable that all of them were present in the skeleton of the telson.

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