Bifurcation of an ultimate leg in Cryptops parisi Brolemann, 1920 (Chilopoda: Scolopendromorpha: Cryptopidae)

Ветвление надвое последней ноги у Cryptops parisi Brolemann, 1920 (Chilopoda: Scolopendromorpha: Cryptopidae)

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КЛЮЧЕВЫЕ СЛОВА: Chilopoda, Cryptops parisi, схистомелия, Сербия.

ABSTRACT. A case of schistomely (= bifurcation) of one ultimate leg in an adult female of the scolopendromorph centipede, Cryptops parisi, is presented. A possible origin of the anomaly observed is discussed. All previously published records of leg bifurcation in centipedes are summarized.


РЕЗЮМЕ. Представлен случай схистомелии (= ветвление надвое) последней ноги у одной взрослой самки скропендроморфа Cryptops parisi. Обсуждается возможное происхождение данной аномалии. Резюмированы все до сих пор отмеченные случаи схистомелии ног у губоногих многоножек.

Introduction

The oldest published records of abnormal phenotypes in centipedes date from the end of the 19th and early 20th century [Hutton, 1878; Brölemann, 1894, 1904; Gadeau de Kerville, 1898; Léger, Duboscq, 1903; Duffaut, 1908; Selbie, 1913; Takesita, 1918]. The first attempt to review and classify all previous published records was made by Balazuc & Schubart [1962]. That study resulted in the definition of five principal structural types of centipede anomalies, namely: (1) helicomerism (spiral segmentation), (2) homeotic mutation (the mutation of one structure into another), (3) schistomely (the bifurcation of appendages), (4) symphysomely (“symphysoméles”; for instances of “fused” antennal or leg articles), and (5) atrophies of appendages (usually as the result of regeneration or injury on antennae or legs). Much later, Minelli & Pasqual [1986] accepted only the first three types of anomalies from that classification. The last two types were presented as doubtfully representing teratology, with a high possibility that damage occurred due to regeneration during post-embryonic life. Lewis [1987] commented on such a reduced classification and indicated that all centipede malformations recorded could not be covered only by those three types. He claimed that certain cases could be due to some developmental problems (developmental abnormality) or a possible regeneration after damage, which cannot be explained in terms of such a classification. In several recent studies, the classification of the centipede anomalies recorded is mostly based on the delimitations by Minelli & Pasqual [Leśniewska, 2012; Leśniewska, Barber, 2014; Leśniewska et al., 2009a, b].

In this study, we describe and analyse an anomaly on one ultimate leg in Cryptops parisi Brolemann, 1920. This is the first formal record of schistomely within the family Cryptopidae, and the second one reported for terminal legs in Chilopoda.

Material and methods

From March to November 2012, for the purpose of developmental studies we collected 1212 specimens representing the genus Cryptops Leach, 1814 at Izbice near Novi Pazar in southwestern Serbia, Balkan Peninsula (N 43°07.333’, E 22°34.354’; elevation about 700 m a.s.l.; under stones and in leaf litter in a mixed beech forest). Altogether, three Cryptops species were identified: C. anomalans Newport, 1844, C. hortensis (Donovan, 1810), and C. parisi. The last-mentioned species was dominant in the sample with a total of 956 specimens. One adult female of C. parisi (collected on August 18th, 2012) showed an unusual structure of the left ultimate leg.

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This female is presently stored in a plastic tube, preserved in 70% ethanol, and deposited as specimen CP372 in one of the collections of the Institute of Zoology, University of Belgrade – Faculty of Biology, Serbia. For species identification, recording the meristic and morphometric parameters, and taking the pictures, we used a Carl Zeiss Stemi 2000-C stereo microscope with a mounted digital camera and an integrated Axio V540 system in conjunction with the Carl Zeiss 4.8.2.0 software package. Species determination followed the diagnostic characters reported by Lewis [2011]. Determination of the sex was based on the external morphological characters of the postpedal segments described by Pichler [1987]. All terms used in the description are harmonized with the terminology proposed by Bonato et al. [2010]. For the purpose of a comparison with the previously published records indicating the same type of abnormality, we used the currently accepted species names listed in the ChiloBase electronic database [Bonato et al., 2016] and in the study of Bonato & Minelli [2014].

**Results**

The unusual feature of the *C. parisi* female in question was not spotted directly in the field during the collection. That individual was captured from leaf litter, showed a behaviour normal for the given species, and lacked any indication of differences from other specimens collected at the same locality. A closer look under a stereo microscope revealed a four-segmented stump elongated from the base of the left terminal leg (Figs a–e). The specimen, except for the abnormal structure, was determined as an adult female with characteristics quite usual for the species.

The best way to picture this abnormal structure is to describe it as a miniature third terminal leg with a reduced number of segments. The bifurcation starts from the basal segment (coxa), which is held in common by regular legs and this irregular leg. The first unshared segment is the trochanter (Figs c–d). The following segment is the largest one, being expanded in the proximal part and narrowed distally. This article looks like the prefemur of a regular terminal leg, but is notably smaller in size and it displays a conspicuous setation with a striking colouration. The two remaining apical segments are white and poorly chitinized (Figs a–c). Those features probably indicate that the differentiation of this part is still not completed. The setation is sparse, with only 2–3 setae scattered along this part of the structure.
If we exclude a slightly altered pattern of setation at the base of the prefemur of the left terminal leg, there are no visible differences between the terminal legs in this female (Figs a–b, e). Measuring the approximate size shows a slightly longer left terminal leg (4.56 mm) compared to the right one (4.51 mm), but with a somewhat narrower base of the prefemur in the left one (0.4 mm) than in the right one (0.46 mm). The length of the irregular structure is 0.73 mm, and its width in the widest part is 0.19 mm. The overall length of the specimen amounts to 19.66 mm.

Discussion

From the oldest to recent records, there are only 23 schistomelic specimens of Chilopoda described in the literature (see Table). Eighteen of them are from the order Geophilomorpha (eight different species from a total of four families, namely, Dignathodontidae, Himantariidae, Linotaeniidae, and Schendylidae) [Léger, Duboscq, 1903; Duffaut, 1908; Minelli, Pasqual, 1986; Leśniewska, 2004, 2012; Iorio, 2005]; four specimens are from the order Scolopendromorpha (three species, all from the family Scolopendridae) [La Greca, 1955; Lewis, 1968; Vega-Román, Hugo-Ruiz, 2015]; and only one is from the order Lithobiomorpha (family Lithobiidae) [Demange, 1959]. No schistomelic abnormalities have been recorded in the orders Scutigeromorpha and Craterostigmomorpha. Schistomely in centipedes is usually present as a bifurcation of some trunk leg (in 19 cases). Significantly rarer are similar abnormalities of antennae, maxillipeds, gonopods or terminal legs (only one case per structure).

The above schistomely reported in C. parisi from Serbia represents only the second case of such an irregular structure of the terminal legs in centipedes. The previous case was reported by Lewis [1968] for one female from the Nigerian population of Scolopendra morsitans Linnaeus, 1758 (cited as S. amazonica Bücherl, 1946). That specimen had both regenerative ultimate legs, with bifurcation only on the left one. Apart from the fact that in both specimens the abnormal phenotype is expressed in females and on the left terminal legs, there are no other similarities between these two cases. In the Nigerian S. morsitans specimen, bifurcation occurred from a deformed femur. Starting from this segment, a central branch is extended into two articles and has a rounded apex; developed laterally there is a narrower appendix with a full number of segments. In the C. parisi specimen, the first bifurcated article is the trochanter. It is quite clear in both cases that the bifid terminal legs are obvious signs of a regenerative process, e.g., the result or repercussion of some disorder in regenerative mechanisms.

The origin of the bifurcation in the C. parisi specimen is somewhat harder to explain than in the previous case. There is no visible sign that this specimen had been damaged and regenerated. Both terminal legs have similar dimensions (Fig. a) and only a slightly de-
Table. Published records of centipede schistomely.
Таблица. Опубликованные случаи схистомелии у губоногих.

<table>
<thead>
<tr>
<th>Order /Family</th>
<th>Species name</th>
<th>Body structure with expressed anomaly</th>
<th>No. of specimens with abnormal phenotypes</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithobiomorpha</td>
<td><strong>Lithobiidae</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Lithobius borealis</em> Meinert, 1868</td>
<td>gonopods</td>
<td>1</td>
<td>Demange, 1959</td>
</tr>
<tr>
<td>Scolopendromorpha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scolopendridae</td>
<td><em>Akymnopellis chilensis</em> (Gervais, 1847)</td>
<td>trunk leg</td>
<td>2</td>
<td>Vega-Román, Hugo-Ruiz, 2015</td>
</tr>
<tr>
<td></td>
<td><em>Scolopendra morsitans</em> Linnaeus, 1758</td>
<td>terminal leg</td>
<td>1</td>
<td>Lewis, 1968 (as <em>S. amazonica</em> (Bücherl, 1946))</td>
</tr>
<tr>
<td></td>
<td><em>Scolopendra sp.</em></td>
<td>forcipule</td>
<td>1</td>
<td>La Greca, 1955</td>
</tr>
<tr>
<td>Geophilomorpha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dignathodontidae</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Henia bicarinata</em> (Meinert, 1870)</td>
<td>trunk leg</td>
<td>1</td>
<td>Minelli, Pasqual, 1986</td>
</tr>
<tr>
<td></td>
<td><em>Henia illyrica</em> (Meinert, 1870)</td>
<td>trunk leg</td>
<td>1</td>
<td>Minelli, Pasqual, 1986</td>
</tr>
<tr>
<td></td>
<td><em>Henia vesuviana</em> (Newport, 1845)</td>
<td>trunk leg</td>
<td>1</td>
<td>Duffaut, 1908 (as <em>Chaetechelyne v.</em> Newport, 1845)</td>
</tr>
<tr>
<td>Himantariiidae</td>
<td><em>Haplophilus subterraneus</em> (Shaw, 1794)</td>
<td>antenna</td>
<td>1</td>
<td>Leśniewska, 2004 (as <em>Sigmatacystogaster s.</em> (Shaw, 1794))</td>
</tr>
<tr>
<td></td>
<td><em>Haplophilus subterraneus</em> (Shaw, 1794)</td>
<td>trunk legs</td>
<td>10</td>
<td>Leśniewska, 2012</td>
</tr>
<tr>
<td>Linotaeniidae</td>
<td><em>Himantarium gabrielis</em> (Linnaeus, 1767)</td>
<td>trunk leg</td>
<td>1</td>
<td>Minelli, Pasqual, 1986</td>
</tr>
<tr>
<td>Schendylidae</td>
<td><em>Schendyla nemorensis</em> (C.L. Koch, 1837)</td>
<td>trunk leg</td>
<td>1</td>
<td>Iorio, 2005</td>
</tr>
<tr>
<td></td>
<td><em>Schendyla vizzavone</em> Léger et Duboscq, 1903</td>
<td>trunk leg</td>
<td>1</td>
<td>Léger, Duboscq, 1903</td>
</tr>
</tbody>
</table>

Germany: 51.2% (n = 41) for the population from Koblenz, Germany; 40.6% (n = 32) for the population from Quimper, France; 37.1% (n = 35) for the population from near Seilhac, France; 25.5% (n = 809) for the population from Poznań, Poland; etc. A high frequency of abnormal specimens (50%) was also reported for the species *H. souletinus* (Brölemann, 1907), but using only a small number of examined individuals (14) [Leśniewska, Barber, 2014].

In comparison with such high percentages of abnormality for those populations, our case is one with an extremely low frequency. We here report only a single anomalous individual from among 956 specimens examined, i.e., some 0.105%. Other types of morphological anomalies from this population were not considered, and that is a pivotal reason for such a low frequency. Our opinion is that the described anomaly does not affect the fitness of specimens, since its dorsal position relative to the postpedal segments provides enough space for contact of the genital segment with the spermatophore (indirect sperm transfer). Also, to judge from the condition of setation, it seems that this structure remained after the last moulting. Notwithstanding the assertion of Leśniewska [2012] that naturally occurring morphological anomalies in centipedes are common events, it is clear that some types of anomaly are quite rare. The case reported here on *C. parisi* is such an infrequent type of anomaly.

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**References**


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