Scientists conduct mathematical analysis of a rare cavernicolous crustacean

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A scientific collaboration of researchers from the Lomonosov Moscow State University and the Smithsonian Institution has discovered previously unknown regularities of arthropod limbs based on studies of the remipede Speleonectes tulumensis, a rare crustacean found in saline waters of caves. The results of the research have been published in *PeerJ*, an open-access interdisciplinary journal.

Vyacheslav Ivanenko, the leading researcher in the Department of Invertebrate Zoology at Lomonosov Moscow State University, said, "Our results are significant for studies of diversity and evolution of recent and fossil arthropods, particularly with regard to studies of the fundamental mechanisms of animal evolution. Furthermore, the research turns out to be an interesting example of cooperation between mathematicians and specialists in comparative developmental morphology."

The class Remipedia was discovered in 1981 inhabiting marine caves of the Caribbean Sea. Remipedes are an unusual group of crustaceans, and have been subsequently found in marine caves of Australia, as well as lava tubes of the Azores islands. Ivanenko says, "In Russia, as well as in other countries, there are many caves whose troglobionts, especially microscopic ones, are surprisingly poorly studied for their biology and diversity."

Remipedes have some unusual structural peculiarities, which resulted in their initial placement at the base of the evolutionary tree of crustaceans. However, many carcinologists now consider them more closely related to

insects. One such structural peculiarity is an elongate body whose trunk consists of a large number of body segments—sometimes more than 40. Most of these body segments have a similar pair of appendages equipped with a large number of setae. The appendages are used for swimming. Before this study, there were no detailed studies of these appendages or their evolutionary peculiarities.

Ivanenko and his colleagues conducted an analysis of appendage structure, including the number of segmental elements that make up each appendage and the number of setae on each segmental element. The authors then conducted a vector analysis of the numbers of setae on different appendages of the same animal and discovered that these numbers could be predicted using a mathematical formula which the authors derived.

Furthermore, the authors discovered that the predicted power of the mathematical formula worked for different developmental stages of the remipede. Ivanenko said, "We have found the following regularities in Remipedes structure: The peculiarities of the setation of the appendages has been defined and a minimum set of attributes necessary for effective remipede classification has been elaborated." Furthermore, the authors were surprised to find that changes in setation of remipede limbs are similar to those found on a copepod. The authors believe their analysis will be applicable to other crustaceans including branchiopods, cephalocaridans, leptostracans and decapods.

More information: Viacheslav N. Ivanenko et al, Changes in segmentation and setation along the anterior/posterior axis of the homonomous trunk limbs of a remipede (Crustacea, Arthropoda), *PeerJ* (2016). DOI: 10.7717/peerj.2305

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