Should we indulge prawns more on organismal and environmental research?

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Abstract

The importance of prawns in organismal research is an issue of concern due to their multifaceted and unique biological characteristics. This majorly includes their tolerance to critical environmental situations, sensitivity, exceptional body morphometrics, ecogeographic occurrence and diversity. All of these make prawns a highly adaptable and evolutionary successful organism. While studying the biology of a freshwater prawn species, *Macrobrachium lamarrei*, we have encountered the fact that prawns being evolutionarily successful, manifest tolerance and adaptability in changing environmental conditions. Where global climate change is an issue of concern for researchers, phenotypic expositions in animals for combating the evolution of the planet is also a brainstorming matter for evolutionary biologists. Our model organism manifested tolerance to critical eco-contamination and on the other hand, exhibited sensitivity, behavioural plasticity and profound ecogeographic occurrence. Ecogeographical aspects of this species in terms of ecotoxicological issue are correlated in respect to the adaptational success. We have used *Macrobrachium lamarrei* as a model prawn species to highlight the prawn group to get more attention in organismal and environmental research. Through this article, we want to raise this question of why we are not re-scrutinizing the biological complexities of prawns in terms of behavioural manifestations.

Introduction

Prawns are exceptionally 'interesting' organisms among invertebrates due to their diversity and adaptive strategies. While studying the biology of a freshwater prawn species, *Macrobrachium lamarrei*, we have encountered the fact that prawns being evolutionarily successful, manifest tolerance and adaptability in changing environmental conditions. Where global climate change is an issue of concern for researchers, phenotypic exhibitions in combating the evolution of the planet by organisms is also a brainstorming matter for evolutionary biologists.

The aim of the article is to explicate briefly the understudied biological intricacies of prawns, considering *Macrobrachium lamarrei* as an effective model organism. The evolutionary potency of this organism is reflected in several aspects of its biology. Reliant on the highlights of the biological traits, we have distinguished *Macrobrachium lamarrei* in five different facets: morphology, behaviour, tolerance, sensitivity and occurrence. Cumulatively these aspects are interconnected in making this species successfully 'common' in the freshwaters of Indian subcontinent. The prawn is also an example of successful camouflage strategy by using their semi-transparent appearance in respective light intensity under the water (Bose et al., 2021).

This broader aspect of this article is matter arising to elucidate the fact, that in today's era of organismal research, vertebrates has gained more importance than that of the invertebrates. However, the astonishing fact of biodiversity strongly indicates intricate adaptive peculiarities in several groups of animals, where we believe prawns are in the top list. It is a fact, that prawns are undoubtedly understudied. Through our model organism (*Macrobrachium lamarrei*), we want to highlight the multifaceted biological characteristics of prawns in respect to behavioural ecology and ecogeographic adaptation.

Morphological flexibility and behavioural ecology

The morphology of *Macrobrachium lamarrei* depicts the complexity of the geometrical manifestation, which we predict plays a critical role in the superfast swimming pattern. The locomotion of the prawn is divided into the combining actions of walking on the benthic zone, with the help of the thoracic appendages and swimming in the water with the help of abdominal pleopods. The cumulative effort of the swimming and the walking with fine adaptive modifications on the locomotory appendages, makes the prawn's locomotion unique in a

comparatively broad environment, in a greater premises. However, it has been postulated that the abdominal muscular flexibility and the body geometric morphometrics plays a very critical role in the extreme fast movement of the organism (Figure 1). We have named this abnormally fast movement as "catapulting movement". Fast movement is critically considered to be effective in the ecological context of prey-predation interaction. Superfast movement is a very operative defense mechanism for *Macrobrachium lamarrei* and other prawns with this adaptive strategy.

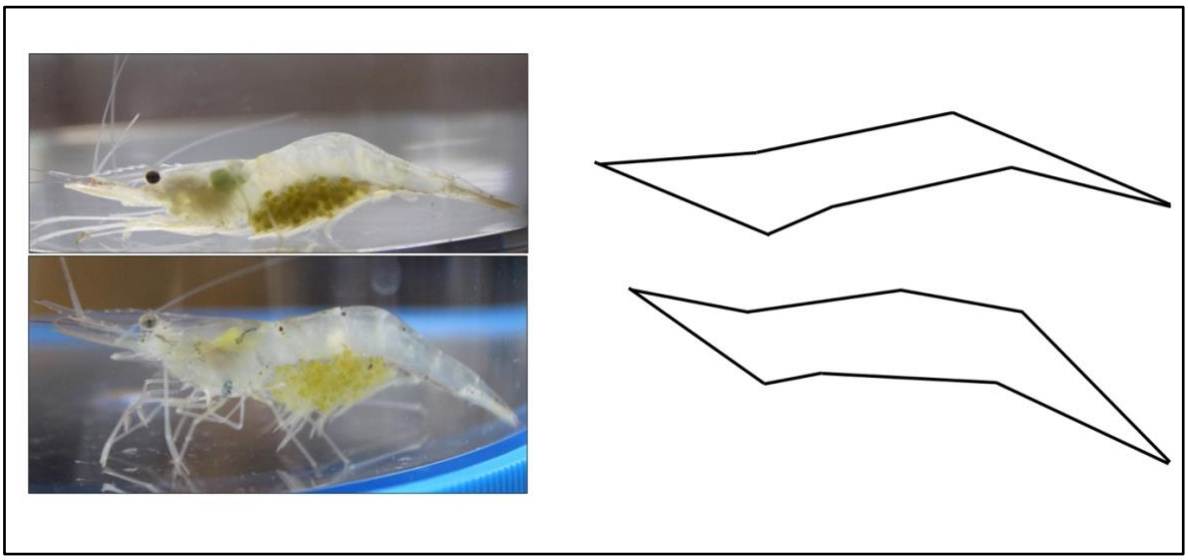

Figure 1: Demonstrates the morphological variation (in manage and approximate geometrical representation) in *Macrobrachium lamarrei* in resting phase.

We predict that the geometrical morphometric assessment of this prawn species in details, in respect to biomechanical approach of locomotion can be of interest for bioengineers (specifically mechanobiologists), which will create new insight in the natural bio-protocols of aquatic locomotion and can implement it in the making of new effective underwater models or devices useful for the human life.

Macrobrachium lamarrei exhibit robust behavioural patterns and show noticeable behavioural plasticity due to change in the environment or pollutant contamination in their ecosystem (Munshi and Bhattacharya, 2022; Munshi et al., 2021). The behavioural ecology of *Macrobrachium lamarrei* indicates it as a very promising and reliable model to study ecosystem alterations. In the broader field of organismal biology, the importance of this species or rather prawns as a group, is undoubtedly in a higher position due to its sensitivity manifestation along with the exposition of tolerance. Behavioural markers are important for

the evaluation of drug effectivity, neuronal activities and effectively climate change, environmental pollution in the biological system (biomonitoring and bioindication). In case of *Macrobrachium lamarrei* we have emphasized on the establishment of grooming (self-grooming) behaviour for the assessment of the above-mentioned bio-incidents. Conventionally, grooming is the act of cleaning the body surface. The pattern of grooming in *Macrobrachium lamarrei* is much complex one, which depicts the complex neurological circuit behind it. Grooming can be established as a behavioural index of neurological stress and repetitive grooming behaviour is a marker of autism spectrum disorders (Munshi et al., 2022; Munshi et al., 2021; Kalueff et al., 2016; Kalueff et al., 2007). A computer vision application was applied by Munshi *et al.*, 2021, to detect the grooming behavioural pattern in this prawn.

Tolerance in respect to environmental contamination

Environmental pollution or contamination is undoubtedly a biohazard for the animal kingdom. Heavy metal contamination tolerance in *Macrobrachium lamarrei* was tested through an investigation, where *M. lamarrei* was collected from naturally contaminated non-industrial rural area. Figure 2 demonstrates the concentration of arsenic (As), cadmium (Cd) and lead (Pb) is very low in the pond water and the water in the junction of pond ecosystem and the agricultural area. Here, junction area indicates the connected portion between the freshwater resources and harvesting land. Water could flow easily between these two ecosystems. Notable amount of these heavy metals are present in the sediment of both from the pond and junction area. In both the environments, the sediments the amount of cadmium is almost of same concentration, which is comparatively low in respect to arsenic and lead. However, the concentration of arsenic and lead is notably very high in the junction sediment than the pond sediment. The pond and the junction sediments are contaminated in terms of arsenic and lead pollution. Interestingly, the prawns also bioaccumulated those metals in their tissue. The detection of the metals were done by Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES).

Data strongly depicts that even the area was not infested with industrial effluents, but the aquatic systems got contaminated by the established hazardous heavy metals which basically a notable instance of the critical negatively impacted anthropogenic activities in the agricultural area. The agricultural runoffs eventually carried out the contamination in the freshwater

ecosystem. The deposition of metals in the sediment of the pond, is a chronic effect of the agricultural runoff mixing with the pond ecosystem.

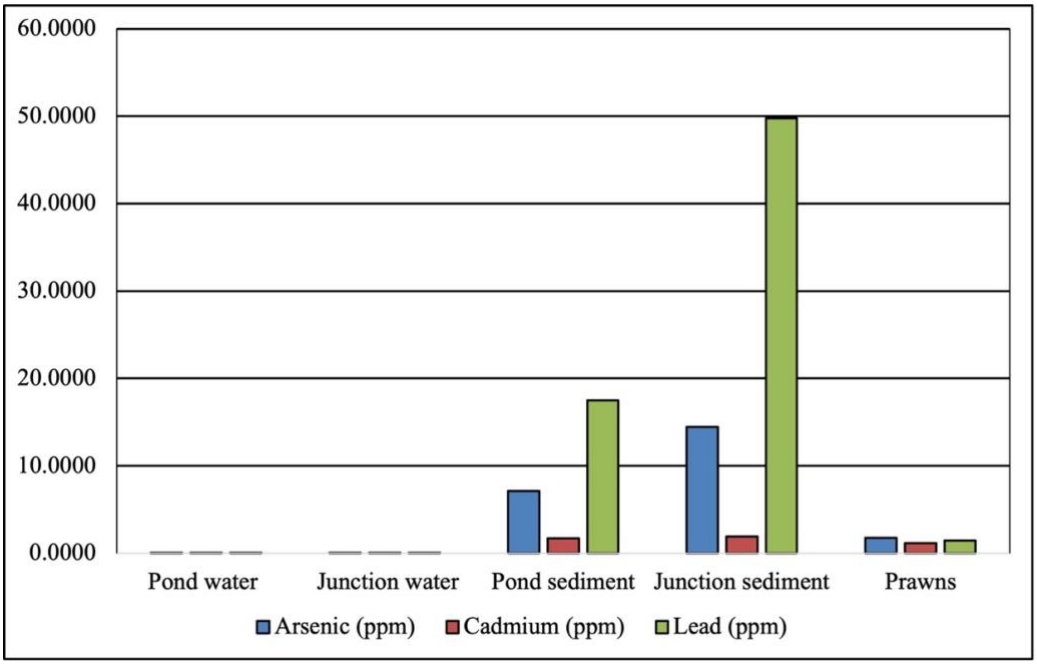

Figure 2: Demonstrating the level of contamination in the natural aquatic (freshwater) habitat of *Macrobrachium lamarrei*, and in prawns from that environment.

The significance of this work is a reliable example of the prawn's tolerance in respect to living in a highly spoiled environment. Climate change, environmental plasticity, pollution are primely considered by the researchers from diverse areas, due to its prominence and huge impact on today's world. Ecotoxicological tolerance is important for organisms due to survivability. Adaptation in the changing ecosystems directs organisms for evolutionary success.

The biological success of this species has resulted in its high occurrence. Ecogeographical aspects of this species in terms of ecotoxicological issue are correlated in respect to the adaptational success. The article is a question of why we are not re-scrutinizing the biological complexities of prawns. It is a fact that organisms manifest several phenotypic complexities which is part of their survival strategies. Prawns, despite of being an invertebrate but represent the most diverse group in the animal kingdom. Researchers working on aquatic biosystems should think of prawns as model aquatic organism and apply advanced technical methodologies and theories to work on them.

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