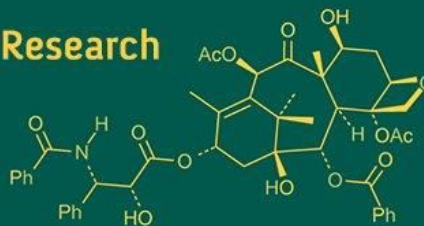
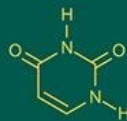


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Size composition and fecundity of *Sartoriana tribolata* (Alcock, 1909) in River Burhi Gandak of Bihar

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Abstract

The study provides insights into the population dynamics of the freshwater crab, *Sartoriana tribolata*, in the River Burhi Gandak of Bihar. It examines their temporal distribution and size frequency distribution, revealing an average weight of 22.28 ± 13.83 g and a mean carapace width of 37.23 ± 8.43 mm. Berried females were first observed in April, reaching their peak in May to June. These females carried macroecithal eggs with a distinct orange color, enveloped within two layers of membrane. Fecundity ranged from 350 to 910 eggs, with an average of 613 ± 113 eggs, and was significantly correlated with carapace width. Breeding molting among females predominantly occurred in March-April, with an average egg diameter of 2.1 mm.

Keywords: *Sartoriana tribolata*, River Burhi Gandak, fecundity, size composition, egg size

Introduction

Aquatic ecosystems play a significant role in supporting biodiversity and providing essential ecosystem services. Rivers are particularly dynamic habitats that host diverse communities of aquatic organisms, including numerous species of freshwater crustaceans (Prakash, 2021) ^[9]. Among these, the freshwater crab species *Sartoriana tribolata* (Alcock, 1909) holds significance due to its ecological role and potential influence on the health of riverine ecosystems (Machahary *et al.*, 2023) ^[6]. The River Burhi Gandak, located in the Indian state of Bihar, is of one such dynamic river system characterized by fluctuating water levels, sediment transport, and variable environmental conditions. Understanding the population dynamics of *S. tribolata* in this ecosystem is not only important for the conservation of this species but also for gaining insights into the overall health and functioning of the river. *Sartoriana tribolata*, is a freshwater crab species endemic to the Indian subcontinent (Chetia *et al.*, 2022) ^[4]. It is a key component of the riverine food web, serving as both predator and prey, and is known to contribute to nutrient cycling through its activities, including burrowing and feeding (Wehrtmann *et al.*, 2019) ^[11]. However, despite its ecological importance, there is limited scientific knowledge regarding the size composition and fecundity of this species in the River Burhi Gandak.

This research aims to fill this knowledge gap by investigating the size composition and fecundity of *S. tribolata* in the River Burhi Gandak. Size composition, defined by the distribution of individuals across various size classes within a population provides insights into the age structure, growth rates, and recruitment patterns of a species, this information is crucial for assessing the health and resilience of the population, while fecundity is a critical parameter for understanding the reproductive potential and population dynamics (Rahman *et al.*, 2020) ^[10]. By conducting a comprehensive study in this ecologically significant river system, we seek to shed light on the life history traits of *S. tribolata* and their potential implications for the river's ecological balance. In the face of escalating anthropogenic pressures and alterations to river ecosystems, such research is pivotal for conservation and management strategies. Furthermore, the findings of this study may contribute to the broader understanding of the ecology of freshwater crustaceans in dynamic riverine environments, serving as a foundation for future studies and conservation initiatives in similar ecosystems.

Materials and Methods

Study area

The study was conducted at three distinct sites along the River Burhi Gandak, where significant fisheries activities were observed. These sampling locations were as follows:

Muzaffarpur (26° 9' 9.2916" N, 85° 22' 37.2216" E), Dholi (26° 0' 10.6488" N, 85° 36' 23.5908" E), and Pusa (25° 59' 41.1" N, 85° 39' 41.3" E).

Specimen collection

Crab sampling occurred bi-weekly from August 15th, 2022, to July 30th, 2023. We primarily used manual collection, occasionally supplemented by gill nets and drag nets as bycatch. We obtained freshwater crabs from various burrows, including muddy and clayey ones, using the water-filling method. Immediately after collection the samples were passed through series of preservation steps and finally preserved in 10% formalin.

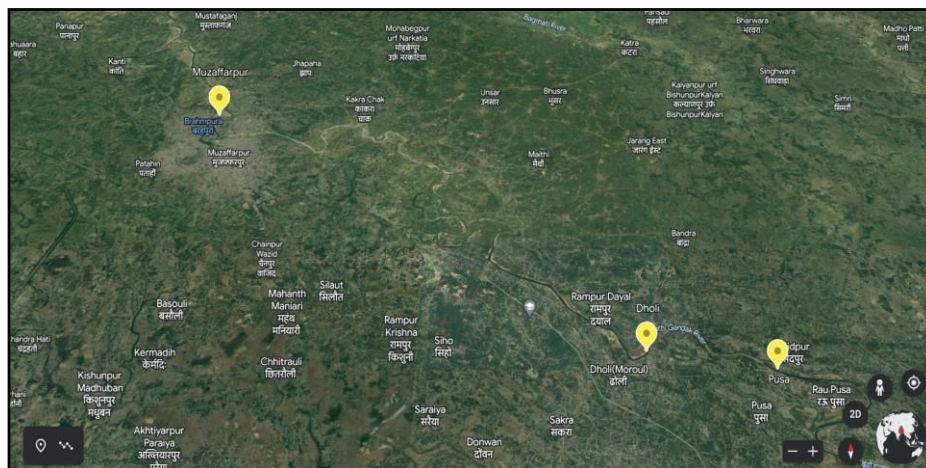


Fig 1: Map showing different sampling sites on River Burhi Gandak (Source: Google Earth)

Identification and morphometric characterization

The India Biodiversity Portal and relevant research papers has been used for the identification of crabs, due to the lack of a dedicated database. Samples were categorized by sex based on distinguishing features. Measurements included weight (digital weighing machine, 0.01g) and various lengths (sliding vernier caliper, 0.01mm). After gathering data length-weight relationship was evaluated using Le-Crane power equation as given below

$$W = aL^b$$

Fecundity assessment

Fecundity (total number of eggs per brood) was evaluated by gentle separation of egg from abdominal flap using the spatula and forceps. Then the egg diameter measurement and egg counting were done under microscope.

Result and Discussion

During the study period, a total of 279 samples of *Sartoriana tribolata* were meticulously collected from various sampling sites, resulting in a sex ratio of 1.0:1.2 for males and females. The crabs displayed notable abundance during the monsoon season, particularly within the carapace width range of 36-41 mm, as visually depicted in Figure 2. These crabs exhibited a maximum weight of 72 g, with an average weight of 22.28 ± 13.83 g, alongside a mean carapace width of 37.23 ± 8.43 mm. Notably, both male and female crabs exhibited negative allometric growth in relation to their carapace width and total weight, as evidenced by the 'b' values of 2.89 for males and 2.79 for females, as illustrated in Figure 3. This finding aligns with Mahapatra *et al.* (2017) [7] research, which reported a similar negative allometric growth pattern in *Sartoriana spinigera* from an East Kolkata wetland with a 'b' value of 2.46. Among these collected samples, 89 berried females were identified, exhibiting carapace width ranging from 35.8 to

58 mm. The presence of berried females commenced in April, peaking during May and June. These females carried macrolecithal eggs, distinguished by their vibrant orange color and encapsulated within two layers of membrane, comprising a thicker outer layer and a thinner inner layer, effectively safeguarding the large embryonic yolk sac, outer layer also perform attachment to maternal pleopods. This attachment manner and the vivid orange color of the eggs align with Abit *et al.* (2020) [1] findings in the giant freshwater crab species *Isolapotamon bauense*.

Fecundity in *S. tribolata* exhibited a range of 350-910 eggs, with an average fecundity of 613 ± 113 eggs, associated with a mean carapace width of 47.6 ± 11.5 mm. Freshwater crab have much lower fecundity as compare to marine crabs i.e., 277,886±136,270 for *Callinectes similis* (Chazaro-Olvera, 2000) [3] This fecundity demonstrated a significant ($p < 0.001$) correlation with carapace width, as depicted in Figure 7. Notably, Ali and Al-Maliky (2017) [2] confirmed a positive correlation between fecundity and carapace width in the freshwater crab *Potamon mesopotamicum*, reporting an average fecundity of 568 eggs per female. Another study on intertidal crab *Petroliastes japonicus* by Hamasaki *et al.* (2021) [5] also reflects the significant correlation for the same. In contrast, Olusoji *et al.* (2010) [8] found no discernible correlation between fecundity and carapace width in the freshwater crab *Sudanonautes africanus*.

Observations of reproductive molting in females were concentrated in the months of March and April, with an average carapace width of 43.5 mm, as illustrated in Figure 4. Further analysis of egg diameter, based on 100 samples, revealed a range from 1.66 to 2.25 mm (Fig. 6), with an average diameter of 2.1 mm. Interestingly, Ali and Al-Maliky (2017) [2] also noted a comparable egg diameter of 2.066 ± 0.105 mm in *Potamon mesopotamicum*. In contrast, Olusoji *et al.* (2010) [8] reported fecundity in the freshwater crab *Sudanonautes africanus*, ranging from 120-449 eggs, with an average egg size of $1.66 \text{ mm} \pm 0.068 \text{ mm}$.

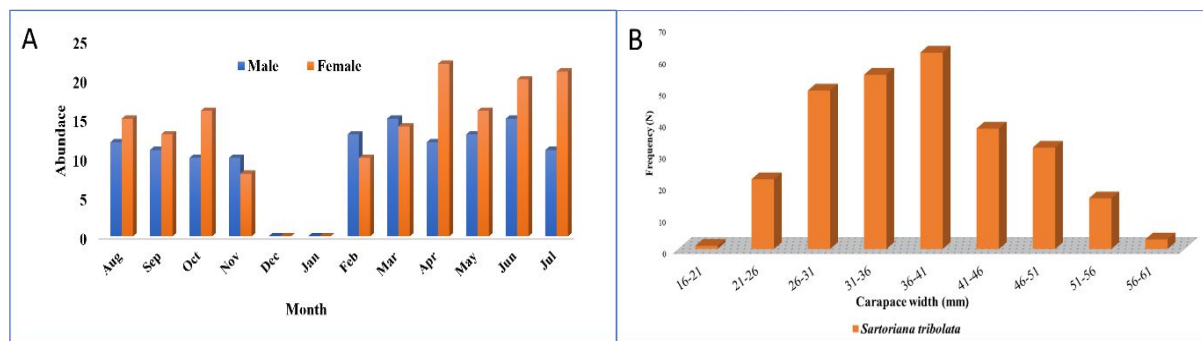


Fig 2: Distribution of *Sartoriana tribolata*, A-Temporal distribution, B-Size frequency distribution

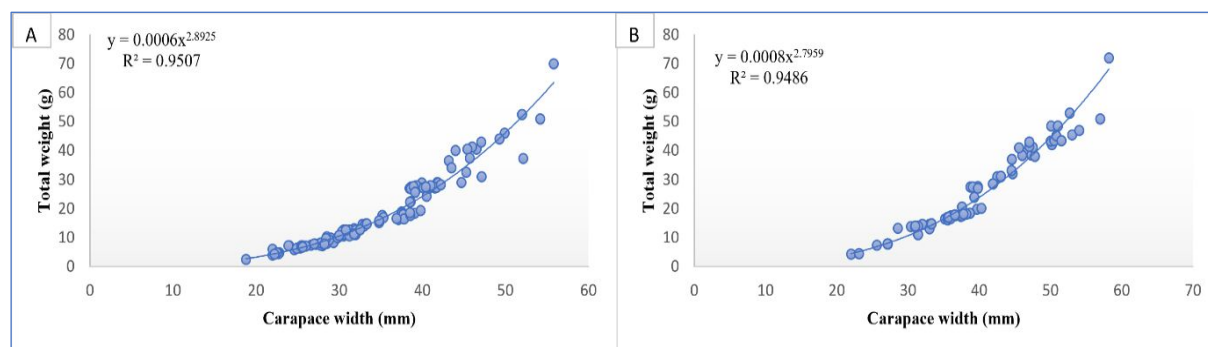


Fig 3: Length-weight relationship of *S. tribolata*, A-for male crabs, B-for female crabs



Fig 4: Molting in female crab, A-Pre-molting stage, B-Molting female during breeding season



Fig 5: Assessment of fecundity of *S. tribolata*, A-Berried female, B-separating egg from crab, C-egg counting.

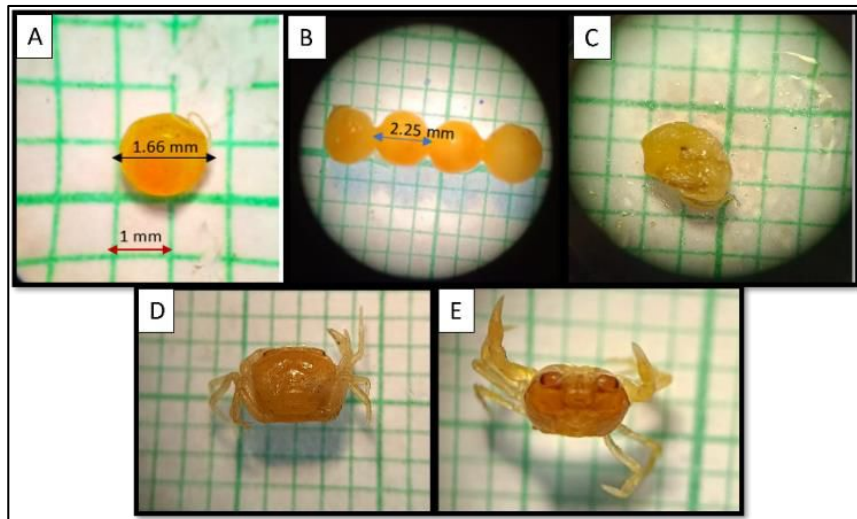


Fig 6: Egg developing stage of *S. tribolata*, A-First embryonic instar, B-Second embryonic instar, C-Eyed stage, D-Hatchlet, E-Advance stage of crablet (moving)

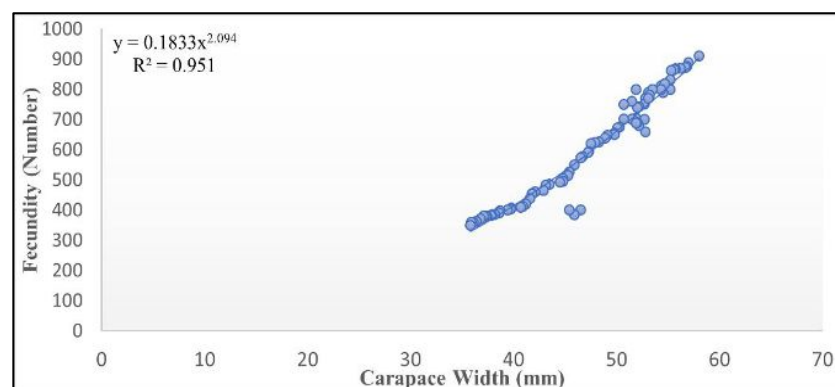


Fig 7: Relationship between fecundity and carapace width

Conclusion

In conclusion, this study highlights key aspects of *Sartoriana tribolata* in the River Burhi Gandak, underscoring its ecological significance. The results expand our knowledge of the species and emphasize how crucial it is for safeguarding riverine environments in the face of growing human intervention. Insights into the reproductive biology of berried females, egg characteristics, and the correlation between fecundity and carapace width are crucial for conservation efforts and maintaining river health. Furthermore, this research advances our knowledge of freshwater crustacean ecology in dynamic riverine ecosystems, laying a foundation for future conservation and ecological studies

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