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Insights into the Habitat Choice for the Culture of *Himalayapotamon emphysetum* under Laboratory Conditions

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The main aim of the present study was to scrutinize the substrate and microhabitat preferred by the Himalayapotamon emphysetum under laboratory conditions. In the first experiment, different substrates: gravel, stones, and cobbles were placed in the round plastic containers, and in the second experiment: grass, aquatic plants, and wood fragments were used as microhabitats for analyzing the preference of the crab species. Minimum mortality was observed when the crabs were provided with the substrate of stones and wood fragments as the microhabitat. The results of the present study provide a better understanding of the breeding and culture of commercially important crab species of Jammu and Kashmir Union Territory and can be used as a reference for determining the culture conditions for Himalaypotamon emphysetum that will boost the economy of this region. The studies related to the preference of habitat and substrate of any species is essential for aquaculture and breeding programs.

Keywords: Decapods; Freshwater Crabs; Himalayapotamon emphysetum; Microhabitat; Substrate.

Decapod crustaceans, generally categorized into lobsters, shrimps and crabs are paramount faunal components that are widely distributed in a variety of habitats such as coral reefs, mangroves, estuaries, marine water, freshwater streams, lakes, rivers, seafloor vents, open ocean, ponds, ditches, semi-terrestrial habitats and even in relation with other organisms[1]. Diversification among decapods occurred over a period of 455 million years, being recognized by over 3000 fossil species and 15,000 living species distributed among 233 families approximately[2,3]. Freshwater crabs complete their entire life cycle in a freshwater ecosystem and do not require marine or brackish ecosystems. They are of great ecological significance and constitute a substantial amount of biomass in the river systems. Within the Brachyura, there is an enormous conglomeration of freshwater crabs and this infra-order is species rich among all the decapods. The diversity of freshwater crabs encompasses approximately 127 species[4] across the country.

With the increase in human population, the demand for food rich in essential nutrients is rising especially in developing nations. This increasing demand has necessitated the investigation of underutilized natural food resources such as fin and shell fishes. Studies done by Manhas et al. have revealed that shellfishes found in J&K UT are rich sources of proteins and minerals, and thus have tremendous potential in the field of aquaculture[5]. However, only two species

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of freshwater crabs *viz., Maydelliathelphusa masoniana* and *Himalayapotamon emphysetum* are on record from the plain and hilly regions of Jammu and Kashmir Union Territory[6]. The culture of these freshwater crab species will palpably increase the economy of this UT and will act as an important means of subsistence for the fishermen's community.

The choice of the behavior is closely linked to the ease of hiding place because excavation is effortless where the substrate is made up of small grain sizes[7]. To set up an experiment regarding the habitat choice of any species in the laboratory, it is important to examine its behavior in the natural waters that include their substrate and microhabitat such as coarse sand, gravel, pebbles, fine sand, silt, rocks, leaves, wet grass, moss, and aquatic macrophytes. In the present study, an experiment was conducted to investigate the habitat choice of adult females and males of *Himalayapotamon emphysetum* under laboratory conditions, using different microhabitats and substrates as the recognition of a suitable substrate is crucial to improve the probability of the survival of any species and to assure the success of recruitment of animal population[8]. Various aspects related to the culture of marine crab species have been addressed in detail by various workers[9,10]; however, the insights into freshwater crab culture have been rarely discussed.

MATERIAL AND METHODS

Crab collection was done from the shallow areas of the three different river streams *viz.,* Baba Dhansar, Jhajjar, and Kooh, the tributaries of river Chenab. Crabs were found below the stones, boulders, gravel, and sand. Sometimes, during the heavy flow of water in the streams cast net with 5mmx5mm mesh size was also used for crab collection. The crabs were transported immediately to the laboratory in plastic containers filled with the water of the stream for further experimentation. In the laboratory, acclimatization of the crab specimen was done in dechlorinated water kept in troughs which were prepared by adding sodium thiosulphate to the filtered water. This water was then replaced by filtered water, to which the stream water was also added to maintain the conditions of the natural environment to some extent, to avoid shock due to temperature change and other physical and chemical stress. For constant oxygenation, plastic troughs were equipped with aerators. Different types of substrates and microhabitats were provided to offer shelter to the crab specimen. Live and compound feed was given once a day, especially during early hours, and on every alternate day, the troughs were cleaned properly.

The experiment for the selection of substrate was done first, followed by the experiment for the selection of microhabitat. The experiment was carried out in three different round tubs (62cm in diameter and 31 cm in height), filled with filtered and stream water. All the experiments were carried out at room temperature under natural light conditions. The sides of the rounded tubs were opaque to prevent interference from an external environment. The bottom of Tub-1 was filled with gravel that was 0.3-3 cm in diameter. Similarly, the bottom of tub-2 and tub-3 were filled with stones (20x13x3cm) and cobbles (10-12 cm in diameter) respectively. The substrates were arranged randomly in each container. The first experiment with each substrate was carried out for

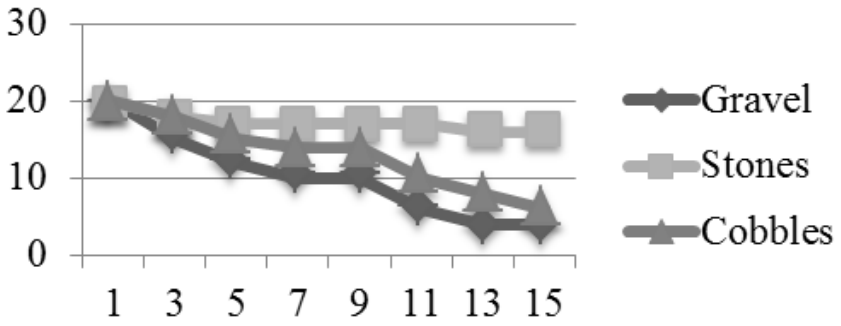
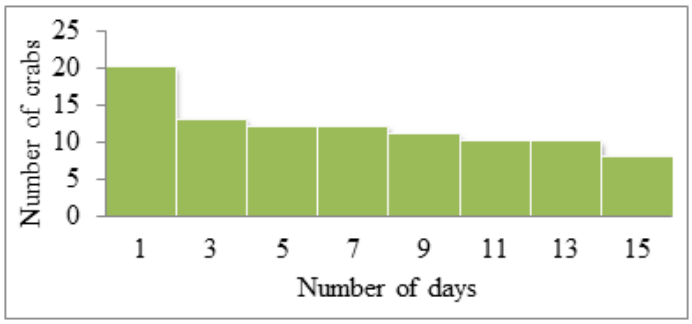


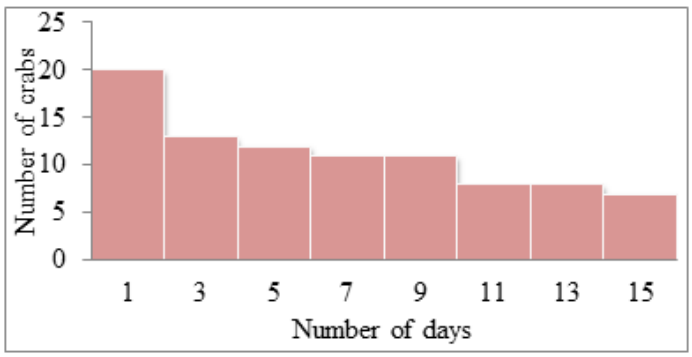
Fig. 1. Substrate choice among adult crabs of *Himalayapotamon emphysetum*

fifteen consecutive days and the mortality rate of the crabs was recorded.

In the second experiment, the three options selected for the microhabitat were: grass, aquatic plants, and wood fragments. These microhabitats were placed in round plastic containers containing the substrate that was preferred by crabs in the first experiment. About twenty crab specimens were placed in the tubs. Data from the laboratory experiment was analyzed to infer the choice of the substrate and microhabitat preferred by the crab.



(a)



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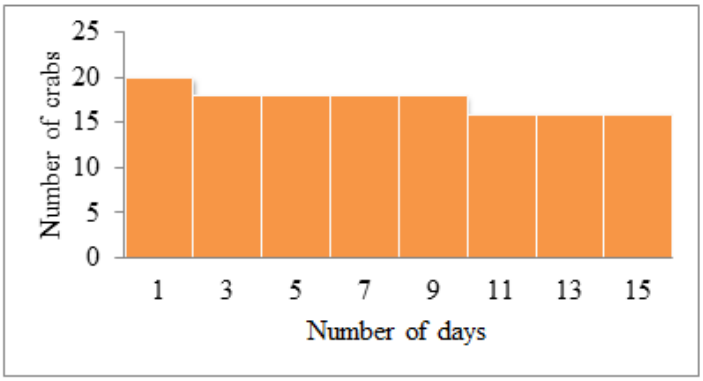

(c)

Fig. 2. Microhabitat choice among adult crabs of *Himalayapotamon emphysetum* (a) stones and grass (b) stones and aquatic plants (c) stones and wood fragments

RESULTS AND DISCUSSION

Continuous monitoring of the experimental setup revealed that out of gravel, stones, and cobbles used in the first experiment, the crab species preferred the substrate consisting of stones. Both male and female individuals prefer to live under the stones. At the time of feeding, they were found to lie at the surface of these stones. In the second experiment, the only substrate used was stones. The same kind of microhabitat was preferred to a significant extent by both the male and female crab species. Both the sexes of crabs selected wood fragments as their microhabitat.

It is essential to consider the substrate and microhabitat among the culture conditions to ameliorate the chances of survival of crab species under laboratory conditions. Crabs attack, kill and eat their species and so the phenomenon of cannibalism is very common among the crabs as reported[11]. Besides this, aggression and cannibalism reduce the survival rate of *Scylla sps*[12]. However, with the type of substrate and microhabitat preferred by the crab species in the present studies, minimal cannibalism was observed in the trough provided with stones and wood fragments as a large number of crabs were recovered at the end of the experiment.

Experiments conducted in the laboratory revealed that *Himalayapotamon emphysetum* prefers to live under the stones. This substrate was preferred by all the adult individuals of this crab species (Fig. 1). Mitra and Valarmathi[13] observed a similar choice of habitat in *Himalayapotamon chambaensis*, collected from the different localities of Chamba district, Himachal Pradesh. They found that this crab species prefers to live beneath the rocks and boulders in the stream. In a study on the habitat preference of *Cryotograspus angulatus*, it has been observed that this species preferred muddy, sandy, beaches and even lives under the stones[14]. According to their study, the crabs survive better under the stones as they protect the growing individuals. This study is in line with our findings that *Himalaypotamon emphysetum* live under the stones most of the time and rise to the surface generally at the time of feeding. The literature surveyed revealed that the *Hemigraspus sanguineus, Gaetice depressus, Acmaeopleura parvula, Cyclograspus insularum,* and *C. lavauxi* all belonging to the family-Varunidae live under the stones or boulders during low tides[15,16,17]. According to them, these crab species use stones as a type of refuge during low tides.

The results of Schuwerack et al.,[18] depicted that *Macrophthalmus definitus* and *M. convexus* prefer to live under the sea grass and algal mats. Our results for the choice of microhabitat revealed that both males and females of *H. emphysetum* chose fragments of wood as their microhabitat (Fig. 2). Post-settlement juvenile forms of *Menippe mercenaria*, are found to inhabit habitats that are complex in structure to avoid predation[19]. A similar observation was made in the present study in which the crabs were found beneath the stones in the experimental troughs. The highest mortality among the crab, *Paralithodes camtschaticus*, kept in the tank provided with sand as a substrate has been observed[20]. The culture prospects of different crab species in West Bengal have been presented[21] and it has been reported that the adult individuals of *Scylla serrata* and *Scylla tranquebarica* generally remain hidden under the logs of wood. Similar microhabitat *i.e.,* wood fragments were chosen by the species selected for the present study.

CONCLUSION

Characterization of the habitat occupied by any crab species provides significant information regarding its successful culture and management. The results of this study revealed that crabs prefer structurally complex substrates for their survival in laboratory conditions as seen in their natural habitat. Knowledge regarding the selection of microhabitat and substrate preference is crucial before taking into consideration the stock enhancement and breeding practice of any crab species. It is expected that the present paper will provide a standard protocol to the researchers for carrying out the future research on the culture of *Himalayapotamon emphysetum* which can be further helpful to the farming community.

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Conflict of Interest

The authors declare no conflict of interest.

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