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Sharda Padghane
Aquatic Parasitology and Fisheries Research Laboratory, Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, India

Shivaji Chavan
Aquatic Parasitology and Fisheries Research Laboratory, Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, India

Correspondence
Sharda Padghane
Aquatic Parasitology and Fisheries Research Laboratory, Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, India

Habitat preference and maintenance of freshwater crab *Barytelphusa cunicularis* in concrete tank culture model

Sharda Padghane and Shivaji Chavan

Abstract
This study was conducted in Nanded, Marathwada region, during year 2015-17, to know the habitat preference of freshwater crab *Barytelphusa cunicularis* in captivity in constructed tank model 10X8X5 (L,W,H, Ft.). Habitat preference of the crab was investigated when provided three different trials by maintaining water level, water quality, food, shelter. Highest percent of crabs were preferred Muddy + Stony habitat, where they prepared burrows also high survival rate. The result of the study indicate that, *Barytelphusa cunicularis* mostly prefers open compartment habitat. Similarly the setup of habitat containing Mud + Stony habitat was most preferred in constructed tank as compared to bamboo cages and close compartments. Open compartment habitat was successful trials for maintenance and it serve for burrow preparation as well as hiding place for protection from predators, to avoid mortality rates, to minimize intra-specific struggle in *Barytelphusa cunicularis* and suggested as best system to encourage low cost, eco-friendly backyard crab culture and maintenance.

Keywords: Freshwater crab *B. cunicularis*, culture model, habitat preference

1. Introduction
Crabs are one of the fast growing animals from phylum Arthropoda. True crabs are placed under suborder Brachyura of order Decapoda of class Crustacea and they demonstrate the best scope for their captive culture as compare to all arthropods. Brachyuran crabs achieve their most noteworthy assorted qualities in tropical aquaculture. Crabs rise up out of their safe house tunnel like burrows during night time in search of food. They are basically omnivorous; many can catch live prey. Crab species inhabits a wide variety of habitats like mud flats, under stones, in the gravel, and sand in the crevices of rocks and constructed burrows etc.. Freshwater crabs are found in all important habitat types, including floodplains, swamps, lakes, damp backwoods streams, etc. [1]. Decapods crustaceans have complex life histories and behavioural aspects, such as foraging, mating, reproduction, moulting, growth, habitat selection and migration [2]. Crabs play an important roles in the food web of aquatic and terrestrial ecosystem and may serve as indicators of ecological health, particularly in small estuaries where conditions may be strongly correlated to watershed and local factors [3].

Here, we studied the behavioural aspects on hypothesis whether its habitat selection is based on either food or shelter or hiding places. In initial step the habitat preference of *Barytelphusa cunicularis* was examined to determine whether their habitat choice was based on food by simultaneously controlling food availability in the habitats. Finally, size and sex of this species may affect its habitat choice was also observed, hence these factors were controlled during experimentation. The main idea was to investigate one of the important part like habitat selection in captivity by this species. This will be useful to initiate the culture of *B. cunicularis* in constructed pond / tank as backyard cottage industry for poor fisher families.

2. Materials and Methods
2.1 Tank Construction
A typical concrete tank was constructed using locally made ceramic roasted bricks and cement plastered side walls to prevent water leakage and floor bed of thick concrete of cement for the maintenance and culture of freshwater crab *Barytelphusa cunicularis*. The tank was preferably rectangular in shape with dimensions 10x8x5 Ft. (length x width x height). In one corner of tank, steps were constructed to facilitate maintenance activities in the tank (fig.1). Initially, it was open tank, later on protected on top with metal sieve (2 cm mesh) and covered with green

shade porous nylon cloth to prevent escape of crabs. It was last step in maintenances we learned and confirmed as essential requirement to suggest a crab culture model during present study.

2.2 Crab collection and maintenance

The crabs *B.cunicularis* used in the study were collected from Godavari River and its tributaries in Marathwada region of Maharashtra with the help of local fisherman /crab catches [4]. Collected crabs were brought in to the laboratory and maintained in large aquarium (120 Cm L × 30 Cm W) containing aerated, de-chlorinated tap water. Pond-grown five pairs mature crabs (90 to 240 g body weight and 20 to 33 mm carapace length) transferred in constructed concrete tank provided with sand, rock, mud, stones as substrate. The tank was filled with neutralized freshwater to 1 Ft height of water column. The tank was cleaned twice in a week. The cleaning include removing the entire water from the tank using an electric pump and removal of foreign bodies including plant leaves, broken body parts of crab insect etc.

2.1.1 Habitat Trials: To find out fecundity, weight gain, mortality etc., feeding trials were carried out from July, 2016 to July, 2017.

a) Open Compartmentalization (First Trial)

Three separate compartments (2 metre L and 40 cm width) containing soil, sand and medium sized stones (fig. 2) were constructed in the tank using partition of bricks, each compartment was having interconnectivity and free mobility for the introduced crabs.

b) Bamboo Cages (Second Trial)

Specially designed five bamboo cages of sizes 2X1 ft. (fig.3) with lids were purchased from local bamboo craftsman for culture of the crabs species. One pair containing male and female crab was kept in each bamboo cage. Cages were kept on the bottom of constructed tank.

c) Close Compartmentalization (Third Trial)

Five close compartment (50 cm L × W) were constructed by using bricks (fig. 4). Each compartment was divided to form two sub compartments for one pair containing male and female of *B. cunicularis*. One sub compartment was filled with soil and another with water (1Ft. water column) each compartment was covered by waterproof plastic sheet cover to prevent escape of crabs.

2.1.2 Intra-species interaction

Five pairs of crabs (male and female, 5:5) were selected for every trial conducted in tank culture model to observe the intra-species interaction. Due to aggressive behaviour of crabs to observe the interactions like, they fight each other for escape and food. Breaking the walking legs and Chelate legs were also observed in bamboo cages and close compartment.

2.1.3 Escape behaviour

For the crab culture, the shelter serve as protection and refuge against predation [5]. It was found that, the crabs under captivity for any experimental purpose always try to escape [6, 7]. In the present study the crabs were able escape from the tank by crawling on vertical (90 ◦) wall of the culture tank (fig.5a, b). In trial studies (n=10) 28 crabs (93.33%) out of 30 in initial stock. Therefore the tank was completely covered on top surface (fig.6) with iron mesh (2 Cm). Remarkably it was found that, from the step area of tank any one of the crab didn't crawled out from the tank.

2.2 Management

2.2.1 Maintenance of water quality

Water exchange is the most economical method to maintain normal water quality in any culture system. Important ways to prevent disease are to insure good water quality in the rearing environment by regular water exchange or regular treatment to removed waste and pollutants. About 90% of water from the culture tank was removed after every third days by using electric pump and freshwater was refilled in the tank.

2.2.2 Food supply

Crabs are opportunistic omnivore, feed on variety of food items, but prefer to feed on animal food [8]. In this experimental setup, the crabs were fed with 10% of their biomass [9, 10]. Daily food was provided containing (prawn and rice flakes at 17.00 h). Feed was distributed throughout the enclosed pond area.

2.3 Disease Management

Many problems can be avoided by appropriately quarantining new stock before release into culture tanks, maintaining water quality and a stress free environment and regular disease monitoring of stock. The dead crabs if any in the tank were removed to avoid the contamination and disease.

3. Results

3.1 Habitat Trials

3.1.1 Open compartmentalization

This type of experimental setup was selected to conduct experimental culture for a period of three month during rainy season June-August 2016. Five pairs of *B cunicularis* male and female (1:1) were released in first batch in the constructed tank. In this setup stony area was most preferred habitat by this crab species, immediately all (100%) individuals selected this habitat as an immediate hiding place. But at certain time this experimental setup was unsuccessful due to 99% of escaping behaviour of crabs, it was observed when crab was crawling on the vertical rough surface of the wall of constructed tank. But, after covering of tank crabs were provided with three internal open compartment which contain Stone, Mud, and mixture of Mud+ Stone, 1Ft. water level and water quality (fig.7, 8). Highest percentage (99%) of crabs were survive in Muddy+ Stony area, as compared to only Stony and Muddy area. Therefore based on these three variable habitats, percentage of habitat selected was calculated (Fig.10). Open compartment was observed as most suitable for crabs as best habitat. Highest percent of crabs were observed in that habitat (also observed by using infrared night HDCIV camera.).This habitat serves as suitable for burrowing activity, free space for movement, moulting activity, etc.

3.2 Statistical analysis

The present experiment deals with the habitat selectivity hypothesis in three different variables containing Muddy, Stony and Muddy +Stony. For each habitat after three trials ANOVA was calculated, indicating calculated P value <0.05 (Table-1) shows significant difference in selectivity of three different kinds of habitat condition provided to *B.cunicularis*.

3.2.1 Bamboo cages

Bamboo cages were purchased from local market of Nanded, one pair of male and female were kept in each cages for the purpose of fattening and breeding aspects. This experimental setup was also unsuccessful, because crabs tried to compete with each other to escape out from the cages through cage

covers. Probably food and specific required space was not available for free movement. In this experimental setup only dominant individual were able to survive or both male and female died (fig.9) by broken legs. Bamboo cage trial was provided congested habitat for the crabs because 50% mortality was observed in first month after starting the experiment.

3.2.2 Close compartmentalization

After failure attempt in bamboo cages, close compartmentalization setup was tried. In this case, two sub compartments were prepared using brick, one compartment was filled with water and another with black soil. Both sub compartments were covered on top with fibre sheet. During start of summer in month of March all setup was well developed, crab started burrow preparations. But, after 3-4 days crabs started to leave their own compartments and started to encroach another sideby compartment. In this process there was breakage of legs and death due to escape stress was found in 95% individuals.

3.2.3 Intra-species interaction

Both in bamboo cage system and close compartmental system (fig. 4 & 9), there was damage to crabs especially brakeage of walking legs and chelate legs; consequently the death. In both the system the death rate was between 95-100% of the experimental population. Crabs are well known to drag behind each other, that same behaviour was observed in this species. Main reason of damage and death was their attempt to escape from narrow area.

Fig 2: Open compartment

Fig 3: Bamboo Cages

Fig 1: Constructed Tank model

Fig 4: Close compartment

Fig 5: a & b Vertical climbing of the crab on the concrete tank wall and escape

Fig 6: Crab Culture Tank covered with mesh wire.

Fig 8: Internal setup of the culture tank.

Fig 7: Most preferred habitat.

Fig 9: Unsuccess experiment in Bamboo cages.

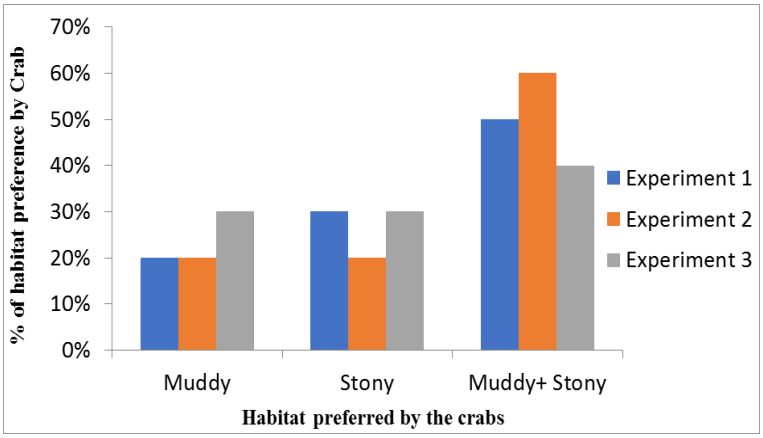

Fig 10: Percentage of habitat preferred by the crabs.

Table 1: ANOVA Single factor - Significant Variation between three habitat preferred by Crab *B. cunicularis*

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	12.66667	2	6.333333	11.4	0.009042	5.143253
Within Groups	3.333333	6	0.555556			
Total	16	8				

4. Discussion

Laboratory experiment was conducted to examine escape frequency among different shaped vents, position and sizes [11]. In their experiment it has been found that highest rate of escape with the square shaped vent, followed by the circle, rectangle and ellipse. Similarly, in the present study in experimental tank setup showed that rough surface of tank wall and due to uncovered open tank, the crabs were able to escape out of the tank [12]. Conducted an experiment based on grouping pattern of crabs. They measured type of substrate, depth and salinity. The results of PCA analysis showed that each population occupies a different base substrates (P<0.01). The type of substrate was also positively correlated with depths and salinities. Whereas in similar experiment of present setup it was found that, calculated P value (0.009042) was greater than recorded p value (0.05), there were no significant difference between selection of muddy, stony and muddy + stony habitat of the open compartment, hence null hypothesis is rejected, means P<0.05 considered as significant value.

[13], recoded maximum diversity of brachyuran crab in gulf of Kutch, Gujarat from open mudflat followed by mangrove mudflat and rocky shore. Open mudflats provide unique kind of habitat to several species of brachyuran crabs. Similarly, highest percentage of habitat preference was found in Muddy + Stony habitat by the experimental crabs *Barytelphusa cunicularis* in three different trials in the present study.

[14], examined the substrate preference and settlement behaviour of 36 megalopae of *P. gibbesi* using three natural substrates in experimental trials: gravel, cobbles and flat stones. Video recordings of 30-min trials in the experimental setup, were used to assess the substrate preference. Time required for selection of substrate and behaviour of the megalopae was observed. Strong preference was given to hard and stable substrates i.e., cobbles and flat stones with interstices used to hide, the same was most suitable to get shelter and food. In the present experimental setup, by direct observation active burrows (burrows with crabs) and also video recording on nocturnal movements showed that crabs were emerged out from muddy +stony areas.

In the laboratory experiment [15, 16], for the juvenile crabs observed that predation mortality was lower in sea grass and algal habitat than sand and mud. Similar experiment was conducted for adult crabs representing less mortality under stone and mud flat, prepared burrows as shelter.

Experiment based on food choice or habitat preference was conducted by [17], in their experiment with food availability having no effect on habitat choice but preference was based on shelter/structure of habitat. Similarly present study also based on structure of habitat preferred by the crabs. The present species prefers open habitat model in tank culture system.

5. Conclusion

The ability to select right habitat is the best challenge for the settlement of life, post reproductive activities, avoidance from the predators and other metabolic activities in various organisms. The result obtained from the present study, indicate that *Barytelphusa cunicularis* mostly prefers open compartment habitat. Similarly the setup of habitat containing Mud and Stone was most preferred in constructed tank as compared to bamboo cages and close compartments. Open compartment habitat was successful trials and it serve for burrows preparation as well as hiding place for protection from predators, to avoid mortality rates, intra-specific struggle in *Barytelphusa cunicularis* and suggested as best system to encourage low cost, eco-friendly backyard crab culture and maintenance.

6. Abbreviations

W= width, L=length, H=height, Fig.=figure, / = or, % = percentage, < = less than, Ft=feet

7. Conflict of interest

Authors declare no conflict of interest.

8. Authors contribution

First author was responsible for all experimental work, data acquisition and analysis and writing and preparation of manuscript. Corresponding Author was contributed to experiments and data analysis also responsible for study concept, designing and coordinating the research, supervising the work and revising the manuscript. Both authors read and approved the final manuscript.

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