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Survey and characterization of habitat and habitat ecology of freshwater crab *Barytelphusa cunicularis*

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Abstract:

Freshwater crabs occupies most important position in various parts including pond, lake, paddy field, muddy region etc to maintain the stability of ecosystems. Crabs are one of the most important arthropods in the freshwater well as marine water habitat having unique role in nutrient cycling and small scale aquaculture; also it is dominant arthropods in terms of its biomass than others in the particular habitat. Burrows of crab *Barytelphusa cunicularis* were mostly found in areas with boulder and rock in Godavari river basin in two study areas and main river bed in another two tributaries. Frequency of occurrence of crab burrows occurrence in 1.0 M^2 area was varied in four river basins. Average 8, 17.2, 9.35 and 6.92 burrows per $1M^2$ were recorded during six month field visits in year 2015-2017 during late winter to summer season (December to May).

Keywords:

Barytelphusa cunicularis, Habitat, Burrow, Frequency, etc.

Introduction

Freshwater crabs are semi-terrestrial crustaceans. They actively construct the burrows along riverside in muddy and stony areas. Burrows are important to freshwater crabs for a number of functions such as allowing them to adapt to a semi-terrestrial existence, to avoid environmental stresses and protection from predators in water and land. Crab excavates burrows in the mud to avoid wave action of water in their habitat. Crabs excavate tunnel like burrows by dragging up of soil using trailing movement of walking legs and bulldozing it far from the mouth of the tunnel/burrows with the main cheliped (Green, 2004). The crab species excavate burrows of various size and shape (Y, S, J, L, U, V), with more complex architecture (Morrisey *et. al.* 2011). There is strong correlation between burrow size and carapace length of crabs. Each species shows different morphological characteristics (Strachan *et. al.,* 1999). It depends on species and its various purposes (Qureshi & Saher, 2012). The animals those create habitat, that directly or indirectly modulate the availability of resources are considered as "ecosystem engineers" (Lawton and Jones 1995). Present investigation was planned to estimate population density, size and shape of burrow of the crab species. It developed as an important database for suggesting crab-culture model for the fisher community under ex-situ conditions, for the backyard crab culture of this species.

2 Material and Methods

2.1 Study area

The present study was conducted at four study sites namely Godavari river at Dhanagar takli (19º.7′25.1148″ N, 77º3′50.7456″ E), Asna river (19˚14'0.5424"N, 77˚16'9.2496"E), Lendi river (18˚28'16.9716"N, 77˚16'50.2464"E) and Godavari river near Vishnupuri dam at Nanded (19º6′44.7084″ N, 77º17′20.2956″ E) during year 2015-2017. Asna and Lendi River are tributaries of Godavari River situated 5.0 km north east to the Nanded city of Maharashtra state in India.

2.2 Field Study

Field study was carried out during year 2015-2017. It was for crab burrow counting manually in 1 M^2 area from randomly spreaded burrows all across the study area. The selected four sites were characterized by main river bed, river bank with trees, agricultural field, and boulders & rocks (Table 1, 2, 3 & 4).

2.3 Abundance of crab burrows

During 2015-2016 at both study sites of Godavari River (at Dhanagar takli and Vishnupuri Dam) plots were marked each of 1.0 M^2 in rectangular pattern randomly as per availability of burrows in the area (Table.3.1 & 3.2). Similar study was carried out during 2016-2017 at Asna and Lendi River (Table 3.3 & 3.4). Burrows were recorded according to habitat condition used by this crab species. The burrow count was carried out in main river bed, in river bank with trees, in river bank near agricultural field and burrows in boulders and rocks with the help of labours the area was searched and marked for this study.

Observations:

Table 1. The number of burrows/M^2 of *B. cunicularis* recorded during year 2015-2016, in Godavari river (near Dhanagar Takli) Nanded, Maharashtra.

Habitat conditions used for burrow preparation	Burrows/ 1.0 M^2 Counted in 5 plots					Total
	1	2	3	4	5	
Burrows in main river bed	-	-	-	-	-	-
Burrows in river bank with trees	-	-	-	-	-	-
Burrows in river bank near agricultural field	4	6	3	2	1	16
Burrows in river bank with boulders & rocks	5	10	3	4	2	24
Total	09	16	06	06	03	40

Table 2. The number of burrows/M^2 of *B. cunicularis* recorded during year 2015 -2016, in Godavari river (Vishnupuri dam) Nanded, Maharashtra

Habitat conditions used for burrow preparation	Burrows/ 1.0 M^2 Counted in 5 plots					
	1	2	3	4	5	Total
Burrows in main river bed	**4**	**5**	**2**	**3**	**2**	**16**
Burrows in river bank with trees	**1**	**2**	**1**	**1**	**1**	**06**
Burrows in river bank near agricultural field	-	-	-	-	-	-
Burrows in river bank with boulders & rocks	**20**	**18**	**12**	**09**	**05**	**64**
Total	25	25	15	13	08	86

Table 3. - The number of burrows/M^2 of *B. cunicularis* recorded during year 2016 - 2017, in Asna River near Nanded, Maharashtra.

Habitat conditions used for burrow preparation	Burrows/ 1.0 M^2 Counted in 14 plots														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Burrows in main river bed	06	05	03	04	06	01	01	-	06	-	08	08	07	02	57
Burrows in river bank with trees	-	-	01	-	-	-	01	-	-	-	-	04	-	01	07
Burrows in river bank near agricultural field	03	05	03	04	-	-	-	-	02	-	-	01	03	03	24
Burrows in river bank with boulders & rocks	03	-	03	02	06	01	01	01	06	-	06	04	07	03	43
Total	12	10	10	10	12	02	03	01	14	-	14	17	17	09	131

Table 4. -The number of burrows/ M^2 of *B. cunicularis* recorded during year 2016 - 2017, in Lendi River, Nanded, Maharashtra.

Habitat conditions used for burrow preparation	Burrows/ 1.0 M^2 Counted in 14 plots														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Burrows in main river bed	12	03	02	01	01	-	02	02	04	01	02	04	01	05	40
Burrows in river bank with trees	02	-	01	01	-	-	01	02	01	01	01	-	01	01	12
Burrows in river bank near agricultural field	06	02	-	-	-	-	01	-	01	01	01	-	01	02	15
Burrows in river bank with boulders & rocks	06	02	04	01	-	04	01	02	01	01	01	02	04	01	30
Total	26	07	07	03	01	04	05	06	07	04	05	06	07	09	97

3 Results

Table 5. Burrow size category and frequency (in percentage) and Mean of total burrows counted ± Error of occurrence in Four Field Station during 2015 -2017.

Size class (Cm)	Godavari River	Vishnupuri Dam	Asna River	Lendi River
5.0-5.5	15	9.3	19	12.37
5.5-6.0	10	29	19.8	15.4
6.0-6.5.	37.5	31.3	39.6	18.5
6.5-7.0	30	25.5	12.9	22.6
7.0-7.5	7.5	4.6	8.39	30.9
Mean ±SE	8 ± 2.35	17.2 ± 4.69	9.35 ± 1.52	6.92 ± 1.56

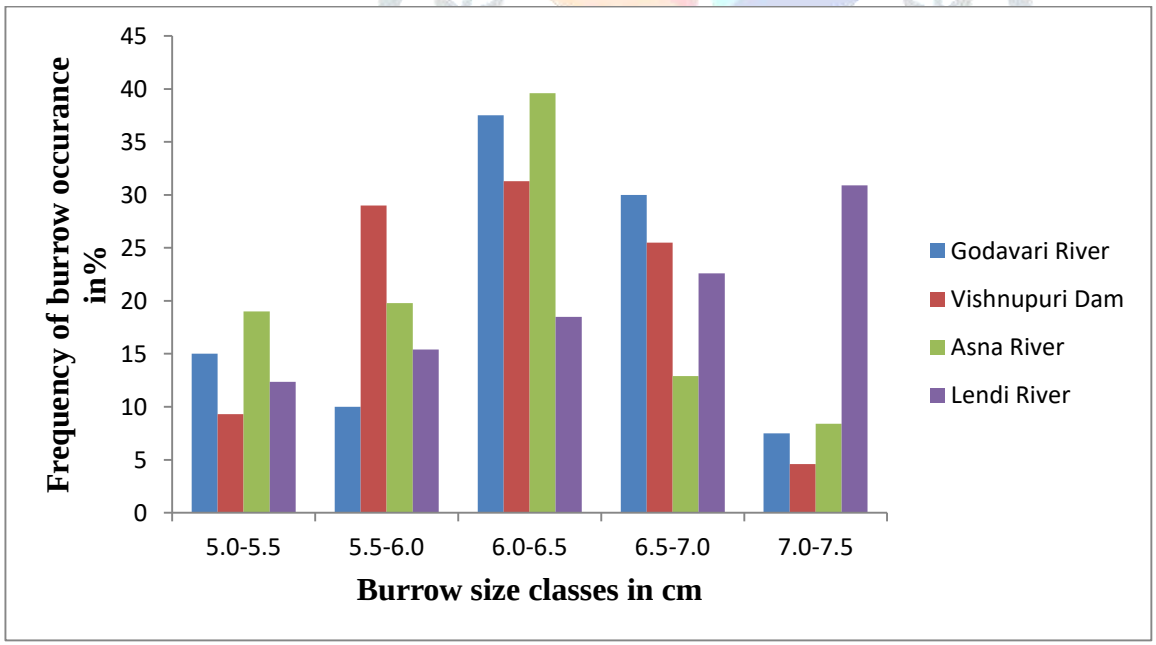

Fig. 1) Burrow size classes (cm) and frequency of burrow occurrence in (%).

Table 6. Descriptions of habitat and habitat ecology of five different Sampling sites.

Habitat Site type	Godavari river (Dhangar Takli)	Godavari river (Vishnupuri dam)	Asna River (Sanvgi road)	Asna River (Pasadgaon)	Lendi River
➢ Coastal vegetation	--	--	√	√	√
➢ Lime stone	--	--	--	--	--
➢ Agricultural land around swamp	√	√	√	√	√
Vegetations in the water					
➢ Plant/ bushes	*Acacea*	*Azadircta indica*	*Ipomea*	*Ipomea*	*Ipomea*
➢ Trees	*Azadircta indica*				
➢ flowers					
Habitat features					
➢ Stony margin	√	√	√	√	√
➢ Muddy margin	√	√	√	√	√
➢ Plant debris	√	√	√	√	√
➢ Animals/ birds					
Types of weeds					
➢ *Chara*	√	√	√	√	--
➢ *Hydrilla*	√	√	--	--	--

a) Under stone

b) Burrow in muddy area

c) Burrow under rock

d) Mud flat

e) Active burrow

f) Under stone

Fig. 2. (a-f). Type of micro-habitat conditions selected for construction of burrows by *Barytelphusa cunicularis* in Godavar River, Asna & Lendi Rivers, and the tributaries Godavari River.

4. Discussion

Crabs are ecologically important creatures in an aquatic ecosystem for nutrient mixing during burrow preparation in a habitat (Wang *et.al*. 2010). Devi, P. (2014) conducted survey in fifteen different field station in backwater area of Cochin, Kerala, India and observed that the crab species *Varuna litterata* construct burrows along the embankments or sides of pools, creeks and shallow banks. Whereas, *Barytelphusa cunicularis* in present investigation construct majority of burrows in river banks with boulder and rock in Godavari river (at Dhanagar takli and Vishnupuri dam, 24 & 64 respectively). Similarly, in the river bed (57 & 40 number of burrows respectively in Asna and Lendi River).

Distribution and abundance of freshwater crab *Potamonautes odhneri* from natural vegetation forest site in rivers of Kenya was examined (Dobson *et.al*., 2007). The adults of this species were found in the river bed, they observed 40% invertebrates reproduced in the open agricultural sites and reported that it is a part of recruitment of young crabs; whereas in the present study we found (16, 00, 24 &15 burrows, with respect to river habitat) in agricultural fields, along the four rivers at the study sites.

Sen *et. al*. (2017) found a correlation between burrow architecture and size class, sex of the fiddler crab *Uca rosea in* Sundarbans of west Bengal in India. Similar results we obtained to get an idea from burrow size about the size class of this crab species. Size class of burrow 6.0 - 6.5 cm were more frequencies of burrow

occurrence (37.5, 31.3, 39.6 in Godavari River and Asna River, while 30.9 was in Lendi River in size class 7.0 - 7.5 cm).

The crab carapace width showed significant correlation with the diameter of burrow opening. Burrow volume and total length of burrows Vachhrajan and Trivedi, (2016) in a study observed that crabs utilize deep burrows with large diameter located on the upper part of sandy shore. In the present study on crab burrow carried out in two rivers in 5 different plots and another two river in 14 different plots of $1M^2$ area, according to habitat condition used by crabs (Table 3.1, 3.2, 3. and 3.4).

Crab burrowing in salt marshes can mix surface and deeper soil over a period of years (Jin Qing Wang, 2010), accelerating litter decomposition and promoting the efficient reuse of nutrients by plants. Variation in the burrow architecture with crab age appears to be related to the crab's behaviour (Chan, *et. al.* 2006). Whereas in the present study the size of burrow tunnel (diameter in cm) directly represent the size group of the crab species in different microhabitat of study area.

Morrisey *et. al*. (1991), found that burrows of mud crab *Helice crassa* were more abundant at muddy site than at sandy sites. Similarly in the present investigation burrows were more in boulder and rocky regions in two areas and main river bed in the two the tributaries.

Micheli *et. al.* (1991) studied behaviour and ecology two crab species *Sesarma meinerti* and *Cardisoma carnifex* in mangrove were having same foraging activity but differ in burrowing activity, one was diurnal and another was nocturnal. *B. cunicularis* found in present study was having nocturnal habit to construct the burrows in different microhabitats (Fig. 2. a-f) and diurnal habit to hide in the burrow. It also prefers night time for foraging (6.00 p. m. to 6.00 a. m.).

Chua, *et al.* (2015), studied characteristics of habitat of freshwater crabs in Singapore's tropical rainforest, to conserve a range of habitat for the survival of four crab species. Lim *et. al.* (2003, 2006) compared nine crab burrow dimensions and differentiated the crab size class. The fiddler crab burrows were with steeper decent slope in sandy habitat than muddy habitat. In the present study also burrow size class and their abundance (Frequency) in a particular plot of $1M^2$ area was recorded (Table.3.5) in Four tributaries.

5. Conclusion

Burrows of crab *Barytelphusa cunicularis* were mostly found in areas with boulder and rock in Godavari river basin in two study areas and main river bed in another two tributaries. Frequency of occurrence of crab burrows occurrence in 1.0 M^2 area was varied in four river basins. Average 8, 17.2, 9.35 and 6.92 burrows per $1M^2$ were recorded during six month field visits in year 2015-2017 during late winter to summer season (December to May).

6. Conflict of interest

Authors declare no conflict of interest.

7. 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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