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Impact of physicochemical parameters on freshwater crab *Barytelphousa cunicularies*

Gaikwad B H[1*], Magare B K[1], Vidhya Pradhan[2]
[1] Shivaji Arts Commerce and Science College Kannad Dist. Chhatrapati Sambhajinagar, Maharashtra, India
[2] Rafiq Zakaria College for Women, Chhatrapati Sambhajinagar, Maharashtra, India
Corresponding Author: Gaikwad B H
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Abstract
Crabs live in some of the most variable habitats on Earth, including estuaries, mangroves, mudflats of dam andponds, rocky shores of river and Nala, and the open sea. Their survival, growth, molting, reproduction, and behavior depend heavily on the physical and chemical condition of the water. This article explores how the key physicochemical parameters (temperature, salinity, pH, dissolved oxygen, nitrogenous wastes, hardness and calcium, turbidity, and pollutants) affect crabs ***Barytelphousa cunicularies*** in Marathwada region. The burrowing crab Barytelphusa cunicularis is most abundant in Godavari River and its tributaries. Present study deals with study of fresh water crabs ***Barytelphousa cunicularies*** in river Shivna, the tributaries of Godavari River in Kannad region.

Keywords: *Barytelphousa cunicularies*, Shivna River, freshwater crab, physicochemical parameters

Introduction
Crabs are decapods crustaceans with important ecological roles as scavengers, predators, bioturbators, and prey in coastal food webs. Several species also support major fisheries and aquaculture. Unlike air-breathing animals, crabs are in constant exchange with their medium through their gills, so changes in water quality act quickly on their physiology. Most crabs are also poikilotherms and, in many cases, osmoconformers or partial osmoregulators, which makes them especially sensitive to environmental change. The burrowing crab Barytelphusa cunicularis is most abundant in Godavari River and its tributaries. This crab excavates and maintains large semi-permanent open burrows with funnel shaped entrances whereas the tunnel shaped burrows internally curved as a wave with short distance (2-4 Ft.). Present study was carried out during year June 2012 to May-2014. The impact of various physiochemical parameters on fresh water crab ***Barytelphousa cunicularies*** in river Shivna, the tributaries of Godavari River in Kannad region were studied.

Key Physicochemical Parameters and Their Effects
1. Temperature
Temperature is often the most influential factor because it controls metabolic rate.

- **Metabolism and feeding:** Within the tolerance range, higher temperature increases oxygen consumption, feeding rate, and growth. Beyond the optimum, metabolic demand exceeds oxygen supply and performance drops.

- **Molting:** Crabs grow only by molting (ecdysis). Warmer water shortens the intermolt period, while cold water prolongs it.

- **Reproduction and larval development:** Spawning is often triggered by seasonal temperature shifts. Larval development is faster in warm water, but extreme heat raises larval mortality and can cause deformities.

- **Behavior:** Cold stress reduces activity, burrowing, and feeding. Heat stress causes restlessness and eventually mortality.

For tropical mud crabs, growth is generally best at about 25 to 32°C. Sustained values outside this range cause stress [1].

2. Salinity
Salinity affects osmo regulation, the process by which crabs balance water and ions between body fluids and the environment.

- **Osmoregulation:** Estuarine and semi-terrestrial crabs are usually strong osmoregulators, using gill ion-transport enzymes such as Na^+/K^+-ATPase. Sudden salinity changes force them to spend more energy on ion regulation, leaving less for growth [2, 4].

- **Larvae are more sensitive than adults.** Many species need higher, near-marine salinity for larval development (roughly 25 to 32 ppt for *Scylla*), while juveniles and adults tolerate wider ranges and often grow well at moderate salinity (roughly 15 to 25 ppt).

- **Molting and survival:** Low salinity can delay molting and weaken the new shell. Extreme or abrupt changes cause lethargy, loss of appetite, and mortality.

- **Migration:** Many species, including the blue crab, move between salinity zones depending on life stage. Females migrate toward higher salinity to release larvae.

3. pH
- **Acid-base balance:** Low pH disturbs hemolymph pH and ion balance, and raises energy costs [5].

- **Shell formation:** The exoskeleton is made of chitin reinforced with calcium carbonate. In acidic water, calcium carbonate dissolves more readily and mineral uptake after molting is impaired, producing softer or thinner shells.

- **Ocean acidification:** Rising atmospheric CO_2 is lowering seawater pH. Studies on various crab species report effects including reduced calcification, altered metabolism, slower growth, and impaired larval development, though responses vary considerably between species [6].

- **Practical range:** Most cultured crabs do best at pH around 7.5 to 8.5. Values below about 7 or above about 9 are stressful.

4. Dissolved Oxygen (DO)

- **Hypoxia:** Low DO reduces feeding, growth, and molting success, and causes crabs to leave the water where they can (as seen in "jubilee" events). Prolonged hypoxia leads to mass mortality [7].

- **Molting vulnerability:** Soft, freshly molted crabs have high oxygen demand and are the most vulnerable stage [8].

- **Thermal link:** Warm water holds less oxygen while metabolic demand rises, so heat and hypoxia often act together [9, 10].

5. Ammonia, Nitrite, and Nitrate

- Ammonia is the main nitrogenous waste of crustaceans. Unionized ammonia (NH_3) is particularly toxic, damaging gills and interfering with oxygen transport and the nervous system.
- Nitrite oxidizes hemocyanin (the crab's oxygen-carrying pigment), reducing oxygen-carrying capacity.
- Nitrate is much less toxic but can cause chronic stress at high concentrations.
- The toxicity of ammonia rises with higher pH and temperature, and it is generally more harmful to larvae and molting crabs [11, 13].

6. Alkalinity, Hardness, and Calcium

Because crabs must harden a new shell after every molt, the availability of calcium and carbonate ions is critical. Low alkalinity or hardness slows shell hardening, increases the risk of cannibalism on soft-shelled crabs, and can lower survival, especially in low-salinity or freshwater-influenced conditions.

7. Turbidity, Light, and Photoperiod

- **Turbidity:** Moderate turbidity provides cover and is tolerated by many estuarine crabs, but very high suspended solids can clog gills, reduce feeding efficiency, and smother eggs and larvae.

- **Photoperiod:** Day length influences molting cycles, activity rhythms, larval vertical migration, and gonad maturation. Artificial light at night can disrupt these rhythms.

8. Pollutants: Heavy Metals, Pesticides, and Hydrocarbons

- Heavy metals (cadmium, copper, lead, mercury, zinc) accumulate in the hepatopancreas and gills. Effects include gill damage, enzyme inhibition, oxidative stress, impaired osmoregulation, and reduced reproduction. Because crabs bioaccumulate metals, they are also used as bioindicators.
- Pesticides and endocrine disruptors can interfere with molting and reproductive hormones, since arthropod molting is hormonally controlled.
- Oil and hydrocarbons cause tissue damage, behavioral changes, and reduced larval survival.

Interactive Effects

There are always joint interactions of various parameters. The important interactions include temperature and salinity interaction, temperature and oxygen, pH and ammonia, and multiple stressors in climate change. The temperature and salinity interaction reveal tolerance to salinity at temperature extremes. The warm, low-oxygen water compounds increase metabolic stress whreas higher pH increases the toxic NH_3 interaction. Warming, acidification, deoxygenation, and salinity shifts occur together, and combined effects can be greater than any single one. It is found that there is high sensitivity of parameters like temperature, oxygen, pollutants, salinity, calcium, pH etc in embryo / eggs, Zoea / megalopa larvae and molting crabs. In Juveniles life stage, moderate to high sensitivity towards molting stress, DO, ammonia, hardness of water. In adult condition results showed that it is more tolerant for pollution and extreme temperature.

Physiochemical effect: Because of environmental factors, freshwater crabs suffers from various diseases which include black necrotic disease, box burnt diseases, black mat syndrome, rust disease brown spot, black spot, burn spot, tail rot and spot disease etc[14]. Metabolic processes are the most sensitive for environmental stress as all enzymatic reactions on the substances and physiological responses were incorporated in a unique manner [15].

The weight of male crab generally is great than female crab. The larger increments in weight at moulting of male crabs may be due to the allometric growth of their chelae. The live weight as well as carapace width is related with most frequency for both male and female crabs [16].

The oxygen consumption increases with the number of animals and growth of animals in laboratory captivity condition [17]. The oxygen present in the atmosphere get dissolved in the water naturally due to atmospheric pressure. The process of dissolution and evolution is a reversible process. The dissolved oxygen is responsible for the survival of aquatic life. Although pH has no direct effect on human health, it shows close relationship with some other chemical constituents of water [18]. The various physiochemical parameters are shown in Table1.

Correlation: In the present study, the co-relation of crabs found in the water bodies with the physico-chemical parameters, shows less dependent. This may be due to the fact that crabs may get adjust themselves with the surroundings. Secondly, the effect of various parameters on growth rate of crab varies with water quality. The area under study is far away from the industrial zone, hence the possibility of pollution due to industrial waste is ruled out. The agricultural wash outs are only probable cause of pollutants. Therefore, all the physico-chemical parameters of natural fresh water form all the stations were under permissible limit. Hence healthy growth of aquatic life was possible. The water bodies also contain submerged macrophytes along with aquatic grasses which are ideal habitat for life like crabs.

During the study period 3 Jan 2012 to 4 May 2014, total 92 male and 78 female crabs were catched, the ratio of M:F is 1:18 to 1.20. For male the average body weight was found to be 137 gm with maximum weight of 280 gm (5 Aug 2012) and minimum weight 62 gm on 10.11.2013. The length of carapace varies from 5.3 cm to 10.2 cm with average value of 7.49 cm and width of carapace varies from 4.8cm to 7.2 cm with an average of 5.8 cm. During same period 78 female crabs, ranging in weight from 66 gm to 200 gm were cached. The average weight (110 gm) was found to be less than the average weight of male crabs. The body length of carapace was found to vary from 6 cm to 9 cm where as carapace vary from 5 cm to 7 cm. The average carapace length and width is 7.0 cm and 5.5 cm respectively. There are slightly lesser compared to length and width of male. The female crabs show different ovary coloration ranging from Dark to Yellowish to white, indicating various stages or reproduction process. The average, maximum and minimum values of male as well as female crabs are shown in the Table 2.

The survival rate of crabs depends on temperature also. There are reports [19] that the survival rate of Dungeness crabs is high at 10 15^0 C and the size is also highest, the study was carried from southeastern Alaska.

Table 1: Various physiochemical parameters from June2012 to May 2014

Months	Temp 0^0C	Humidity	pH	Turbity	E. Cond(mS)	TDS	Dissolved Oxygen	Free CO_2	Total Alkanity	Total Hardness	Nitrates	chlorides
Jun-12	26.2	52.3	7.9	90	284	192	3.1	6.5	144	82	0.14	32.48
Jul-12	25	75	8.2	44	270	182	6	5	124	84	0.3	27
Aug12	22	78	8.3	60	260	202	6	4.6	122	85	0.4	26.94
Sep-12	23	79	7.8	74	296	196	5.8	4.2	120	94	0.3	25.1
Oct-12	20.2	52	8	80	240	150	5	2.4	88	70	0.36	13
Nov12	19.3	54	8	114	246	158	6	4.6	108	82	0.3	20
Dec-12	15	50	8.2	118.2	260	164	6.8	6.8	146	84	0.2	17.4
Jan-13	16	53	8.2	126.3	258	176	4.6	7	132	78	0.24	16.1
Feb-13	16.3	40	8.2	132	300	192	3.2	5	134	80	0.1	18.54
Mar13	25	32	8.2	128	320	200	4.8	0	146	82	0.1	24.1
Apr13	26	28	8.2	124	320	208	5.48	0	150	90	0.28	27
May13	26.4	34	8.5	120	268	216	5.54	0	162	82	0.34	32.6
Jun-13	27.4	65	8.4	115	285	160	3.5	3.7	146	114	0.24	25.58
Jul-13	27	74	8.2	70	270	178	7	4.6	136	98	0.18	25.56
Aug13	25.4	82	8.2	76	250	200	5.3	4.4	132	106	0.24	27
Sep-13	25	80	8.1	92	270	204	7.6	5.5	132	116	0.4	22.74
Oct-13	19	62	8.2	121	260	170	7.3	4.7	118	72	0.23	18.12
Nov13	16.8	46	8.2	125	265	160	6	5.2	136	84	0.32	24.16
Dec-13	16.4	50	8.1	130	273	148	7	3.84	130	102	0.28	25.58
Jan-14	16	53	8.2	136	280	178	7.3	5.7	152	106	0.2	28.6
Feb-14	20	49	8.2	134	292	180	6	0	146	116	0.22	31.26
Mar14	25.8	41	8.4	130	316	200	3.5	2.6	162	118	0.1	34.1
Apr14	28.2	34	8.5	121	321	212	3.4	5.8	156	120	0.16	32.68
May14	29.8	31	8.5	116	280	206	3.7	4.4	146	112	0.16	27

Table 2: The average, maximum and minimum values of male as well as female crabs

Sex	**Total Catch**	**Wt. of Body**			**Length of Carapace**			**Width of carapace**		
		Max.	**Min.**	**Avg.**	**Max.**	**Min.**	**Avg.**	**Max.**	**Min.**	**Avg.**
M	93	62	280	137	5.3	10.2	7.4	4.8	7.2	5.8
F	78	66	200	110	6.0	9.0	7.0	5.0	7.0	5.5

Conclusion

Impact of physiochemical parameters on fresh water crab especially *Barytelphousa cunicularies* in river Shivna showed that molting crabs are more sensitive for climate change as compared to adult crab. It is necessary to provide shelter and adequate minerals to protect molting crabs. It is important to protect natural habitats of crabs by controlling effluent, agricultural runoff, or industrial discharge for wild populations.



Fig 1: *Barytelphousa cunicularies crab*

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