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Impact of Habitat Fragmentation on Freshwater Crab Diversity in Marathwada region of Maharashtra

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Abstract:

Habitat fragmentation is a significant ecological issue that affects biodiversity all over the world. Facing the problem of habitat loss, kinds of creatures, such as freshwater crabs of which are very much habitat-special, thus can be inevitably the most types vulnerable to landscape changes. This research paper will ponder upon the impact of the habitat fragmentation of Barytelphusa cunicularis in the Marathwada region of Maharashtra, India. Both species richness, and population distribution, were meticulously evaluated through numerous field surveys, and ecological assessments, in different areas. Along with this, we also elucidated the key threats linked to human activities such as deforestation, urbanization, and the expansion of agriculture that are the major reason of the wildlife disappearance. The study applies different sources such as GIS mapping, habitat fragmentation indices, and statistical modelling to classify the severity of the habitat changes. The result is that the splitting of the habitat generally results in fewer and smaller populations, changes in the genetic composition of populations, and also other community aspects. The loss of suitable habitats has created the highest impact on the Barytelphusa cunicularis populations resulting in more vulnerability to the threats of contamination, enforced environmental changes, and predation. The altered and fragmented habitats have now become inadequate ecological networks, thus, reducing the spread of organisms and increasing the competition for the resources that are not available everywhere. Also, the issue of water pollution and diverse climate conditions further are responsible for addressing the decrease in populations, which is an essential threat to the sustainability of these freshwater crab populations. Conservation measures such as restoration of habitats, planning of land-use in a sustainable and proper way, and promoting public participation through community involvement are among them that need to be taken into account for the mitigation of these adverse impacts. The stricter environmental laws, the better protection of the reserves, and the safer areas are paramount to securing the survival of the species.

Keywords: Habitat Fragmentation, Barytelphusa cunicularis, Freshwater Crabs, Biodiversity, Maharashtra, Conservation, Anthropogenic Impact.

Introduction:

Habitat fragmentation, one of the main things that lead to the loss of biodiversity, has a very strong effect on those animal and plant species that can only move in small distances and also live their lives in *Barytelphusa cunicularis* habitat. This crab species is not only a job for a wetland invertebrate but also an enforcer of the ecological pyramid cycle and the main nutrient provider. These crabs stir the bottom sediments, and those particles bring food to the surface which is then swarmed by microorganisms. On the other hand, the main functions of these tiny monsters are to make the ecosystem more productive by the use of their movement through the soil and to improve the water quality. The semiarid climate and seasonal freshwater bodies that are found in the Marathwada are the traits

that make it look like no other the place for the crab species. In the meantime, the increased conversion of native vegetation into farmlands and increased levels of river and ground water extractions due to changing water patterns have not only transformed the region but also have done so at the cost of the diversity of living organisms. These tiny monsters are now living on their small islands of the spaces left and this is being caused not only by them unable to fly, get food for themselves or reproduce but also by a lack of a genetic variation caused by inbreeding. The fate of aquatic habitats and their aquatic animals is at stake as the habitat fragmentation question of the Marathwada region arises. This work will try to answer how the Marathwada aquatic species with *Barytelphusa cunicularis* are going to react to the habitat isolation issue came up as the urban growth took place. To go in the right direction, we propose checking the crab species location on their habitats using geographic processing systems and then making a decision on the conservation measures of the environments that are on the brink of disappearance (Rao & Das, 2017).

Study Area:

The Marathwada area is blessed with several natural aquatic biomes such as, rivers, lakes, and wetlands, which provide suitable environment & habitat for *Barytelphusa cunicularis*. The research is mainly based on the river basins and the freshwater ecosystem that gives shelter to the rich biodiversity in the region of Marathwada (Chakraborty & Nair, 2021).

Methodology:

Study Design: This study was carried out with a conglomeration of field surveys, laboratory analysis, and geospatial techniques which were used to make out the consequences of habitat fragmentation on *Barytelphusa cunicularis* populations. Various freshwater locations in the Marathwada area were covered including rivers, streams, ponds, and reservoirs (Kumar et al., 2020).

Field Surveys: Many field research trips were conducted in all the major freshwater niches across the Marathwada illustrating the kind of species they are in the area, their population, and the habitat conditions. The surveys were done both in the pre-monsoon and the post-monsoon periods so as to take into account seasonal changes (Patil et al., 2019).

Sampling Techniques:

- Direct Hand Collection: Throughout the gravel fiver's bank, the crabs were manually taken out from under rocks, vegetation and burrows.
- Baited Traps: Locally, it was trapped with organic bait which had been designed and placed in water bodies to attract crabs.
- Visual Surveys: Crab activity and burrow presence were noted simply by going along riverbanks in line with a continuously marked straight line.
- Quadrat Sampling: 1m² quadrats were used to estimate population density at selected sample sites (Singh & Sharma, 2018).

Habitat Assessment:

- GIS Mapping: The tools of GIS remotes sensing and satellites have been used to analyse land-use changes and habitat fragmentation.
- Water Quality Analysis: The physicochemical parameters such as pH, dissolved oxygen, temperature, and pollutant levels were measured using portable field kits and laboratory analysis.
- Vegetation and Substrate Analysis: To examine habitat quality, the structure and composition of riparian vegetation and substrate

characteristics were also documented (e.g., sand, silt, clay).

Data Analysis:

- Fragmentation Metrics: Landscape spline mapping was the most effective way to generate landscape fragmentation indices. With the GIS tools distances between patches, etc. were calculated.
- Statistical Analysis: Besides correlation analysis, regression analysis was adopted to draw out whether the relationship between crab populations and habitat fragmentation.

Results:

Table 1: presenting landscape fragmentation indices computed using GIS tools for the study:

Fragmentation Metric	Description	Mean Value ± SD	Interpretation
Patch Density (PD)	Number of habitat patches per unit area	5.8 ± 1.2 patches/km²	Higher patch density indicates increased fragmentation.
Connectivity Index (CI)	Degree of landscape connectivity (0-1)	0.42 ± 0.08	Lower values indicate reduced habitat connectivity.
Edge Density (ED)	Total edge length per unit area (m/ha)	102.3 ± 15.4	Higher values suggest fragmented landscapes with more edge effects.
Mean Patch Size (MPS)	Average size of habitat patches (ha)	1.6 ± 0.5 ha	Smaller patches imply greater fragmentation.
Core Area Index (CAI)	Percentage of core habitat within patches	38.2 ± 6.7%	Lower values indicate habitat degradation and fragmentation.

Table 2: presenting correlation and regression analysis results on the relationship between habitat fragmentation and *Barytelphusa cunicularis* population dynamics:

Variable	Correlation Coefficient (r)	Regression Coefficient	p-Value	Interpretation
Patch Density vs. Population Density	-0.72	-1.85	<0.01	Higher fragmentation leads to lower crab populations.
Connectivity Index vs. Species Richness	0.68	2.12	<0.05	Greater habitat connectivity supports higher species richness.
Water Quality (DO) vs. Population Density	0.75	3.05	<0.01	Better water quality positively influences crab populations.
Land Use Change (%) vs. Crab Abundance	-0.65	-2.45	<0.05	Increased urbanization negatively impacts crab abundance.

Discussion:

Anthropogenic Threats: The most important dangers that cause habitat fragmentation are the destruction of the forest, the increase of agricultural land, the development of the city, and pollution. The increased cutting of the land for other returnees and the construction of more dams have changed the natural water flow that adds to the degradation of the natural habitats (Kumar et al., 2020; Singh & Sharma, 2018).

Ecological Implications: The breaking of the whole piece has been the starting point

of the ecological chain of affectation with the increased competition among beautiful and strength resources and the shrinking of the population growth. These factors cause a decrease in the resistance of *Barytelphusa* cunicularis populations and their exposure to environmental stressors (Patil et al., 2019; Rao & Das, 2017).

Adaptive Strategies and Conservation Needs: A series of crabs already have a set of disturbing behaviours which include altered burrowing and changed foraging. Furthermore, ecosystem health and survival in the long run are largely dependent on strategies like reforestation, pollution control, and the incorporation of ecological freeways (Chakraborty & Nair, 2021).

Conclusion:

Habitat fragmentation has emerged as a significant threat to the biodiversity of freshwater ecosystems, particularly affecting species with limited dispersal abilities such as *Barytelphusa cunicularis*. This study highlights the negative impact of habitat fragmentation in the Marathwada region, demonstrating how land-use changes, water pollution, and declining habitat connectivity have contributed to population decline and genetic isolation of freshwater crabs. The results underscore the importance of maintaining habitat integrity, restoring degraded ecosystems, and implementing conservation policies to mitigate these effects.

To ensure the long-term survival of *Barytelphusa cunicularis*, it is essential to adopt sustainable land-use practices, strengthen environmental regulations, and enhance community-based conservation initiatives. Integrating habitat restoration efforts with scientific research and policy frameworks will be crucial in preserving the biodiversity of freshwater ecosystems in Maharashtra.

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