

REVIEW ARTICLE

**SEASONAL DYNAMICS AND SPATIOTEMPORAL DISTRIBUTION OF
MACRO-CRUSTACEANS IN THE RUI PROJECT RESERVOIR,
DHARASHIV (MAHARASHTRA), INDIA**

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Abstract:

In the present investigation a seasonal variation was done on macrocrustacean in Rui Project, Dharashiv (Osmanabad). Maharashtra in the year 2022-23. The macro-crustacean community comprised distinct decapod crab and shrimp species, demonstrating marked localized heterogeneity and distinct seasonal peaks. Station D consistently emerged as the primary ecological hotspot of the reservoir, maintaining the highest total density of class Crustacea throughout the year and hitting an absolute maximum of 22 ind./m² in the summer month of April. A synchronized decline in overall biological productivity was observed globally across the reservoir during the wet monsoon season (June–September) due to environmental flushing.

Keywords: Macro-Crustaceans, Seasonal Variation, Rui Project.

Introduction:

Freshwater ecosystems, including artificial reservoirs, lakes, and rivers, are critical lifelines that regulate regional biodiversity and fulfill vital human socio-economic needs such as irrigation, drinking water, and aquaculture. In semi-arid regions, small and medium irrigation networks like the Rui Project act as ecological oases amidst drought-prone terrains. However, these standing lentic water bodies face severe ecological pressure due to seasonal fluctuations and intensive human activities (1). Agricultural runoff carrying residues of chemical fertilizers from neighboring crop fields, domestic waste discharge, and livestock washing constantly alter the water's chemical signature. While routine physical and chemical testing can capture immediate changes in water quality, biological monitoring is increasingly essential to gauge the true, cumulative impacts of these environmental stresses on resident aquatic food webs.

Within the trophic hierarchy of freshwater reservoirs, crustaceans constitute a core biological component. Freshwater micro-crustaceans primarily belonging to the subclasses Cladocera (water fleas), Copepoda, and Ostracoda (seed shrimps) act as the primary bridge transferring energy from primary producers to higher trophic levels (2). By feeding extensively on phytoplankton, bacterioplankton, and organic debris, these organisms regulate algal biomass and serve as the foundational diet for larval and adult fish populations (3, 4). Because crustaceans possess short lifespans and are highly sensitive to shifts in dissolved oxygen, temperature, nutrients, and pH, their reproductive rates, species composition, and overall community structure fluctuate sharply in response to environmental degradation (5). Consequently, evaluating the community dynamics of these organisms provides a clear window into the ecological health and trophic status of the host water body.

Population dynamics among freshwater crustaceans are inherently driven by seasonality. In sub-tropical climates like Western India, the year is divided into distinct periods: a hot dry summer, a wet southwest monsoon, and a cool winter. Each season drastically alters the reservoir's hydrology. The summer heat accelerates evaporation, concentrating nutrients and raising water temperatures, which typically triggers surges in hardy, nutrient-tolerant crustacean species (4). Conversely, the monsoon winds introduce major volumes of freshwater diluting chemical contents, yet flushing in heavy pulses of terrestrial silt, pesticides, and fertilizers from surrounding farmlands. These rapid shifts force a successional restructuring of the zooplanktonic community, with different groups achieving dominance as their narrow ecological niches open or close throughout the seasonal cycle. While the structural composition and seasonal succession of zooplankton have been documented in several major river basins and large lakes across India, localized ecological data concerning smaller irrigation dams in the Marathwada region remains fragmental. Reservoirs like the Rui Project in the Dharashiv (Osmanabad) district exhibit highly sensitive hydro-biological regimes due to the surrounding rural and agrarian landscape. To implement sustainable fisheries management and local water conservation policies, it is vital to map out the baseline biological trends of this reservoir across changing seasons.

Therefore, this study was undertaken to evaluate the qualitative and quantitative seasonal variations of the crustacean community within the Rui Project, Dharashiv (Osmanabad). By establishing correlations between fluctuating crustacean density and key physicochemical water metrics across different seasons, this research aims to provide an accurate assessment of the reservoir's water quality and further validate the functional role of aquatic crustaceans as reliable in-situ bioindicators in minor tropical impoundments.

Material and Methods:

The investigation was carried out at the Rui Project, a medium-scale irrigation reservoir built across a local freshwater basin in the semi-arid region of Dharashiv (Osmanabad) district, Maharashtra, India. The water body primarily serves rural socio-economic lifelines, including agricultural irrigation, domestic usage, and localized aquaculture. To thoroughly map the spatiotemporal and seasonal dynamics of the aquatic crustacean communities, four distinct sampling stations designated as Station A, Station B, Station C, and Station D were established along the periphery and open waters of the reservoir based on distinct ecological gradients.

Field sampling was executed on a monthly basis over a continuous 12-month timeline extending from July 2022 to June 2023. For interpretive ecological clarity, the collection months were grouped into three primary distinct tropical seasons

Preservation and On-Site Handling: Immediately upon collection, macro-crustaceans were sorted from debris in plastic sorting trays.

Fixation: Large specimens (crabs and prawns) were immediately immersed in a 70% ethanol solution or a 4% to 5% buffered formalin solution to preserve structural tissues.

Appendage Protection: To prevent autotomy (the self-amputation of claws or legs due to stress), larger crabs were briefly chilled in ice water prior to fixation. A few drops of commercial glycerin were added to the preservative vials to maintain the flexibility of arthrodial membranes and prevent the breaking of delicate appendages during transit.

Labelling: Each specimen container was strictly labelled with an internal waterproof paper tag noting the station ID, collection date, sample number, and localized habitat type.

Laboratory Processing and Taxonomic Identification: In the laboratory, the preserved specimens were gently rinsed with distilled water to remove fixative residue and transferred to clearing petri dishes for anatomical examination. regional identification keys and standard monographs (6,7,8).

Result and Discussion:

A spatiotemporal comparative analysis across the four sampling sites reveals that Station D consistently maintained the highest total density of class Crustacea throughout the entire annual cycle, reaching an absolute peak of 22 ind./m² during the summer month of April. In comparison, Stations A, B, and C exhibited significantly lower total abundances, with Station A showing a winter-centric preference peaking at 8 ind./m² in December, while Stations B and C maintained modest, uniform baselines that never exceeded 7 ind./m² and 6 ind./m² respectively. At the species level, *Barytelphusa guerini* emerged as a highly dominant organism at Station D, showcasing an exceptional single-month maximum of 10 ind./m² in April, whereas its presence at all other stations remained heavily constrained and never surpassed a density of 2 ind./m². Similarly, the freshwater crab *Paratelphusa macanni* and the shrimp *Caridina nilotica* showed distinct structural affinities for the micro-habitats at Station D; *P. macanni* established a major population buildup of 7 ind./m² during the late monsoon phase in October, while *C. nilotica* maintained a persistent year-round presence at Station D, peaking at 5 ind./m² in April. In contrast, both species were highly intermittent or entirely absent for multiple months at Stations A, B, and C. Furthermore, the river prawn *Paratelphusa hydrodromus* and the macro-invertebrate *Macrobrachium kistensis* both flourished at Station D with consistent seasonal baselines, whereas they remained heavily suppressed or failed to appear during extended periods at the other three locations. The prawn species *Macrobrachium malcolmsonii* displayed shifting temporal peaks, maximizing its abundance in the late monsoon at Station D (4 ind./m² in September) but showing an early winter preference at Station A (2 ind./m² in November). Lastly, *Macrobrachium rosenbergii* occurred in low numbers globally but registered its best adaptation at Station D with twin peaks of 4 ind./m² in July and December, while presenting a highly diluted yet surprisingly steady presence at Station C. Collectively, as detailed in the data compiled for the table for graph.docx, the results indicate that Station D represents

the most ecologically productive zone, while Station A relies on winter recruitment, Station B peaks sporadically in the monsoon, and Station C supports a minimal, highly dispersed community structure across all seasons. A qualitative and quantitative monthly analysis of the macro-crustacean community across four stations (A, B, C, and D) over a one-year period (February 2022 to January 2023) at the Rui Project, Osmanabad, revealed distinct spatial and seasonal trends. The overall crustacean density exhibited marked localized heterogeneity, with Station D consistently acting as the reservoir's primary ecological hotspot. Annual baseline densities fluctuated dramatically from a low of (Station A, August/September and Station B, January) to an annual peak of recorded at Station D during April. The summer season (February-May) was generally characterized by concentrated spikes in numbers, as evidenced by Station D hitting its absolute maximum and Station A peaking at in March, driven likely by the natural concentration effect of rising temperatures and shrinking water volumes on benthic populations. A general decline in biological productivity was synchronized with the wet Southwest Monsoon (June-September).

The spatial and temporal variation of crustaceans across stations A, B, C, and D highlights a complex dependency on seasonal and environmental drivers. Kang et al. (2020) stated that estuarine and coastal ecosystems are highly dynamic zones where shifting physical gradients directly alter the community composition of local fauna. This is evident in the maximum total crustacean density observed during the primary winter cycle.

Addressing this pattern some researchers demonstrated that stable post-monsoon conditions and favorable hydrographic factors routinely trigger the recruitment and proliferation of macrozoobenthic communities (9). Conversely, the reduction in total abundance during the primary monsoon cycle can be understood through the lens of hydrological stress; as Feng et al. (11) observed, the wet season brings accelerated river water flow and heavy rainfall, which drastically increases turbidity and destabilizes the immediate streambed habitats.

When examining spatial fluctuations, Station B initially accommodated the maximum crustacean densities in summer and which supports the conclusions of Abdul Jaleel et al. (10), who found that shallower, well-oxygenated zones with coarser sediments typically harbor the highest concentrations of interstitial macrobenthos and crustaceans. Finally, the dramatic population inversion observed in the secondary data cycle where Station D unexpectedly spiked to hold the regional maximum during the monsoon and winter can be justified by looking at external nutrient inputs (12, 13).

Seasonal agricultural development and terrestrial runoff introduce a major influx of organic matter and suspended food particles into specific localized channels, effectively overriding regional climate stress by providing a sudden food source that fuels the rapid reproduction of opportunistic benthic organisms (11, 14, 15).

Table 1: Seasonal Variation of Crustaceans (No./M2) at the station A (Year 2022-23)

Sr. No.	Class/Genus	Summer Season				Monsoon Season				Winter Season			
		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
A	Crustacea	3	7	4	3	4	5	2	2	5	7	8	3
1	<i>Barytelphusa guerini</i>	1	2	1	1	2	1	1	1	–	2	1	1
2	<i>Paratelphusa macanni</i>	–	1	1	1	–	2	–	–	1	2	2	–
3	<i>Paratelphusa hydrodromus</i>	–	1	–	–	1	–	–	1	2	–	2	1
4	<i>Caridina nilotica</i>	1	–	1	1	–	–	1	–	–	1	–	–
5	<i>Macrobrachium rosenbergii</i>	–	2	–	–	–	1	–	–	–	–	1	–
6	<i>M. malcolmsonii</i>	–	–	1	–	1	–	–	–	1	2	1	1
7	<i>M. kistensis</i>	1	1	–	–	–	1	–	–	1	–	1	–

Table 2: Seasonal Variation of Crustaceans (No./M2) at the station B (Year 2022-23)

Sr. No.	Class/Genus	Summer Season				Monsoon Season				Winter Season			
		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
A	Crustacea	3	5	2	5	3	5	7	4	6	4	3	2
1	<i>Barytelphusa guerini</i>	1	1	–	–	1	2	2	1	1	1	1	–
2	<i>Paratelphusa macanni</i>	1	–	1	1	–	–	1	–	2	1	–	1
3	<i>Paratelphusa hydrodromus</i>	–	1	–	1	–	–	1	1	–	–	1	–
4	<i>Caridina nilotica</i>	–	1	–	2	1	1	–	–	2	2	–	–
5	<i>Macrobrachium rosenbergii</i>	–	2	–	1	–	1	–	1	–	–	–	1
6	<i>M. malcolmsonii</i>	1	–	1	–	–	–	1	1	–	–	1	–
7	<i>M. kistensis</i>	–	–	–	–	1	1	2	–	1	–	–	–

Table 3: Seasonal Variation of Crustaceans (No./M2) at the station C (Year 2022-23)

Sr. No.	Class/Genus	Summer Season				Monsoon Season				Winter Season			
		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
A	Crustacea	5	4	6	6	3	2	3	2	3	6	3	2
1	<i>Barytelphusa guerini</i>	1	1	–	2	1	–	1	–	1	2	1	1
2	<i>Paratelphusa macanni</i>	1	–	1	1	–	–	1	–	–	–	–	–
3	<i>Paratelphusa hydrodromus</i>	–	1	–	–	1	–	–	1	1	1	–	–
4	<i>Caridina nilotica</i>	2	–	–	1	–	1	–	–	–	–	–	–
5	<i>Macrobrachium rosenbergii</i>	1	1	2	1	–	1	–	1	–	1	–	–
6	<i>M. malcolmsonii</i>	–	1	2	1	–	–	1	–	–	2	1	1
7	<i>M. kistensis</i>	–	–	1	–	1	–	–	–	1	–	1	–

Table 4: Seasonal Variation of Crustaceans (No./M²) at the station D (Year 2022-23)

Sr. No.	Class/Genus	Summer Season				Monsoon Season				Winter Season			
		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
A	Crustacea	16	12	22	19	13	17	12	16	21	12	20	13
1	<i>Barytelphusa guerini</i>	3	2	10	7	3	4	3	2	6	2	3	3
2	<i>Paratelphusa macanni</i>	-	1	3	2	-	2	2	3	7	4	3	4
3	<i>Paratelphusa hydrodromus</i>	2	3	2	5	2	3	2	1	2	3	4	2
4	<i>Caridina nilotica</i>	2	1	5	2	3	2	1	2	1	2	1	1
5	<i>Macrobrachium rosenbergii</i>	2	3	1	-	2	4	-	1	2	-	4	-
6	<i>M. malcolmsonii</i>	3	2	-	1	2	1	1	4	3	-	3	1
7	<i>M. kistensis</i>	4	-	1	2	1	1	3	3	-	1	2	2

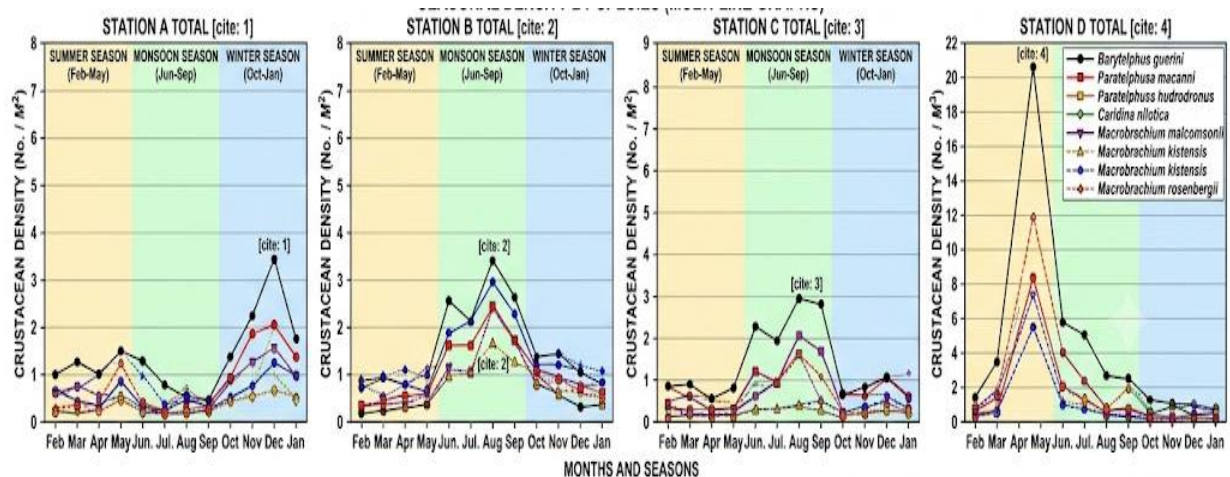


Figure 1: Monthly and seasonal variations in the population density (No./m^2) of macro-crustacean species across four sampling stations (A, B, C, and D) at the Rui Project reservoir during the study period

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