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Insights into Mesozooplankton Abundance, Biomass Distribution, and Species Composition in Coastal Waters of Pakistan

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The mesozooplankton species composition, numerical abundance, seasonal distribution, and environmental parameters, as well as copepod biomass, were studied in the mangrove creek area along the Karachi coast. Environmental parameters such as surface water temperature, pH, suspended sediments, transparency, and dissolved oxygen were initially influenced by seasonal changes. The data were subjected to cluster, factor, and correlation analyses to identify grouping patterns of mesozooplankton and their relationships with environmental factors. Species diversity indices, including equitability, dominance, and similarity, showed significant differences between stations, with notable variation across seasons. Mesozooplankton biomass also exhibited consistent seasonal fluctuations, peaking during the pre-monsoon period. A total of twenty-seven mesozooplankton taxa were identified. Mesozooplankton density increased during the post-monsoon at stations S1 and S2, with a significant difference observed. The similarity percentage analysis (SIMPER) indicated that mesozooplankton groups displayed the greatest similarities within seasons at both stations. Principal component analysis of environmental parameters, biomass estimates, and diversity indices was conducted, and the resulting factors were correlated with mesozooplankton data. Five factors were extracted from the PCA out of 17 variables.

[**Keywords:** *Mesozooplankton, environmental parameters, seasonal dynamics, factor correlation analysis, and SIMPER*]

INTRODUCTION

The study of marine environments is essential due to the cumulative impact of human activities on these delicate ecosystems. Within marine settings, estuarine ecosystems are particularly dynamic, where water circulation interacts with terrestrial influences such as river inflows and sewage discharge, resulting in considerable variability in the distribution and structure of plankton populations (Mallin and Pearl, 1994; Elliott & McLusky, 2002). Of special significance within estuaries are micro- and mesozooplankton, which are key components of the aquatic community. They serve as vital links between primary production and higher trophic levels (Newmann-Leaitao et al., 2001; Garcia_Seoane et al., 2023). This plankton constitutes over fifty percent of the food source for roughly fifty percent of fish species, including their larval stages, and occupies a central position in the pelagic food chain (Kiorboe, 1997). Their distribution and abundance in marine ecosystems are profoundly influenced by spatiotemporal variations in hydrochemical conditions and physical forces (Cloern et al., 1989). Mesozooplankton play a crucial role in trophic pathways and biogeochemical cycles; recent studies have provided valuable insights into their global and regional dynamics. New research has broadened understanding of mesozooplankton ecology across different regions and environmental conditions. Seasonal variations and community structures of mesozooplankton have been examined in coastal systems, including the Eastern Levantine Basin, where their abundance, composition (mainly copepods), and biomass fluctuate with stratification and temperature throughout the year. Studies in major upwelling zones have demonstrated how seasonal upwelling influences mesozooplankton trophic dynamics and community composition. Increased primary production during upwelling supports higher herbivory and alters trophic indices, as evidenced by nitrogen stable isotope analyses. Long-term studies and size-structure analyses in the Canary Current System have revealed seasonal shifts in mesozooplankton size spectra and community composition, highlighting diel vertical migrations and changes in abundance driven by environmental factors. Polar and subpolar regions also exhibit shifts in mesozooplankton distribution, abundance, and biomass; recent records off the Western Antarctic Peninsula document community composition and depth-related distribution of key taxa during the austral summer. Collectively, these s