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SEASONAL VARIATION AND DIVERSITY OF MANGROVE GASTROPODS FROM SANDSPIT BACKWATER MANGROVE AREA, KARACHI COAST

Sidra Mushtaq, Farzana Yousuf and Ateeqa Baloch
Department of Zoology, University of Karachi, Pakistan (SM, FY); Marine Reference Collection and Resource Centre, University of Karachi, Pakistan (AB)
email: sidramushtaq2795@gmail.com

ABSTRACT: This study investigates the seasonal variation and diversity of mangrove-associated gastropods in the Sandspit backwater mangrove ecosystem along the Karachi coast from July 2023 to February 2024. Gastropods were sampled across low, mid and high tidal zones during pre-monsoon, monsoon and post-monsoon seasons. A total of six species belonging to four families and five genera were recorded, with Potamididae being the most dominant family (62.5%), followed by Littorinidae, Ellobiidae, and Onchidiidae. Species richness and abundance were highest in the low-tide zone and showed slight seasonal increases during the post-monsoon period. Diversity indices indicated a moderately diverse but highly even gastropod community ($H' = 1.08$; $D = 0.337$; $J' = 0.990$). Comparison with previous studies spanning four decades revealed a marked decline in gastropod richness at Sandspit, suggesting potential environmental degradation, habitat alteration, and anthropogenic pressures. Notably, *Littoraria angulifera* and *Littoraria carinifera* were recorded for the first time from this area. The findings provide an updated assessment of gastropod diversity and highlight the need for continued monitoring and conservation of mangrove-associated fauna along the Karachi coast.

KEYWORDS: Mangrove gastropods, Sandspit backwaters, Seasonal variation, Species diversity, Karachi coast.

INTRODUCTION

The coastal environment is vital for maintaining ecological balance and climate stability, with mangroves being one of its most important ecosystems. Found along tropical and subtropical coasts and estuaries, mangroves are salt-tolerant trees that thrive at the land-sea interface under dynamic tidal conditions (Nybakken, 1992; Kordi, 2012). Highly productive and diverse, mangroves provide essential ecological, economic and environmental benefits (Mitsch, 2005). They regulate tides, reduce wave and wind energy, stabilize shorelines, and protect coastal areas from erosion and storm damage (Miththapala, 2008).

Gastropods are the largest and most diverse group of molluscs, comprising 75,000-150,000 species found in both aquatic and terrestrial habitats (Vermeij, 1973; Barker, 2001). In mangrove ecosystems, they play essential ecological roles by inhabiting roots, trunks, and sediments, where they aid in nutrient cycling, organic matter decomposition, and sediment stabilization (Slim *et al.*, 1997; Fratini *et al.*, 2008). Acting as grazers, detritivores, and filter feeders, mangrove gastropods enhance ecosystem productivity and support higher trophic levels as an important food source for birds, crabs, and fish (Al-Sayed *et al.*, 2008).

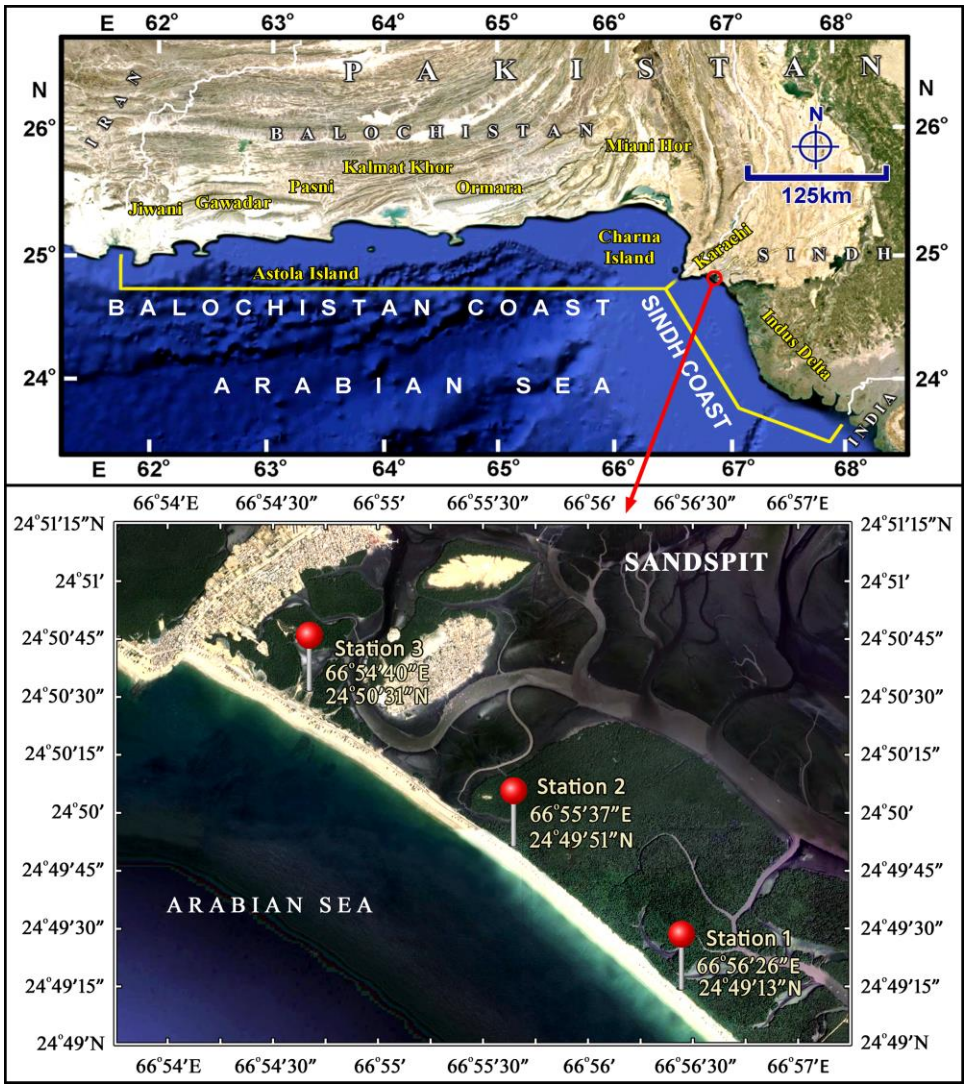

Fig. 1. Study area map; Sandspit, stations: I (24° 49' 13" N 66° 56' 26" E); station II (24° 49' 51" N 66° 55' 37" E); station III (24° 50' 31" N 66° 54' 40" E).

Due to their abundance, low mobility, and sensitivity to habitat changes, gastropods serve as reliable bioindicators of mangrove health and water quality (Tjokrokusumo, 2006; Yap *et al.*, 2009). Beyond their ecological value, certain species possess bioactive compounds with potential pharmacological applications, including antitumor properties (Putri *et al.*, 2012).

From the Sindh coast, mangrove gastropods were studied by Saifullah, (1982), Tirmizi and Barkati (1983 a, b; 1985; 1988), Barkati and Tirmizi, (1987), Barkati and Rahman (2005), Nazim *et al.*, (2015), Ziaullah *et al.*, (2015) and Khanam *et al.*, (2020). This study

aims to document and analyze the seasonal variation and diversity of mangrove gastropods inhabiting the Sandspit backwater mangrove ecosystem along the Karachi coast.

MATERIALS AND METHODS

Sampling was carried out at three stations in the Sandspit backwaters, Karachi (Fig. 1), from July 2023 to February 2024 during low tide. Seasonal surveys covered pre-monsoon (Jan-Feb), monsoon (Aug-Sep), and post-monsoon (Nov-Dec) periods. At each station, three transects were laid from low to high tide marks, with three fixed quadrats (0.5 × 0.5 m) placed in the low, mid, and high tidal zones. Gastropods collected from each quadrat were bagged, labeled, and taken to the laboratory, where they were photographed, sorted, measured, sexed, and examined microscopically. Species identification followed standard taxonomic literatures (Tirmizi, 1985; Kazmi *et al.*, 2018) and WoRMS (2025). Samples were preserved in 70% ethanol and deposited in the Marine Reference Collection & Resource Centre, University of Karachi. Community structure was analyzed using Shannon-Wiener diversity (H'), Pielou's evenness (J'), and Margalef's richness index (D).

RESULTS AND DISCUSSION

Results: At Sandspit, air temperature ranged from 22°C to 31°C, peaking during the post-monsoon season and reaching its lowest values in the pre-monsoon period. Water temperature followed a similar pattern, varying between 21°C and 30°C, with the highest temperature recorded in the post-monsoon and the lowest in the pre-monsoon. Salinity showed noticeable fluctuations, spanning from 36‰ to 42‰, with maximum values during the monsoon and minimum values in the pre-monsoon season. The pH remained relatively consistent, varying only slightly between 7.8 and 7.9; the highest value was noted in the monsoon, while the lowest was recorded during both pre- and post-monsoon periods (Fig. 3).

The present study assessed the occurrence and abundance of gastropod species across low, mid, and high tidal zones using the quadrat method in the Sandspit backwaters mangrove area of the Karachi coast from July 2023 to February 2024. The highest abundances were recorded in the low-tide zone during the pre-monsoon (n = 71), monsoon (n = 75), and post-monsoon (n = 51) periods, while the lowest counts were observed in the mid- and high-tide zones, with pre-monsoon (n = 28), monsoon (n = 25), and post-monsoon (n = 29)

A total of six gastropod species belonging to four families and five genera were documented from the study area. The family Potamididae comprised two species: *Telescopium telescopium* and *Pirenella cingulata* while Littorinidae also included two species, *Littoraria angulifera* and *Littoraria carinifera*. Onchidiidae was represented by a single species *Onchidium sp.*, and Ellobiidae by *Melampus taeniolatus*. (Fig. 2, Table 1).

Seasonal abundance patterns revealed that Potamididae was the most dominant family with a total of 235 individuals, followed by Littorinidae (n = 75), Ellobiidae (n = 45), and Onchidiidae (n = 21). Potamididae recorded seasonal counts of 89 (pre-monsoon), 86 (monsoon), and 60 (post-monsoon). Littorinidae showed increasing abundance from pre-monsoon (n = 15) to monsoon (n = 28) and post-monsoon (n = 32). Onchidiidae shows seasonal abundance (n = 8) in pre-monsoon, (n = 7) in monsoon, (n = 6) in post-monsoon; Ellobiidae shows seasonal abundance (n = 12) in pre-monsoon, (n = 16) in monsoon, (n = 17) in post-monsoon.

Fig. 2. A, *Telescopium Telescopium*, B, *Pirenella cingulata*, C, *Littoraria angulifera*, D, *Littoraria carinifera*, E, *Onchidium sp.*, F, *Melampus taeniolatus.*

Overall percentage composition indicated that Potamididae contributed the highest share (62.5%), followed by Littorinidae (19.9%), Ellobiidae (11.9%), and Onchidiidae (5.5%). Seasonal percentage composition also varied, with Potamididae contributing 71.7% (pre-monsoon), 62.7% (monsoon), and 52.1% (post-monsoon); Littorinidae increasing from 12.0% (pre-monsoon) to 20.4% (monsoon) and 27.8% (post-monsoon); Onchidiidae remaining relatively low at 6.4%, 5.1%, and 5.2%; and Ellobiidae contributing 9.6%, 11.6%, and 14.7% across the respective seasons (Fig. 4).

Diversity index at Sandspit backwaters mangrove area, Karachi coast. represents Shannon-Wiener diversity index (H′) of 1.08, Margalef's richness index (D) of 0.337, and an Evenness (J) value of 0.990, indicating a moderately diverse but highly even gastropod community (Table 2).

Table 1. Gastropod species collected from Sandspit backwaters mangrove area, Karachi coast during July 2023 to February 2024.

S.No	Family	Species
1	Potamididae	*Telescopium telescopium* (Linnaeus, 1758)
		Pirenella cingulata (Gmelin, 1791)
2	littorinidae	*Littoraria angulifera* (Lamarck, 1822)
		Littoraria carinifera (Menke, 1830)
3	Onchidiidae	*Onchidium sp.*
4	Ellobiidae	*Melampus taeniolatus* (Hombron and Jacquinot, 1851)

Table 2. Diversity index Shannon - Wiener diversity index, Margalef's index and Evenness at Sandspit backwaters Karachi coast during July 2023 to February 2024.

Location	No. of individual (n)	Shannon - Wiener diversity index H'	Margalef's index D	Evenness J'
Sandspit backwaters	376	1.088	0.337	0.990

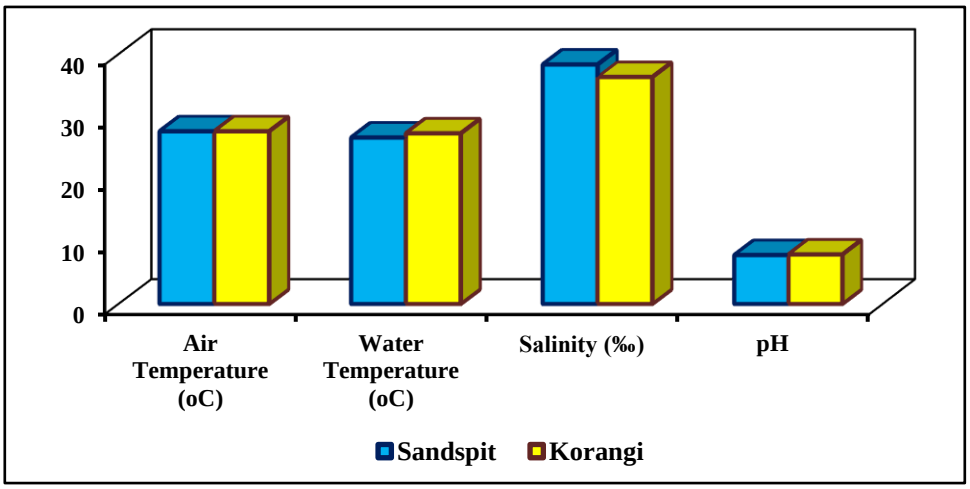

Fig. 3. Physico-chemical parameters of water collected from Sandspit backwater mangrove areas of Karachi coast during July 2023 to February 2024.

Discussion: During the present study, six gastropod species belonging to four families and five genera were recorded from the Sandspit backwaters. The family Potamididae was represented by two species: *Telescopium telescopium* and *Pirenella cingulata*, and was the most dominant group, contributing 62.5% of the total individuals. The family Littorinidae also comprised two species, *Littoraria angulifera* and *Littoraria carinifera*, while one species each belonged to family Onchidiidae (*Onchidium* sp.) and Ellobiidae (*Melampus taeniolatus*). The diversity and distribution patterns observed in this study show notable differences when compared with previous investigations conducted in the same area. Earlier records have documented higher gastropod diversity in the Sandspit backwaters.

Tirmizi, (1985) reported 10 species in the 1980s, while Barkati and Rehman (2005) recorded 8 species from the same region. More recently, Zia Ullah *et al.*, (2015) reported 12 species, and Nazim *et al.*, (2015) documented a total of 18 gastropod species across five coastal sites, with Sandspit backwaters exhibiting the highest diversity, prominently dominated by *Telescopium telescopium* and *Cerithidea cingulata*. In contrast, the present findings of only six species indicate a notable decline in gastropod richness.

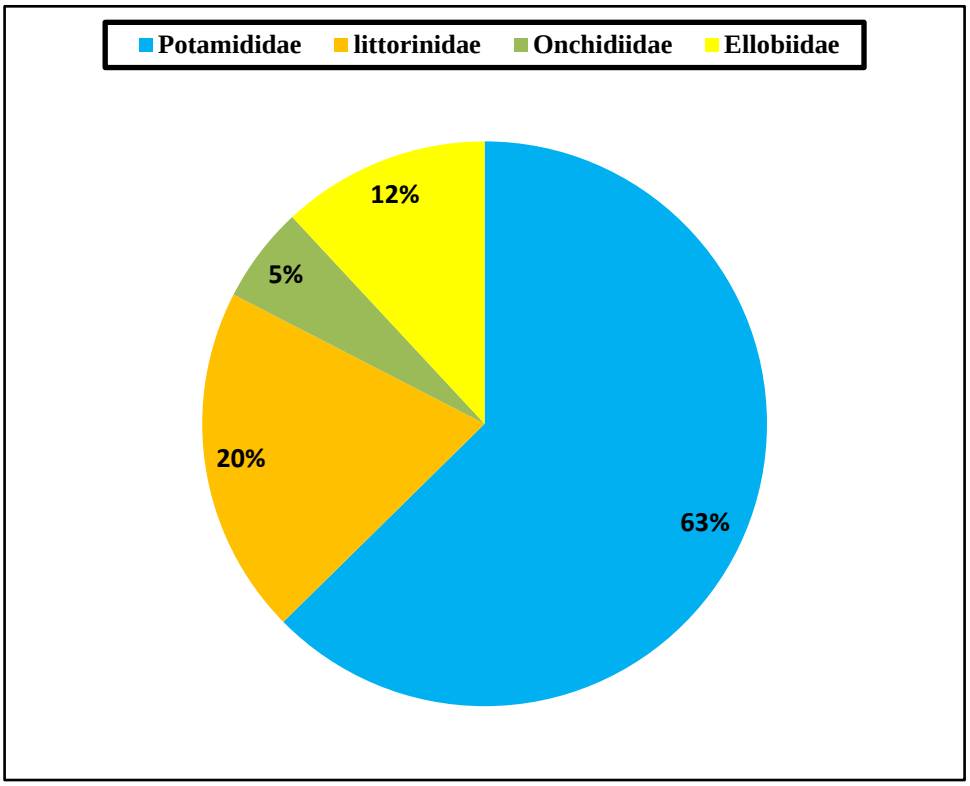

Fig. 4. Percentage composition (%) of gastropods (families) collected from Sandspit backwaters mangrove area, Karachi coast during July 2023 to February 2024.

A comparative evaluation spanning four decades from Tirmizi, (1985) to the present study highlights important patterns of species persistence, disappearance, and new occurrences within the Sandspit backwaters. Gastropods are vital components of mangrove ecosystems, functioning as detritivores, herbivores, and occasional predators. They play a significant role in organic matter decomposition, nutrient recycling, and sediment stabilization (Slim *et al.*, 1997; Zvonareva and Kantor, 2016). Their diversity and abundance are influenced by key environmental factors such as salinity, substrate type, vegetation density, and tidal regimes (Silaen *et al.*, 2013).

Importantly, the present study reports the first occurrence of *Littoraria angulifera* and *Littoraria carinifera* from the Sandspit backwaters. These species may indicate improved taxonomic resolution, natural range expansion, or earlier underreporting due to limited

sampling efforts in previous decades.

This downward trend in species diversity may reflect increasing environmental degradation, habitat fragmentation, pollution, or other ecological pressures affecting molluscan communities in mangrove ecosystems. Declining water quality, alterations in sediment characteristics, reduction in mangrove cover, and intensifying anthropogenic activities are potential factors contributing to biodiversity loss in intertidal habitats. These observations underscore the need for continued monitoring and targeted studies to assess the impact of growing anthropogenic stressors on coastal biodiversity.

CONCLUSION

Overall, this study provides an updated baseline on the current status of gastropod diversity in the Sandspit backwaters. The observed decline in species richness relative to earlier records calls for further ecological investigations and strengthened conservation measure to protect the fragile mangrove-associated faunal communities of Karachi's coastal zone.

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