Pakistan Journal of Marine Sciences, Vol. 34(1), 51-59, 2025.

SEASONAL ABUNDANCE AND DISTRIBUTION OF FAMILY-OCYPODIDAE FROM SANDSPIT BACKWATER MANGROVE AREA, KARACHI COAST

Huma Khan and Farzana Yousuf
Department of Zoology, University of Karachi.
email: huma06149@gmail.com

ABSTRACT: This study examines the seasonal variations and diversity of Ocypodidae crabs inhabiting the Sandspit backwater mangrove ecosystem along the Karachi coast. A total of 79 crabs were recorded across the different tidal zones (low, mid, and high) within three stations from July 2023 to February 2024, covering pre-monsoon, monsoon, and post-monsoon seasons. Four species were identified: *Austruca annulipes, Austruc alactea*, *Tubuca urvillei*, and *Ocypode rotundata* during whole study period. Seasonal variations were observed, within the highest numbers recorded in the post-monsoon season and the lowest during the monsoon. *Austruca annulipes* was the most dominant species in the study area. These findings align with previous studies and highlighted the ecological significance of Ocypodidae crabs in mangrove habitats. The results contribute to understanding mangrove-associated crab diversity in Pakistan and highlight the need for long-term monitoring of environmental parameters influencing crab populations.

KEYWORDS: Ocypodidae, mangrove, crabs, diversity, Karachi Coast

INTRODUCTION

The mangrove ecosystem is an area with high biodiversity.Brachyuran crabs are an important component of the mangrove ecosystem and are among the most significant taxa in terms of species diversity and total biomass in mangrove swamps (Jones, 1984, Macintosh, 1984, Ashton *et al*., 2003). In mangroves, they comprise up to 80% of the macrofaunal biomass, and their densities can reach 80-90 m-2 (Macintosh, 1984). There are herbivores, detritivores, and omnivores among the mangrove crab fauna, with certain species feeding on other crabs (Wilson, 1989; Steinke *et al*., 1993; Nagelkerken *et al*., 2008).

In mangrove habitats, crabs perform a variety of essential functions that are essential to the stability and well-being of these ecosystems. According to Warren and Underwood (1986), this activity also aids in changing the topography and spreading grain sizes across the sediment, which in turn affects the mangrove habitat's structure. Their burrowing practices produce microhabitats that sustain a wide variety of different creatures, enhancing the ecosystem's overall richness (Bright and Hogue, 1972; Gillikin *et al.*, 2001).

The family Ocypodidae consists of burrowing crabs that inhabit intertidal regions across tropical and temperate marine environments globally (Shih *et al*., 2016). They are sometimes referred to asland crabs, though only a small number have entirely eliminated their reliance on periodic tidal flooding. Ocypodidaeis presently composed of two subfamilies: Ocypodinae Rafinesque, 1815, which includes ghost crabs, and Ucinae Dana, 1851, which comprises fiddler crabs (Ng *et al*., 2008; Davie *et al*., 2015). Fiddler crabs are dominant along the intertidal zones of tropical and subtropical shores (Crane,

1975). Following a taxonomic revision by Shih *et al*. (2016), multiple new species of fiddler crabs have been identified, bringing the current classification to 11 genera and 107 species (Shih *et al*., 2018, 2019; Shih and Poupin, 2020). Research on fiddler crabs in this region has predominantly concentrated on their taxonomy and distribution, with some studies addressing molecular phylogenetics (Shih *et al*., 2009, 2018), population genetics (Shih *et al*. 2015; Odhano *et al*., 2018), larval development (Hashmi, 1968; Ghory and Siddiqui 2006; Al-Aidaroos, 2013), as well as aspects of behavior and ecology (Mokhlesi *et al*., 2011; Saher and Qureshi 2012, 2017).

In Pakistan, the family Ocypodidae represented by five genera and a total of 15 species (Kazmi *et al*., 2022). Previous studies on this family in Pakistan have been conducted by Tirmizi (1985), Saher and Qureshi (2012), and Saher *et al*., (2014, 2018a, b).This study aims to document and analyze the seasonal variation and diversity of Ocypodidae crabs inhabiting the Sandspit backwater mangrove ecosystem along the Karachi coast.

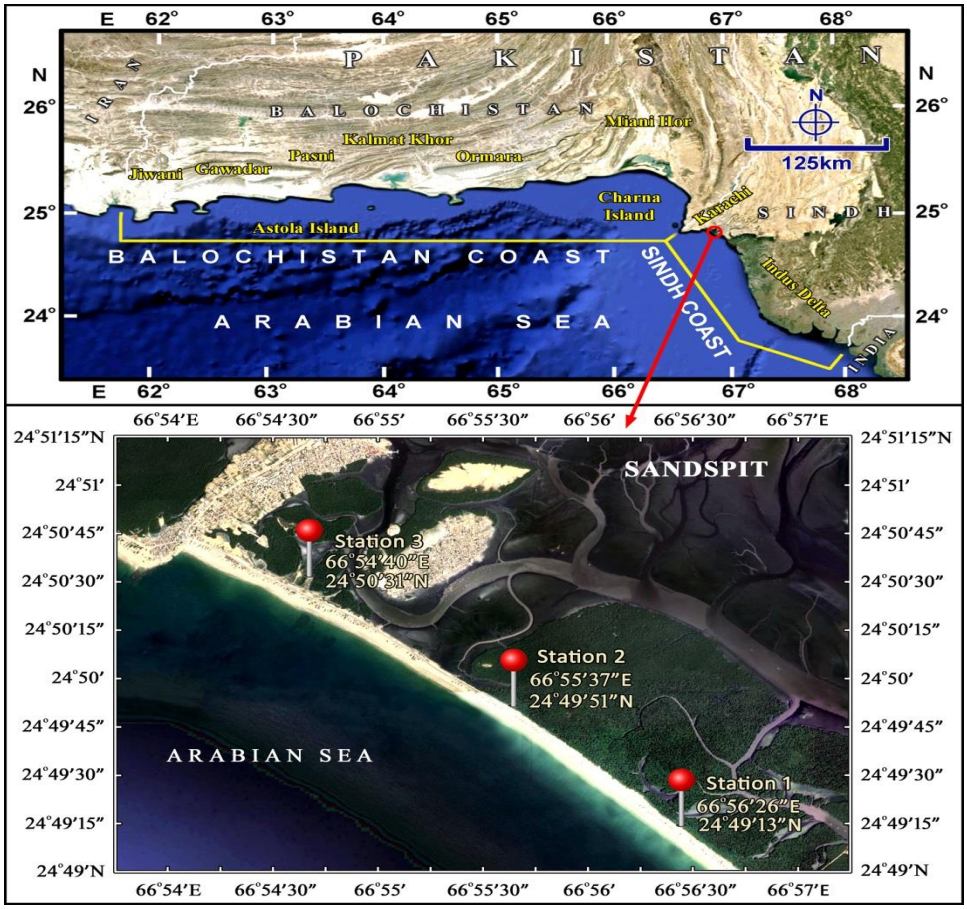

Fig. 1. Study area map; Sandspit, stations: I (24°49'13"N 66°56'26"E); station II (24°49'51"N 66°55'37"E); station III (24°50'31"N 66°54'40"E).

MATERIALS AND METHODS

Monitoring and sampling were conducted at the Sandspit backwaters of the Karachi coast across three designated stations during July 2023 to February 2024. Sampling was performed during low tides at Station I (24° 49' 13" N, 66° 56' 26" E), Station II (24° 49' 51" N, 66° 55' 37" E), and Station III (24° 50' 31" N, 66° 54' 40" E) on a seasonal basis: pre-monsoon (January-February), monsoon (August-September), and post-monsoon (November-December) (Fig. 1). Three transects were established at each station, spanning from the low tide mark to the high tide mark, with three fixed quadrats (0.5m × 0.5m) set up in each zone (low, mid, high), spaced 30 to 50 meters apart. Crabs collected from each quadrat were placed in labeled polythene bags and transported to the laboratory for further analysis. Specimens were photographed in the field, sorted, measured, sexed, and examined under a microscope. Identification was performed using taxonomic keys and available literature (Tirmizi & Ghani, 1983; Tirmizi, 1985; Tirmizi & Ghani, 1996; Tirmizi & Kazmi, 1996), and nomenclature was designated as per WoRMS (World Register of Marine Species, 2025) guidelines. Samples were preserved in 70% ethanol, tagged with date and location, and deposited in the Repository Museum of Marine Reference Collection & Resource Centre, University of Karachi.Statistical analysis of the macrobenthic faunal community structure included the Shannon-Wiener(1949) diversity index (H'), Pielou's(1966) Evenness Index (J'), and Margalef's Index(1951) (D) to assess species diversity and distribution.

RESULT AND DISCUSSION

Physicochemical parameters: Physico-chemical parameters air and water temperature (°C), salinity (‰) and pH were recorded and presented in (Table 1). At Sandspit, air temperature varied between 22°C and 31°C, with the highest temperature 31°C recorded in the post-monsoon period and the lowest 22°C in the pre-monsoon. Water temperature ranged from 21°C to 30°C, with the maximum 30°C observed in the post-monsoon and the minimum 21°C in the pre-monsoon. Salinity levels fluctuated between 36‰ and 42‰, reaching the highest 42‰ during the monsoon and the lowest 36‰ in the pre-monsoon. The pH levels remained relatively stable, ranging from 7.8 to 7.9, with the highest 7.9 recorded in the monsoon, while the lowest 7.8 was observed in both the pre-monsoon and post-monsoon (Fig. 2).

Table 1. Seasonal variations in percentage composition of crabs from Sandspit backwaters mangrove area, Karachi coast during July 2023 to February 2024.

S. No.	Family	Crab species	Nos	Pre-monsoon (%)	Monsoon (%)	Post-monsoon (%)
1.	**Ocypodidae**	*Austruca annulipes*	40	55.17 (16)	41.66 (5)	50.0 (19)
2.		*Austruca lactea*	14	20.68 (6)	25.0 (3)	13.15 (5)
3.		*Tubuca urvillei*	11	10.34 (3)	16.66 (2)	15.78 (6)
4.		*Ocypode rotundata*	14	13.79 (4)	16.66 (2)	21.05 (8)
			Total	**29**	**12**	**38**

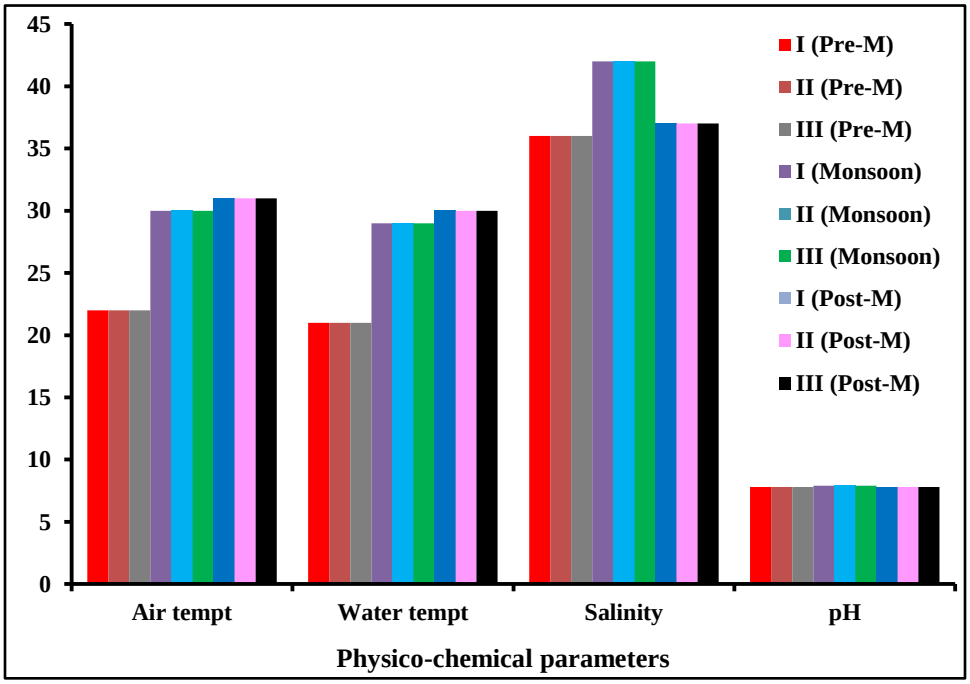

Fig. 2. Physico-chemical parameters of water collected from Sandspit backwater mangrove areas of Karachi coast during July 2023 to February 2024.

The study recorded a total of 79 Ocypodidae crabs across different tidal zones (low, mid, and high) withinthree stations (I, II, III) at Sandspit backwaters mangrove area along the Karachi coast from July 2023 to February 2024 during pre-monsoon, monsoon, and post-monsoon seasons.Crab abundance varied seasonally. The pre-monsoon season had a total of 29 crabs, with the highest numbers in the low tidal zone (n=14), followed by the high (n=9) and mid (n=6) zones. During the monsoon season, crab numbers declined to 12, with the low zone (n=7), followed by the mid (n=3) and high (n=2) zones. In the post-monsoon season, abundance increased to 38 crabs, in the low zone (n=16), in the mid zone (n=9), and in the high zone (n=13).

Four crab species were identified across the tidal zones e.g. *Austruca annulipes*, *Austruca lactea*, *Tubuca urvillei*, *Ocypode rotundata*. *Austruca annulipes* (Fig. 4) was mainly present in the low and mid zones during the pre-monsoon, in the low zone during the monsoon, and again in the low zone post-monsoon. *Austruca lactea* was found in the low zone pre-monsoon, in low and mid zones during the monsoon, and across all three zones post-monsoon. *Tubuca urvillei* appeared in the low and mid zones pre-monsoon, shifted to the mid zone in the monsoon, and was again in low and mid zones post-monsoon. *Ocypode rotundata* was consistently observed in the high zone throughout all three seasons (Table 1; Fig. 3).

Among the species, *Austruca annulipes* was the most abundant, making up 55.17% of the total population in pre-monsoon, 41.66% (monsoon), and 50.0% (post-monsoon). *Austruca lactea* contributed 20.68% (pre-monsoon), 25.0% (monsoon), and 13.15%

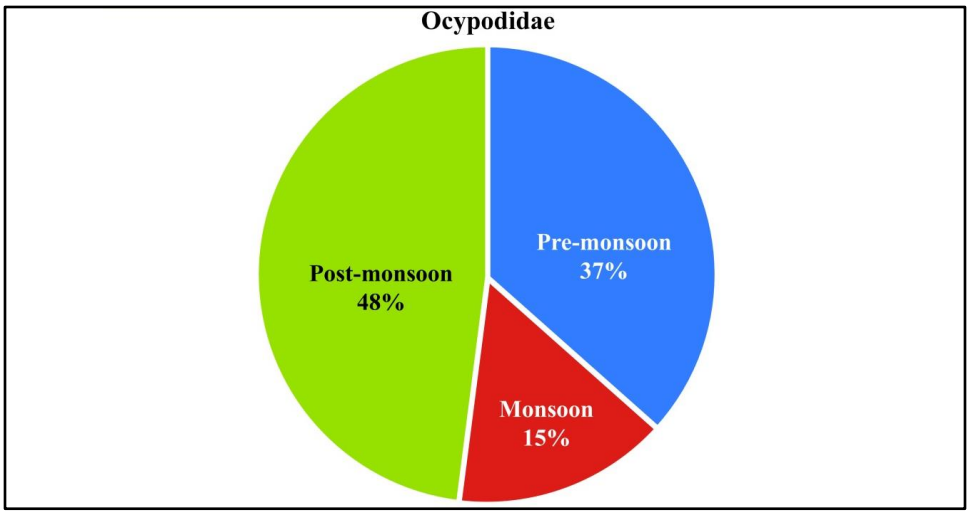

Fig. 3. Seasonal variations in crab abundance from Sandspit backwater mangrove areas of Karachi coast during July 2023 to February 2024.

Fig. 4. A, *Austruca annulipes*; B, *Austruca lactea*; C, *Tubuca urvillei*; D, *Ocypode rotundata*.

(post-monsoon). *Tubuca urvillei* accounted for 10.34% (pre-monsoon), 16.66% (monsoon), and 15.78% (post-monsoon). *Ocypode rotundata* was 13.79% (pre-monsoon), 16.66% (monsoon), and 21.05% (post-monsoon) (Table 1).

Diversity indices showed seasonal variations. The pre-monsoon period had a Shannon–Wiener index (H') of 1.07, Margalef's index (D) of 0.29, and Evenness index (J') of 0.89. During the monsoon, species richness declined, with H' at 0.86, D at 0.21, and J' at 0.77. In the post-monsoon, diversity improved, with the highest values recorded (H' = 1.23, D = 0.32, J' = 0.92), indicating a more balanced species distribution (Table 2).

Table 2. Seasonal diversity index Shannon – Wiener index, Margalef's index and Evenness from Sandspit backwater mangrove area of Karachi coast during July 2023 to February 2024.

Season	No. of individual (n)	Shannon-Wiener diversity index H'	Margalef's index D	Evenness J'
Pre-monsoon	29	1.07	0.29	0.89
Monsoon	12	0.86	0.21	0.77
Post-monsoon	38	1.23	0.32	0.92

The present study provides an assessment of the seasonal variation and diversity of Ocypodidae crabs inhabiting the Sandspit backwater mangrove ecosystem along the Karachi coast. Our findings highlight distinct seasonal patterns in abundance and distribution across tidal zones, supporting previous studies on crab ecology in mangrove environments (Qureshi and Saher, 2012; Saher *et al*., 2018b). The highest abundance was recorded during the post-monsoon season, whereas the monsoon season exhibited the lowest numbers. This seasonal variation is likely influenced by environmental factors such as salinity, temperature, and tidal fluctuations, which affect crab activity and reproduction cycles.

Among the identified species, *Austruca annulipes* was the most dominant, aligning with previous studies that have recognized this species as a key component of the mangrove crab community along the Karachi coast (Nazim *et al*., 2010; Qureshi and Saher, 2012). *Austruca lactea* and *Tubuca urvillei* showed lower relative abundances as compared to *A. annulipes*. *Ocypode rotundata* was consistently found in the high tidal zone throughout all three seasons, suggesting a strong preference for drier, sandy substrates, which is in accordance with findings from earlier studies (Saher and Qureshi, 2011).Comparison with previous studies indicates that our recorded species composition aligns with earlier reports on mangrove crab diversity in Pakistan. For instance, Tirmizi (1985) recorded *Uca annulipes* and *U. urvillei* along the Karachi coast, while Qureshi (2002) and Qureshi and Saher (2012) expanded the list to include *U. lactea* and *U. sindensis* in mangrove areas. Our study similarly documented *Austruca annulipes* and *Tubuca urvillei*, though *U. sindensis* was not observed in the Sandspit region during this study period. The absence of *U. sindensis* may be attributed to habitat differences, temporal shifts in distribution, or sampling limitations.

Findings from other regions also reveal comparable trends in crab diversity and dominance of the Ocypodidae family. Van Tho Le *et al*., (2018) reported that the Ocypodidae family accounted for 45.5% of brachyuran species in the mangrove areas of

Tra Vinh, Vietnam. Similarly, Freitas Jr *et al*., (2021) documented the dominance of Ocypodidae crabs in the Babitonga Bay mangrove ecosystem over an eight-year period. These studies underscore the global ecological significance of Ocypodidae crabs as key benthic organisms contributing to sediment turnover and nutrient cycling in mangrove systems.

The present study contributes research on mangrove-associated crab diversity in Pakistan. Further long-term investigations, incorporating environmental parameters such as sediment characteristics, salinity variations, and food availability, will enhance our understanding of the ecological drivers shaping Ocypodidae crab populations along the Karachi coast.

REFERENCES

Al-Aidaroos, A.M. 2013. Laboratory-hatched first zoeal stage of *Uca* (*Cranuca*) *inversa* (Crustacea: Brachyura: Ocypodidae) of the Red Sea. *Mar. Biodiver. Rec.* 6: e124.

Ashton, E.C., P.J. Hogarth and D.J. Macintosh, 2003. A comparison of brachyuran crab community structure at four mangrove locations under different management systems along the Melaka Straits-Andaman Sea Coast of Malaysia and Thailand. *Estuar.* 26: 1461-1471.

Bright, D.B. and C. Houge, 1972. A synopsis of the burrowing land crabs of the world and list of their arthropod symbionts and burrow associates: Los Angeles County Natural History Museum. *Sci. Contr.* 220: 1-58.

Crane, J. 1975. Fiddler Crabs of the World (Ocypodidae: Genus *Uca*). Princeton University Press, Princeton, New Jersey. pp. 23+736.

Davie, P.J.F., D. Guinot and P.K. Ng, 2015. Systematics and classification of Brachyura. *In*: (Eds.: Castro, P., P.F.J. Davie, D. Guinot, F.R. Schram and J.C. von Vaupel Klein), Treatise on zoology-anatomy, taxonomy, biology-the Crustacea, complementary to the volumes translated from the French of the Traité de Zoologie 9(C) (I), Decapoda: Brachyura (Part 1), Brill, Leiden: 1049-1130.

Freitas Jr, F., R.A. Pescinelli, R.C. Costa, J.C. Hilesheim, F.L. Dieh and J.O. Branco, 2021. Brachyuran crab diversity across spatial and temporal scales in a mangrove ecosystem from the western Atlantic. *Reg. Stud. Mar. Sci.* 43: 101703.

Ghory, F.S. and F.A. Siddiqui, 2006. A comparative study of the first zoeal stage of *Uca urvillei* and *Uca annulipes* (Crustacea: Brachyura: Ocypodidae) reared in the laboratory. *Turk. J. Zool.* 30(2): 161-166.

Gillikin, D.P., S. De Grave and J.F. Tack, 2001. The occurrence of the semi-terrestrial shrimp *Merguia oligodon* (De Man, 1888) in *Neosarmatium smithi* H. Milne Edwards, 1853 burrows in Kenyan mangroves. *Crust.* 74(5): 505-507.

Hashmi, S.S. 1968. Study on larvae of (Gelasimus) (Ocypodidae) reared in the laboratory (Decapoda: Crustacea). *Pak. J. Sci. Res.* 20: 50-56.

Jones, D.A. 1984. Crabs of the mangal ecosystem. *In*: (Eds.: Por, F.D. and I. Dor). Hydrobiology of the mangal. W. Junk Publishers, Boston. pp. 89-109.

Kazmi, Q.B., M.M. Khan, R. Naushaba and M.A. Kazmi, 2022. Marine faunal diversity of Pakistan: Inventory and taxonomic resources. Zoological Society of Pakistan: Lahore. pp. 721.

Le, V.T., V.T. Nguyen, N.D.M. Tran, D. Lee, W. Kim, V.S. Dang, D.D. Phan and D.T. Luong, 2018. Species composition and distribution of brachyuran crabs in Duyen Hai town, Tra Vinh province. *Vietnam J. Sci. Technol. Engineer.* 60(4): 39-44.

Macintosh, D.J. 1984. Ecology and productivity of Malaysian mangrove crab population (Decapoda: Brachyura). *In*: Proc. As. Symp. Mangr. Env. Res. Manag., UNESCO (Paris) 20 (1984). pp. 354-377.

Margalef, R. 1951. Diversidad de especiesen las comunidades naturales. *Publicac. del Instituto de Biol. Aplicad.* 6(1): 59-72.

Mokhlesi, A., E. Kamrani, P. Backwell and M. Sajjadi, 2011. Study on the behaviour of two fiddler crabs, *Uca sindensis* and *Uca annulipes* (Decapoda: Ocypodidae), in Bandar Abbas, Iran. *J. Mar. Biol. Assoc. U.K.* 91(1): 245-249.

Nagelkerken, I.S.J.M., S.J.M. Blaber, S. Bouillon, P. Green, M. Haywood, L.G. Kirton, J.O. Meynecke, J. Pawlik, H.M. Penrose, A. Sasekumar and P.J. Somerfield, 2008. The habitat function of mangroves for terrestrial and marine fauna: a review. *Aquat. Bot.* 89(2): 155-185.

Nazim, K., M. Ahmed, M.U. Khan, N. Khan and S.S. Shaukat, 2010. The diversity of crabs in some mangrove forests of Karachi, Pakistan. *Int. J. Biol. Biotech.* 7(3): 235-240.

Ng, P.K., D. Guinot and P.J. Davie, 2008. Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. *Raff. Bull. Zool.* 17(1): 1-286.

Odhano, S., N.U. Saher and M. Kamal, 2018. Studies on isozyme variations and morphometric relationship among three populations of *Austruca sindensis* (Alcock 1900) from Pakistan. *Thalass.: Int. J. Mar. Sci.* 34: 311-322.

Pielou, E.C. 1966. The measurement of diversity in different types of biological collections. *J. Theoret. Biol.* 13: 131-144.

Qureshi, N.A. 2002. Population Dynamics and Dispersal Pattern of Fiddler Crabs in the Mangroves Areas of Karachi Coast. Centre of Excellence in Marine Biology. pp. 230. PSF/Res/S-KU/Envr(51)

Qureshi, N.A. and N.U. Saher, 2012. Burrow morphology of three species of fiddler crab (*Uca*) along the coast of Pakistan. *Belg. J. Zool.* 142(2): 114-126.

Saher, N.U. and N.A. Qureshi, 2011. Diversity and distribution of mangrove crabs in three intertidal areas of Balochistan, Pakistan. *Pak. J. Mar. Sci.* 20(1&2): 27-36.

Saher, N.U. and N.A. Qureshi, 2012. Spatial distribution of *Uca sindensis* (Crustacea, Ocypodidae) along the coast of Pakistan. *Egypt. Acad. J. Biol. Sci., B. Zool.*, 4(1): 119-129.

Saher, N.U. and N.A. Qureshi, 2017. Construction of earthen structure as a sexual signals in the fiddler crabs. *Int. J. Aquat. Biol.* 5(1): 40-46.

Saher, N.U., N. Kanwal, M.A. Gondal, Z. Amanat and N.A. Qureshi, 2018a. Diversity indices and distribution of brachyuran crabs found in the lagoon waters of Sonmiani, Balochistan. *Ind. J. Geo Mar. Sci.* 47(03): 712-720.

Saher, N.U., N.A. Qureshi and A.S. Siddiqui, 2018b. Influence of sediment characteristics on density and distribution of Ocypodoid crab burrows (superfamily: Ocypodoidea) along the coastal areas of Pakistan. *Acta Ecol. Sin.* 38(3): 234-241.

Saher, N.U., O. Sahir, H.T. Shih, M. Kamal and N.A. Qureshi, 2014. On a new record of the genus *Uca* (Decapoda, Brachyura, Ocypodidae) found along the coast of Pakistan. *Crust.* 87(6): 666-673.

Shannon, C.E. and W. Weaver, 1949. The Mathematical theory of Communication. Urbana: University of Illinois Press.

Shih, H.T. and J. Poupin, 2020. A new fiddler crab of *Austruca* Bott, 1973, closely related to *A. perplexa* (H. Milne Edwards, 1852) (Crustacea: Brachyura:

Ocypodidae), from the South Pacific islands. *Zool. Stud.*, 59: e26.

Shih, H.T., B.K. Chan and P.K. Ng, 2018. *Tubuca alcocki*, a new pseudocryptic species of fiddler crab from the Indian Ocean, sister to the southeastern African *T. urvillei* (H. Milne Edwards, 1852) (Crustacea, Decapoda, Brachyura, Ocypodidae). *ZooKey.* 29(747): 41-62.

Shih, H.T., E. Kamrani, P.J. Davie and M.Y. Liu, 2009. Genetic evidence for the recognition of two fiddler crabs, *Uca iranica* and *U. albimana* (Crustacea: Brachyura: Ocypodidae), from the northwestern Indian Ocean, with notes on the *U. lactea* species-complex. *Hydrobiol.* 635: 373-382.

Shih, H.T., N.U. Saher, E. Kamrani, P.K. Ng, Y.C. Lai and M.Y. Liu, 2015. Population genetics of the fiddler crab *Uca sindensis* (Alcock, 1900)(Crustacea: Brachyura: Ocypodidae) from the Arabian Sea. *Zool. Stud.* 54: 1-10.

Shih, H.T., P.K. Ng, P.J. Davie, C.D. Schubart, M. Türkay, R. Naderloo, D. Jones and M.Y. Liu, 2016. Systematics of the family Ocypodidae Rafinesque, 1815 (Crustacea: Brachyura), based on phylogenetic relationships, with a reorganization of subfamily rankings and a review of the taxonomic status of *Uca* Leach, 1814, sensulato and its subgenera. *Raff. Bull. Zool.* 64: 139-175.

Shih, H.T., P.K. Ng, S. Ravichandran and M. Prema, 2019. Resurrection of *Gelasimus variegatus* Heller, 1862, a fiddler crab closely related to *Austruca bengali* (Crane, 1975) and *A. triangularis* (A. Milne-Edwards, 1873) (Decapoda, Brachyura, Ocypodidae), from the Bay of Bengal, Indian Ocean. *Zool. Stud.* 58: e12.

Steinke, T.D., A. Rajh and A.J. Holland, 1993. The feeding behaviour of the red mangrove crab *Sesarma meinerti* De Man, 1887 (Crustacea: Decapoda: Grapsidae) and its effect on the degradation of mangrove leaf litter. *S. Afr. J. Mar. Sci.* 13(1): 151-160.

Tirmizi, N.M. 1985. Mangrove fauna (invertebrates) of Karachi-Sind Coast. Pakistan Agricultural Research Council, Res. Rept. No. 1 Marine Collection Centre, University of Karachi, pp. 66.

Tirmizi, N.M. and N. Ghani, 1983. Economic importance of shell fish in mangroves. (in Urdu). 22nd National Science Conference, Karachi.

Tirmizi, N.M. and N. Ghani, 1996. Marine fauna of Pakistan: 5. Crustacea, Brachyura, Brachyrhyncha Part 1. Centre of Excellence in Marine Biology, University of Karachi. p. 65.

Tirmizi, N.M. and Q.B. Kazmi, 1996. Marine fauna of Pakistan: 6. Crustacea: Brachyura, Brachyrhyncha Part II (Portunidae). MRC Publication: p. 1-72.

Warren, J.H. and A.J. Underwood, 1986. Effects of burrowing crabs on the topography of mangrove swamps in New South Wales. *J. Exp. Mar. Biol. Ecol.*, 102(2-3): 223-235.

Wilson, K.A. 1989. Ecology of mangrove crabs: predation, physical factors and refuges. *Bull. Mar. Sci.* 44(1): 263-273.

World Register of Marine Species, 2025. https://www.marinespecies.org/