

A DENSE POPULATION AND MASS SCALE SPAWNING OF *ARENICOLA BRASILIENSIS* NONATO, 1958 (CLASS POLYCHAETA: FAMILY: ARENICOLIDA) AT GWADAR, BLOCHISTAN

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ABSTRACT

A dense population of lugworm (*Arenicola brasiliensis*) was observed on the intertidal area on the sandy shore at Gwadar (Pedi Zur) in December 2025, which is the first record of its occurrence in the Gwadar area. The species was found distributed in a stretch of about 1 km. An analysis of the abundance of the lugworm population was carried out, which revealed a maximum population of 38 lugworms (number of coiled casts)/m² in the Mid-Tide level. No lugworm was found in the Splash Fringe Level or in the subtidal zone. A maximum of 8 egg masses/m² in the Mid-Tide Level indicates mass scale spawning of lugworm in the area.

Keywords: Lugworm, *Arenicola brasiliensis*, egg masses, casts, Gwadar (Pedi Zur), spawning, sandy shore

INTRODUCTION

The lugworm is a genus of capitellid annelid that is found globally in coastal sandy and sandy-cum-muddy intertidal zones. Lugworms are found in the intertidal sandy shores and make a U-shaped burrow in sand. At the surface, the head shaft is marked by a small saucer-shaped depression. The lugworm lies in this burrow with its head at the base of the head shaft, swallowing sand. Organic matter ingested with the sand is rapidly digested, and the processed sand is periodically defecated at the surface near the tail end of the burrow in a distinctive, long, coiled casting.

From Pakistan, two species of lugworms, namely *Arenicola cristata* Stimpson, 1856, which was reported by Bhatti and Soofi (1949a-b) and later on included in the list of polychaetes of Pakistan by (Ali *et al.*, 2023; Kazmi and Naushaba, 2013; Kazmi *et al.*, 2023; Mustaqim, 1997) and *A. brasiliensis* Nonato, 1958, which was reported from Pakistan by (Ashraf, 1968) and later on added to the checklist of polychaetes by Ali *et al.*, (2023); Kazmi and Naushaba, (2013); Kazmi *et al.*, (2023); Mustaqim, (1997). Some aspects of ecology and breeding of *A. brasiliensis* on the sandy shore of Buleji (Hawksbay), Karachi, were studied by Ahmad and Niazi (1974); Ahmed, (1977). Moazzam and Rizvi (1983) reported *A. brasiliensis* from Karachi and Pasni. During a recent survey large number of lugworms were found on the Gwadar (Padi Zur). The present paper provides information about the distribution, abundance, ecology, and breeding of *Arenicola* from Gwadar.

MATERIAL AND METHODS

A survey of the intertidal area along the Gwadar (Padi Zur) during the low tide has been regularly undertaken since 2024, which is a part of the environmental assessment of the Gwadar area. On December 23-24, 2025, a large number of coiled sandy casts were observed in the midlittoral zone in an area of about 1.0 km in the Padi Zur (Latitude 25.142558° and 25.13175° and Longitude 62.319006° and 62.319147°) located within the limits of Gwadar Town (Fig. 1). Concentration of lugworms was counted from two adjacent quadrates each of 1 m² from the high-tide level and the low-fringe level. The average of two adjacent quadrants was used for the estimate of the population of lugworms at each tidal level.

RESULTS

A dense population of lugworms was recorded from the study area (Fig. 2). Morphological analysis of the lugworm collected from Gwadar (Padi Zur) revealed that it is *Arenicola brasiliensis* Nonato, 1958, as it is characteristically similar to the description of the species provided by Ashraf (1968), and Tampi, and Rangarajan

(1963). Due to the lack of facilities at Gwadar, an anatomical study was not conducted. *A. cristata* Stimpson, 1856, was previously reported by Bhatti and Soofi (1949a-b) from Pakistan. *A. brasiliensis* can be distinguished from *A. cristata* based on the shape of the casting and egg mass, colour, and habitat. *A. brasiliensis* extrudes distinct, earthworm-like, coiled castings (Fig. 3), whereas *A. cristata* produces formless films or heaps of sand. The egg masses of *A. brasiliensis* are firm and egg-shaped (Fig. 3), whereas *A. cristata* forms gelatinous streamers. *A. brasiliensis* is generally pinkish-tan and less robust, while *A. cristata* tends to be greenish-black. *A. brasiliensis* is commonly found on sandy beaches, whereas *A. cristata* is often found in muddier or quieter areas.



Fig. 1. Map of Gwadar showing the study area (between the two marked spots).



Fig. 2. (a) Coiled casts of *Arenicola brasiliensis* at Gwadar (Padi Zur). (b) Dorsal view of *Arenicola brasiliensis*. (c) Ventral view of *Arenicola brasiliensis*.

Ali *et al.* (2023) provided information about polychaetes from the Makran coast; however, the genus *Arenicola* is not mentioned in their list. Similar Mustafaquim (1997) did not report lugworms from Balochistan. Moazzam and Niaz Rizvi (1983) studied some ecological aspects of *A. brasiliensis* from Karachi and Pasni. The present paper, therefore, records the presence of lugworm (*Arenicola brasiliensis*) for the first time from Gwadar (Padi Zur), Balochistan coast.

Data for the abundance of lugworms in Gwadar (Padi Zur) indicates a dense population of lugworms on the vast sandy beach. The number of a single coiled cast was considered as an indication of a single specimen (Fig. 3), which was used to estimate the distribution and abundance of lugworm on this sandy shore. The lugworms were found to be distributed between the high-tide level and the low-fringe level. No lugworm was observed in the splash-fringe

level (near the boulders) and marine zone (subtidal area). Although the entire area of the eastern side of Gwadar (Padi Zur), between the headland and D. C. Office, was surveyed, lugworms were found to be present in an area of 1 km south of the park (near the office of the Gwadar Development Authority). No lugworm was found outside the study area during the reporting period (23-24 December, 2025). The data for the abundance of lugworms in the intertidal area (5 zones) and every 200 m (along the beach) were collected, which is present in the “Kite Diagram” (Fig. 4).

A very thin population of lugworm was found at both extremities of the study area (Fig. 4). The main concentration of the lugworms was found between 100 and 600 m from the starting point (south of the park near the office of the Gwadar Development Authority). In the intertidal area, their highest concentration was found at the mean tide level, where the highest concentrations of 38 lugworms/m² and 24 lugworms/m² were found at 400 m and 600 m from the starting point, respectively.



Fig. 3. Casts and egg masses of *Arenicola brasiliensis* at Gwadar (Padi Zur)

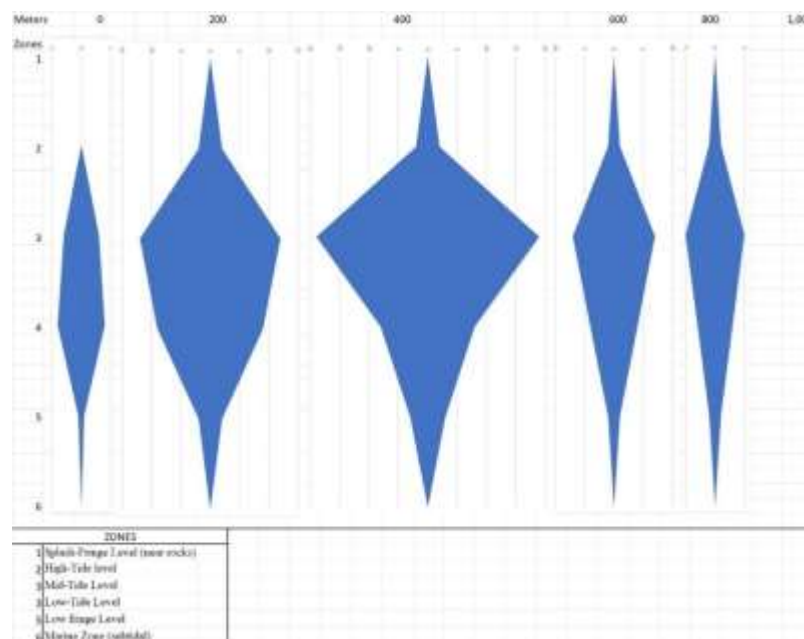


Fig. 4. Kite diagram showing vertical and horizontal distribution of *Arenicola brasiliensis* coiled casts at Gwadar (Padi Zur)

The egg cases were also reported from Gwadar (Padi Zur). The egg case of *Arenicola brasiliensis* is a gelatinous, tongue-shaped mass-produced during mass spawning, filled with developing larvae within a clear jelly, anchored by rootlets in the sand, eventually detaching to allow larvae to hatch and burrow. During the study, egg cases were counted from the sandy shore from 1 km south of the park (near the office of the Gwadar Development Authority), every 200 m. The data of these egg cases counted at Mid-tide level is presented in Table-I which revealed that the number of egg cases was higher (6 to 7/m²) in the area where a dense population of lugworms was counted. No egg case was found at both extremities of the study area. No egg case was also found at the high-water mark (Splash-Fringe Level and High-Tide level) and at the subtidal area (Table-II). The highest concentration of egg cases was found at the Mid-Tide Level and the Low-Tide Level, which is the same level where dense concentrations of casts of lugworms were counted (Fig. 4).

Table 1. Distribution of *Arenicola brasiliensis* at Mid-Tide Level at Gwadar (Padi Zur) (1 km south of the park (near the office of the Gwadar Development Authority).

| Distance from Extreme North | Number of Egg Masses/Square Meter |
|-----------------------------|-----------------------------------|
| 0 | 0 |
| 200 | 1 |
| 400 | 6 |
| 600 | 7 |
| 800 | 2 |
| 1000 | 0 |

Table 2. Distribution of *Arenicola brasiliensis* in the Intertidal area at Gwadar (Padi Zur) (400 south of the park).

| Location in the Intertidal Zones | Number of Egg Masses/Square Meter |
|----------------------------------|-----------------------------------|
| Splash-Fringe Level (near rocks) | 0 |
| High-Tide level | 0 |
| Mid-Tide Level | 8 |
| Low-Tide Level | 7 |
| Low fringe Level | 2 |
| Marine Zone (subtidal) | 0 |

DISCUSSION

Arenicola brasiliensis is reported from different parts of the Pacific, Indian and Atlantic Oceans (Tempi and Rangarajan, 1963). This species is known from the USA (North Atlantic), Hawaii, California, Peru, Brazil, Japan, Australia, New Zealand, the Nicobar Islands, Andaman Islands, India, Yemen, Pakistan (GBIF, 2025). Along the coast of Pakistan, it was reported from Buleji (Hawksbay), Karachi (Ahmad and Niazi, 1974; Moazzam and Niazi Rizvi, 1983; Bhatti and Soofi, 1949a-b; Mustaqim, 1997) and Pasni (Moazzam and Niazi Rizvi, 1983). The present paper extends its distribution further west along the coast of Gwadar, Balochistan. It may be added that identification of lugworm (*Arenicola brasiliensis*) in this paper is based on morphological characters as facilities for anatomical study was not available at Gwadar.

Arenicola brasiliensis, like other lugworms, prefers sandy-cum-muddy beaches. At Buleji (Hawksbay), Karachi, it is found on the flat tidal shore near a rocky outcrop, protected against direct wave action. The shore has stones and cobbles, which help in accumulating sand and mud, making a suitable habitat for the lugworm. Ashraf (1969) pointed out the dense concentration of *A. brasiliensis* on this shore. Hedgpeth (1964) observed that *A. cristata*

Stimpson occurs only where sediment is deposited along a rocky outcrop. A similar habitat was reported by Ahmad and Niazi (1974) at Buleji, Hawksbay, Karachi. Gwadar (Padi Zur) is a protected beach because it is located within the arc of the tombolo, and wave action is minimized because of the Gwadar Headland.

Ahmad and Niazi (1974) and Moazzam and Niaz-Rizvi (1983) recorded a maximum density of 20 lugworms/m² which is slightly less than the maximum density observed during the present study (38 lugworms/m²). Tempi and Rangarajan (1963) reported a density of 6 lugworms/m² on the sandy shores of Malacca Bay in the Car Nicobar Islands, India. Chapman and Newell (1949) observed a maximum density of 33 to 55/m² (converted from square yard) of castings of lugworm (*Arenicola marina*) from flats of Whitstable, UK, which is higher than the observed density during the present study. Goerlitz *et al.* (2013) observed a patchy distribution of a lugworm, *Abarenicola affinis*, at tidal inlets of Otago, New Zealand, with an overall mean abundance of 11.1 individuals/m² (range: 3.8 to 21.3 individuals/m²). Boldina and Beninger (2014) observed a mean density of *Arenicola marina* was 22.82 individuals/m² at Bourgneuf Bay on the French Atlantic coast. From the Dutch Wadden Sea, Beukema (1976) and Cadée (1976) have observed a high density of 42 *A. marina*/m² whereas densities up to 200 *A. claderperri*/m² and 50 *A. cristata*/m² have been reported from Japan (Takahashi, 1934). The observations made during the present also indicate a patchy distribution of lugworm (*A. brasiliensis*) on Gwadar (Padi Zur), ranging from 0 to 38 lugworms/m². The variation reported from various parts of the world may be attributed to the features of the beaches, species involved, and prevailing environmental conditions.

Spawning females of most species of *Arenicola* produce and tether egg masses, which are often 8-10 cm long and 5-7 cm in diameter, by a thick strand of gel extending into the sediment (Strathmann, 2000). During the present study, a maximum of 8 egg masses/m² was observed at the Mid-Tide Zone at Gwadar (Padi Zur). Ahmad and Niazi (1974) have observed a maximum of 22 egg masses/m² at Buleji (Hawksbay), Karachi. Ahmed (1977) reported almost a similar density of egg masses from the Hawksbay area. In Florida, D'Asaro and Chen (1976) observed that *A. cristata*, which has 14 worms/m² can produce an average of 12 egg masses/m². The variation in the number of egg masses in different parts of the intertidal area, as well as on geographical scales, can be attributed to the species involved, and prevailing environmental conditions, especially characteristics of the beach, as well as the temperature regime.

Considering a dense population of lugworm (*Arenicola brasiliensis*) in the intertidal area of Gwadar (Padi Zur), it is expected that this species may have a wider distribution along the Balochistan coast; therefore, there is a need to study the distribution of lugworms on other sandy beaches of the area. There is also a need to study their seasonal distribution pattern in Gwadar and other beaches of Balochistan

REFERENCES

- Ahmad, M. F. and M. S. Niazi (1974). Observation on tubing, intertidal distribution and migration of the common lugworm *Arenicola brasiliensis* Nanato at Buleji coast, Karachi. *Records Zoological Survey of Pakistan*, 6: 1-14.
- Ahmed, M. (1977). An assessment of the magnitude of coastal pollution in Pakistan through a study of its fauna and fisheries. *Thalassia Jugosalvaica*, 13: 395-412.
- Ali, Q. M., Q. Ahmed, G. Kurt, L. Bat, S. Mubarak, H. Qazi, A. Baloch, I. Shaikh, A. Baloch, N. Aziz, S. Ahmed, A. Ali, I. Ahmed, and A. Ghalib (2023). First report on distribution of polychaetes (Annelida: Polychaeta) along the Makran coast of Pakistan, Northern Arabian Sea. *Journal of Materials and Environmental Science*, 14: 277-292.
- Ashraf, S.A. (1968). Occurrence of *Arenicola brasiliensis*, Polychaete from Karachi. *Pakistan Journal of Science* 20: 285-286
- Beukema, J. J. (1976). Biomass and species richness of the macro-benthic animals living in the tidal flats of the Dutch Wadden Sea. *Netherlands Journal of Sea Research*, 10: 236-261.
- Bhatti, K.H. and M. Soofi (1949a). *Arenicola*: a polychaete from Karachi. *Pakistan 1st Pakistan Science Conference* (Abstract).
- Bhatti, K.H. and M. Soofi (1949b). *Arenicola*: a polychaete from Karachi. *Pakistan Journal of Science*, 1: 76-77.
- Boldina, I. and P. G. Beninger (2014). Fine-scale spatial distribution of the common lugworm *Arenicola marina*, and effects of intertidal clam fishing. *Estuarine, Coastal and Shelf Science*, 143: 32-40.
- Cadée, G. C. (1976). Sediment reworking by *Arenicola marina* on tidal flats in the Dutch Wadden Sea. *Netherlands Journal of Sea Research*, 10: 440-460.
- Chapman, F. and G. E. Newell (1949). The distribution of lugworms (*Arenicola marina* L.) over the flats of Whitstable, *Journal of Marine Biological Association of the United Kingdom*, 28: 627-634.

- D'Asaro, C. N. and H. C. K. Chen (1976). *Lugworm Aquaculture*. Florida Sea Grant Program Report No. 16. State University System of Florida, Gainesville, Florida, USA. 123p.
- GBIF (2025). The Global Biodiversity Information Facility. *GBIF Home Page*. (<https://www.gbif.org>)
- Goerlitz, S., K. Berkenbusch and P. K. Probert (2013). Distribution and abundance of *Abarenicola affinis* (Arenicolidae, Polychaeta) in tidal inlets of Otago, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 47: 548-560.
- Hedgpeth, J. W. (1968). *Between the Pacific Tides*. Stanford University Press, Stanford, California.
- Kazmi, Q. B. and R. Naushaba (2013). Checklist of marine worms reported from Pakistani marine waters. *Pakistan Journal of Nematology*, 31: 187-280.
- Kazmi Q. B., R. Naushaba, M. Moazzam and M. A. Kazmi (2022). *Marine Faunal Diversity of Pakistan: Inventory and Taxonomic Resources*. Zoological Society of Pakistan, Lahore, Pakistan 721p.
- Moazzam, M., and S. H. Niaz Rizvi (1983). Some ecological aspects of lugworm *Arenicola brasiliensis* (Annelida) from Pakistan coast. *29th Pakistan Science Conf., Karachi*. P.10B.
- Mustaqim, J. (1997). Marine worms (Polychaeta) of Pakistan. In: (Mufti, S.A., C. A. Wood, and S. A. Hasan, eds.). *Biodiversity of Pakistan*. Pakistan Museum of Natural History (PMNH) and Florida Museum of Natural History (FMNH), Gainesville. pp. 221-227.
- Nonato, E. (1958). Sobre duas Arenicolas da costa Brasileira (Annelida, Polychaeta). *Contribuições Avulsas do Instituto Oceanográfico: Oceanografia biologic*, 3: 1-6.
- Stimpson, W. (1855). On some remarkable marine Invertebrates inhabiting the shores of South Carolina. *Proceedings of the Boston Society for Natural History*, 5: 110-117.
- Strathmann, R. R. (2000). Form, function, and embryonic migration in large gelatinous egg masses of arenicolid worms. *Invertebrate Biology*, 119: 319-328.
- Takahashi, K. (1934). Contribution to the study of Japanese *Arenicola*. Notes on the habits and distribution of *Arenicola* in Japan. Scientific Report of *Tokyo Bunrika Daigaku Ser. B.*, 1: 271-279.
- Tampi, P. R. S. and K. Rangarajan (1963). On the occurrence of *Arenicola brasiliensis* Nonato (Family: Arenicolidae, Polychaeta) in Indian waters. *Journal of Marine Biological Association of India*, 5: 108-112.