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Liomera rugata (H. Milne Edwards, 1834) (Decapoda: Xanthidae) from the Makran Coast: a new contribution to the decapod fauna of Pakistan

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Abstract

The present study documents the first confirmed record of the xanthid crab *Liomera rugata* (H. Milne Edwards, 1834) (Crustacea: Decapoda: Xanthidae) from the rocky intertidal shores of Sistag, Jiwani, along the Makran coast. Identification was established based on key diagnostic morphological characters, including a rugose, granulate carapace with distinct lobation, granulate chelipeds, and a first gonopod bearing an apically truncated tip. The examined specimens exhibit close concordance with previous descriptions from the Indo-West Pacific, thereby corroborating their taxonomic placement. This new regional record extends the known geographic range of *L. rugata* into the northern Arabian Sea, bridging a biogeographic gap between earlier reports from the Persian Gulf, Red Sea, and Indian Ocean. The finding highlights the Makran coast as a biogeographically significant yet insufficiently studied region for brachyuran diversity.

key words: Brachyura, Xanthidae, *Liomera rugata*, biodiversity record, Makran, northern Arabian Sea.

1. Introduction

Brachyuran crabs (infraorder Brachyura) represent one of the most diverse and ecologically successful groups of crustaceans, having colonized an extensive range of marine and terrestrial habitats worldwide (Warner, 1977; Ng et al., 2008). With more than 7,400 species currently described, they play a vital role in benthic ecosystems and contribute substantially to coastal biodiversity (Ng et al., 2008).

Within the infraorder, the family Xanthidae MacLeay, 1838 stands out as one of the most advanced lineages, comprising 13-15 subfamilies, more than 120 genera, and over 600 recognized species globally (Lai et al., 2011; Mendoza and Manuel-Santos, 2012; Naruse et al., 2021). Representatives of this family are commonly encountered in intertidal and reef-associated habitats of the Indo-West Pacific, where they are frequently observed grazing on

algae and detritus or sheltering beneath rocks. Due to their abundance, ecological versatility, and taxonomic richness, xanthid crabs constitute an integral component of reef-associated benthic assemblages (Lai et al., 2011). Many species are readily recognized by their darkly pigmented chelae fingers, a characteristic noted across several genera (Ho et al., 2000; Karasawa and Schweitzer, 2006; Lee et al., 2013).

In Pakistan, the family Xanthidae is represented by 22 genera and 31 species (Kazmi et al., 2022). Foundational contributions to the brachyuran fauna of the region were made by Alcock and Anderson (1894), followed by Alcock (1899) and Odhner (1925). Subsequent studies include those of Hashmi (1963, 1964), Ahmed et al. (1972), and Karim (1973). Additional records were provided by Khan (1977) and Tirmizi and Kazmi (1983), while the monograph by Sèrene (1984) offered significant systematic revisions. Later works by Tirmizi and Ghani (1988, 1992, 1996) and Ghani and Tirmizi (1992) further expanded the national faunal inventory. More recent advances include Mendoza et al. (2012) and regional syntheses by Kazmi and Moazzam (2014), Davei (2021), and Moazzam and Moazzam (2022).

The genus *Liomera* Dana, 1851 (Xanthidae) recently comprises approximately 31 recognized species (DecaNet eds., 2025). These crabs are widely distributed in tropical and subtropical waters of the Indo-West Pacific (Serène, 1984), with records extending from the Indian Ocean and Red Sea to the Persian Gulf and western Pacific (Lee and Ko, 2011).

Despite these extensive efforts, no species of the genus *Liomera* had previously been documented from Pakistan. The Makran coast remains poorly investigated in terms of marine and coastal biodiversity, with only scattered and fragmentary records available for most taxonomic groups (Kazmi et al., 2022).

The present study therefore provides the first record of *L. rugata* from Sistag, Jiwani, along the Makran coast which is scientifically important not merely as a range extension, but because it provides new insight into biogeographic connectivity between the western Indian Ocean, Arabian Sea, and the Makran coast. The occurrence of *L. rugata* from Sistag, Jiwani, an unexplored rocky shore of the Makran coast, highlights the faunal affinity of this region with the Indo-West Pacific biogeographic province and suggests the existence of dispersal pathways along the northern Arabian Sea. Therefore, such baseline species records are essential for strengthening regional biodiversity inventories, understanding faunal connectivity, and providing reference data for future assessments of climate-driven distributional shifts and coastal conservation planning.

2. Materials and methods

Two specimens of *L. rugata* were collected on 27 January 2025 during low tide from the rocky intertidal shore of Sistag, Jiwani (25°01'45"N, 61°43'35"E) (Fig. 1) along the Makran coast, northern Arabian Sea. The crabs were photographed in situ, placed in seawater containing 5% formaldehyde, and transported to the laboratory for further examination. In the laboratory, the specimens were rinsed, labeled with collection date and locality, and subsequently preserved in 70% ethanol for detailed morphological analysis.

Morphological examination was carried out using a stereomicroscope Wild 181300 (Switzerland) at a magnification of 10×50, and photographed using a camera Fujifilm 16MP. Measurements were taken using a ruler. Carapace width (CW) was measured as the distance between the lateral widest margins of the carapace dorsally, whereas carapace length (CL) was measured from the frontal margin to the posterior margin.

Identification was based on standard diagnostic characters, including the morphology of the carapace, frontal region, and anterolateral margins; the number and arrangement of anterolateral teeth; and the structure of the chelipeds, pereopods, and pleonites. In male specimens, the first gonopods (G1) were carefully dissected under a stereomicroscope using fine needles and examined after temporary mounting in glycerin and illustrations were made using a drawing tube (camera lucida). The examined material has been cataloged (MRC&RC-

BRAC-759) and deposited in the Museum Repository of the Marine Reference Collection and Resource Centre (MRC & RC), University of Karachi.

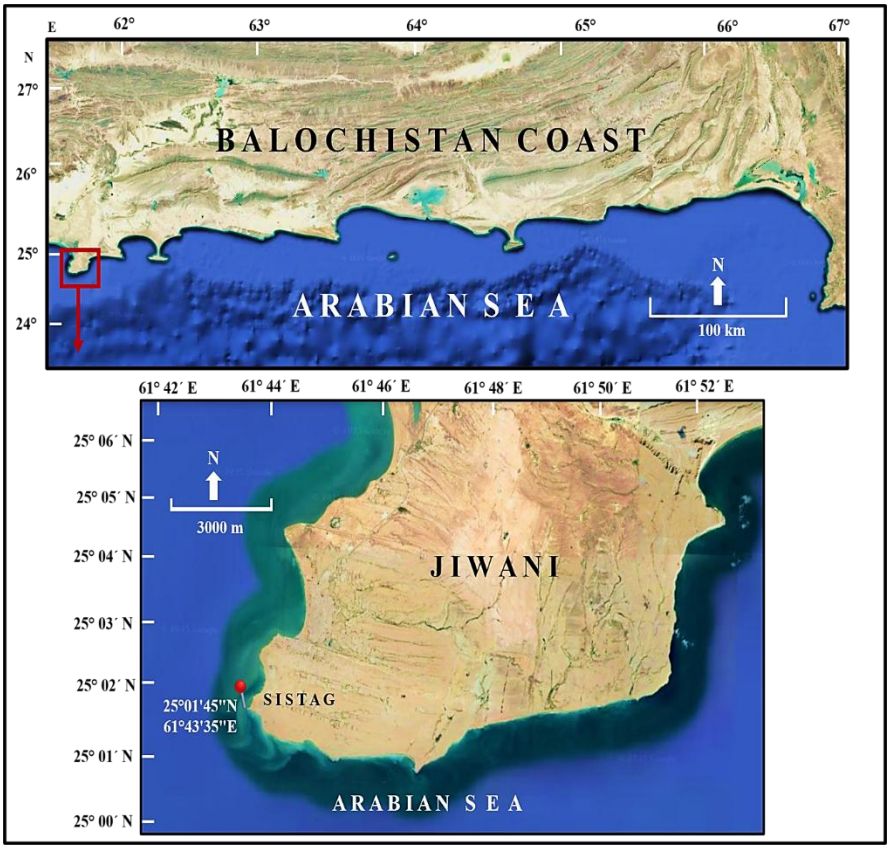

Figure 1. Study area at Sistag, Jiwani, 25°01'45"N 61°43'35"E

3. Results & Discussion

Taxonomic account

Family Xanthidae MacLeay, 1838

Genus *Liomera* Dana, 1851

***Liomera rugata* (H. Milne Edwards, 1834)**

(Figs 2, 3)

Material examined: Male (CW×CL-14×7 mm), Catalogue No. MRC&RC-BRAC-759, damaged female - Pakistan, Makran coast, Jiwani, Sistag, 25°01'45"N; 61°43'35"E, intertidal zone, 27 January 2025.

Description: Carapace broad, convex and transversely ovate, broader than long (Fig. 2A, 3A). Dorsal surface distinctly rugose, covered with minute rounded granules. Deep grooves extend both longitudinally and transversely, dividing the carapace into swollen lobes that impart a brain-like appearance (Fig. 2A, 3A). Carapace regions epigastric, mesogastric, gastric, subhepatic and branchial regions clearly defined by deep grooves and well demarcated (Fig. 2A, 3A).

Frontal region prominent, margin slightly broad and convex with shallow median indentation and two lobes separated medially by a shallow concavity; posteriorly distinguished from epigastric region by a transverse furrow (Fig. 2B). Orbits small, distinct, rounded, not projecting, supraorbital margins with granules (Fig. 2B).

Anterolateral margins convex, finely granulated and distinctly divided into four rounded lobes by shallow sinuous incisions posterior to the external orbital angle (Fig. 2A, 3A). Posterolateral margins gently converging toward lateral end of posterior margin (Fig. 2A, 3A).

Chelipeds almost symmetrical with strongly granular, tuberculate surface (Fig. 2E-F. 3B-C). Merus short, inner, outer surface covered with small rounded granules; carpus somewhat triangular, broader; margins slightly raised and granulated in both dorsal and ventral surfaces. Manus oval to elongate, swollen and strongly convex dorsally, surface granular. Proximal pollex without granule. Fingers shorter than palm, bluntly pointed, cutting margins rather smooth without distinct teeth, granulated at joint with palm, curved.

Ambulatory legs moderately short (Fig. 2D, 3D). Merus, carpus, and propodus densely covered with small, rounded granules; carpus and propodus each bearing a distinct median longitudinal furrow. Dactylus tapering, slender, ending in a sharp yellow corneous claw with short setae.

Male pleon relatively narrow (Fig. 2C). Telson coniform (Fig. 2C). G1 elongated, relatively slender (Fig. 2H); apical part cut transversely, setae concentrated on apical part (Fig. 2I, 3E).

Coloration: Carapace, chelipeds and ambulatory legs dark reddish-maroon in life as well as in preservation. Ventral surfaces distinctly lighter contrasting with the darker dorsal regions. Chelae tips whitish to pale yellowish. Dactyli tapering and tipped with corneous yellowish points.

Habitat: Found in the intertidal zone, occurring beneath rocks and boulders on rocky substrate, in areas exposed to moderate wave action.

Distribution: The species is widely distributed along the Indo-West Pacific (Serène, 1984).

Remarks: Like Original description of *L. rugata* by Milne-Edwards, (1834), our material exhibits a broad, convex, transversely ovate carapace with dense granulations and a distinctly rugose surface. Notably, the rugosity in our material is more pronounced, with deeper grooves separating swollen lobes, highlighting a slightly more developed areolation than originally reported, a feature also emphasized by Fahimi and Naderloo (2024) as a key diagnostic trait. The elevated carapace regions, separated by deep furrows and including the fused 2L+3L region with a prominent notch, conform to the account of Serène (1984). The first gonopod (G1) is elongated, slender, and apically transversely truncated with concentrated distal setae, fully matching the defining morphology of *L. rugata* (Fahimi and Naderloo, 2024).

When compared with closely related congeners, *L. rugata* can be readily distinguished by several key morphological features. Unlike *L. margaritata*, which has fused 1M and 2M, a longitudinally divided 2M, and fused 2L and 3L (Serène, 1984; Lee and Ko, 2011), *L. rugata* exhibits a broad, transversely ovate carapace with deeply rugose, brain-like areolation. In contrast to *L. schubarti* (Fahimi and Naderloo, 2024) which displays unequal carapace proportions, clearly defined areolets, and pearly granules on the chela merus and carpus, *L. rugata* has a carapace width more than twice its length, granular but non-pearly chela surfaces, and a proximal pollex without granules. Furthermore, the first gonopod (G1) in *L. rugata* is uniquely apically transversely truncated with dense distal setae, whereas in *L. schubarti*, it is elongate, straight, and bears long apical setae. These distinguishing characters confirm the identity of the present specimens and clearly separate *L. rugata* from its closest congeners.

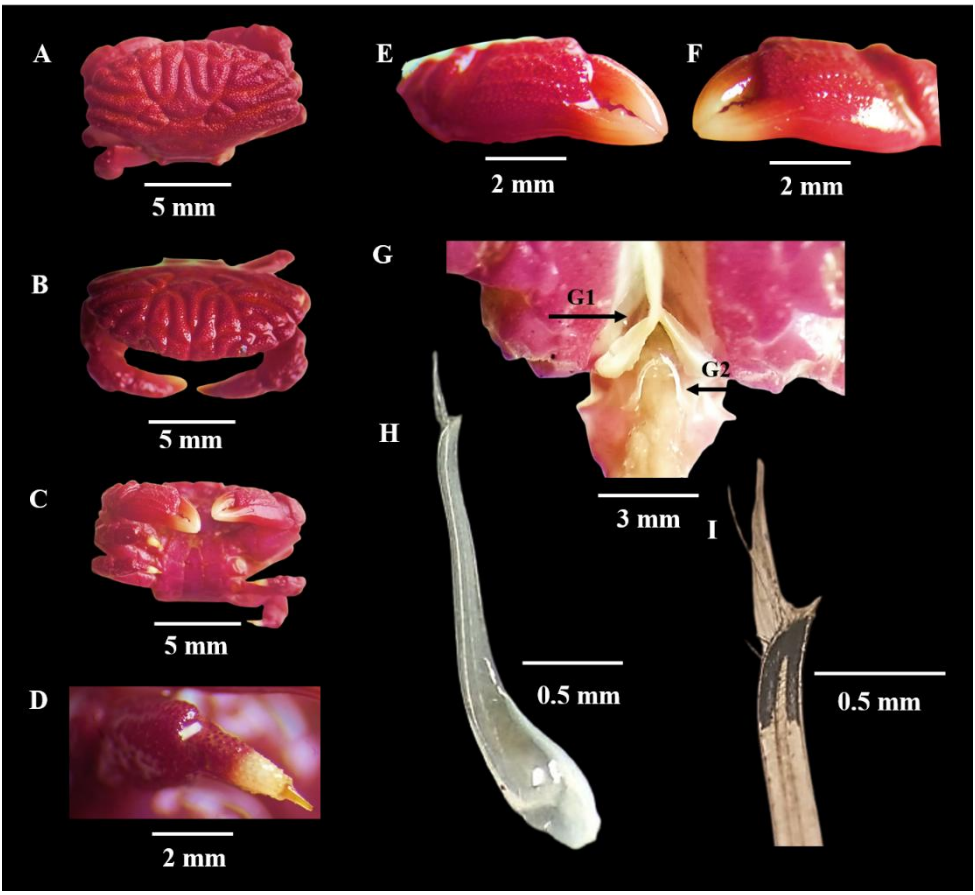

Figure 2. *Liomera rugata.* **A.** Dorsal view, **B.** Frontal view, **C.** Ventral view, **D.** Ambulatory leg, **E.** Right chela, **F.** Left chela, **G.** Abdomen showing first (G1) and second (G2) gonopods, **H.** First gonopod, **I.** Apical part of first gonopod.

4. Discussion

The present study documents the occurrence of *Liomera rugata* on the rocky intertidal shores of Sistag, Jiwani, representing the first record of the genus *Liomera* from Pakistan. This finding extends not only the known geographic range of *L. rugata* but also expands the biogeographic limits of the genus into the northern Arabian Sea.

Liomera rugata, originally described as *Zozymus rugatus* by Milne-Edwards (1834), has since been widely recorded across the Indo-West Pacific (Serène, 1984). The species has been documented extensively from reef-associated habitats in the Lakshadweep Islands, India (Rao et al., 1989; Venkataraman et al., 2004; Devi et al., 2019), as well as from the Red Sea, Saudi Arabia, Oman, Persian Gulf, Indonesia, the Philippines, Christmas Island, Djibouti, Mauritius, Mayotte, Réunion Island, Somalia, Madagascar, South Africa, the Chagos Archipelago, Australia, Easter Island, French Polynesia, Hawaii, the Marquesas Islands, New Caledonia, the Tuamotu Islands, and Wallis and Futuna (GBIF Secretariat, 2023; SealifeBase, 2025). By filling a key regional gap between previous records, the discovery

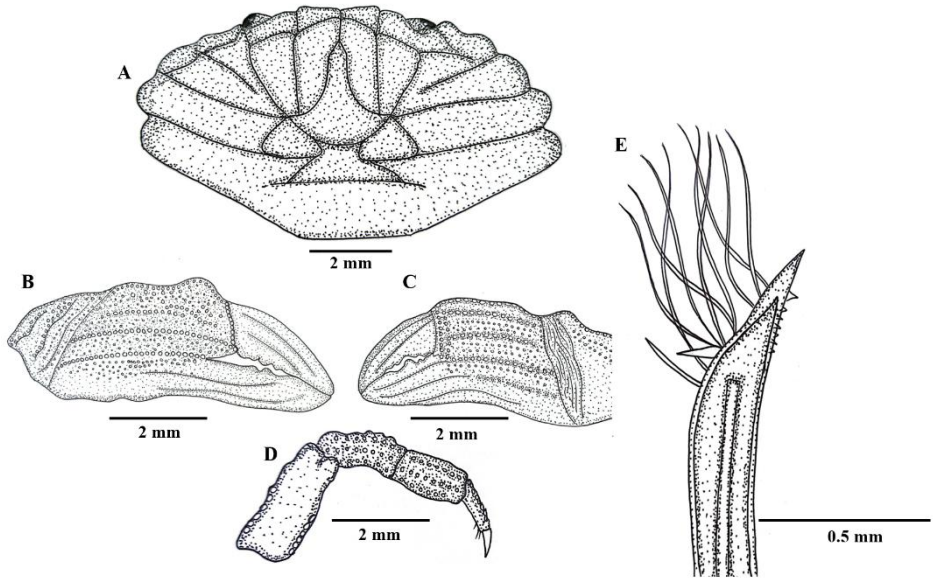

Figure 3. *Liomera rugata.* **A.** Dorsal view, **B.** Right chela, **C.** Left chela, **D.** Ambulatory leg, **E.** Apical part of first gonopod.

highlights the Makran coast as an important yet underexplored component in the connectivity of Indo-Pacific brachyuran assemblages.

The Makran coast, extending from the Strait of Hormuz in the south of Iran to in the south of Iran, represents a biogeographically important transition zone between the Persian Gulf and the open Arabian Sea in the northwestern Indian Ocean (Ghanavati et al., 2021). This region is characterized by strong seasonal variability driven by the Southwest and Northeast monsoons, which generate pronounced changes in circulation patterns, coastal upwelling, and water mass exchange (Shankar et al., 2002; Arora, 2025). Such monsoon-driven currents, together with tidal- and wind-induced circulation, play a critical role in regulating larval dispersal and connectivity of coastal invertebrates (Cowen and Sponaugle, 2009; Kembaren et al., 2018; Onsri et al., 2024), emphasizing the relevance of these mechanisms for species with planktonic larval stages in monsoon-dominated systems such as the Arabian Sea. Seasonally reversing monsoon circulation in the northwestern Indian Ocean generates southward flow during summer and northward flow in winter (Shankar et al., 2002), promoting water mass exchange (Campos et al., 2022) and facilitating larval transport and gene flow between the Persian Gulf and the Gulf of Oman (Sadeghi et al., 2021; Pazoki et al., 2021; Shahdadi et al., 2024). In such systems, larval duration and reproductive timing play a central role in shaping the phylogeographic structure of coastal invertebrates, as demonstrated for meroplanktonic, echinoderm larvae (Gaines and Bertness, 1993; Gaines et al., 2007) and rocky intertidal barnacles by Shahdadi et al. (2024).

The recent discovery of taxa such as polychaetes (Ali et al., 2023, Ali et al., 2024a, Baloch et al., 2025, Ali et al., 2025a, ,) bryozoans (Ahmed et al., 2025, Ali et al., 2025b, Baloch et al., 2025), bivalve (Ali et al., 2025c), holothuroids (Shaikh et al., 2023, Ali et al., 2024b, Ahmed et al., 2025b) and asteroids (Ali et al., 2025d, Ahmed et al., 2026) along the Makran coast, previously known mainly from distant Indo-West Pacific or western Indian Ocean localities, indicates that this coastline harbors faunal elements with broad regional affinities and supports

its role as a biogeographic transition zone. In this context, the occurrence of *L. rugata* further supports the view of Makran as a corridor linking the faunas of the Persian Gulf, Gulf of Oman, and Arabian Sea.

The absence of earlier records of *Liomera* from Pakistan, despite earlier surveys, likely reflects a combination of historical under-sampling of rocky intertidal and subtidal habitats, low detectability or cryptic occurrence, and episodic larval supply mediated by monsoon-driven circulation rather than true absence. Collectively, these processes provide plausible dispersal pathways for *L. rugata* into the Makran region and highlight the biogeographic significance of this coastline as a mixing zone with dynamic connectivity and ongoing faunal exchange across the northwestern Indian Ocean.

The diagnostic morphology of the specimens agrees with previously published Indo-West Pacific accounts (Milne-Edwards, 1834; Serène, 1984; Fahimi & Naderloo, 2024), indicating that the key taxonomic characters of this species remain stable across its range. The strong consistency in carapace sculpture and male gonopod structure supports the reliability of these features for species-level identification within the genus. Accordingly, this new record not only extends the known distribution of the genus into Pakistani waters but also reinforces current understanding of species-level morphological consistency within *Liomera.*

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Conflict of interest

The authors declare that they have no competing interests.

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