

# Species

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## Author Affiliation:

<sup>1</sup>The Marine Reference Collection and Resources Centre, 75270, Karachi, Pakistan

<sup>2</sup>Department of Hydrobiology, Faculty of Fisheries, University of Sinop. 57000 Sinop, Türkiye

## \*Corresponding author

Quratulan Ahmed

The Marine Reference Collection and Resources Centre, 75270, Karachi, Pakistan; Email: [quratulanahmed\\_ku@yahoo.com](mailto:quratulanahmed_ku@yahoo.com)

## ORCID:

Qadeer Mohammad Ali	0000-0002-0499-0801
Quratulan Ahmed	0000-0002-7597-2483
Iqra Shaikh	0000-0003-2482-1631
Levent Bat	0000-0002-2289-6691

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# New records of *Aquilonastra richmondi* (O'Loughlin & Rowe, 2006) and detailed taxonomy of *Aquilonastra iranica* (Mortensen, 1940) from Jiwani Makran Coast Balochistan, Northern Arabian Sea

Qadeer Mohammad Ali<sup>1</sup>, Quratulan Ahmed<sup>1\*</sup>, Iqra Shaikh<sup>1</sup>, Levent Bat<sup>2</sup>

## ABSTRACT

This study significantly enhances the understanding of Asteroidea diversity in the northern Arabian Sea by providing the first confirmed record of *Aquilonastra richmondi* (O'Loughlin & Rowe, 2006) and complete description of *Aquilonastra iranica* (Mortensen, 1940) along the Makran Coast of Pakistan. This study meticulously documented comprehensive morphological characteristics and habitat information for both species *A. richmondi* and *A. iranica* collected from Bandari Beach, Jiwani Makran coast. These findings contribute crucial data to verify identification accuracy and offer reliable descriptions, diagnoses, and illustrations of key taxonomic features. The current research represents a valuable addition to the known *Aquilonastra* fauna in Pakistani coastal waters, expanding the regional understanding of marine biodiversity. All identified specimens have been securely deposited in the Marine Reference Collection and Resource Centre at the University of Karachi, ensuring their accessibility for future research.

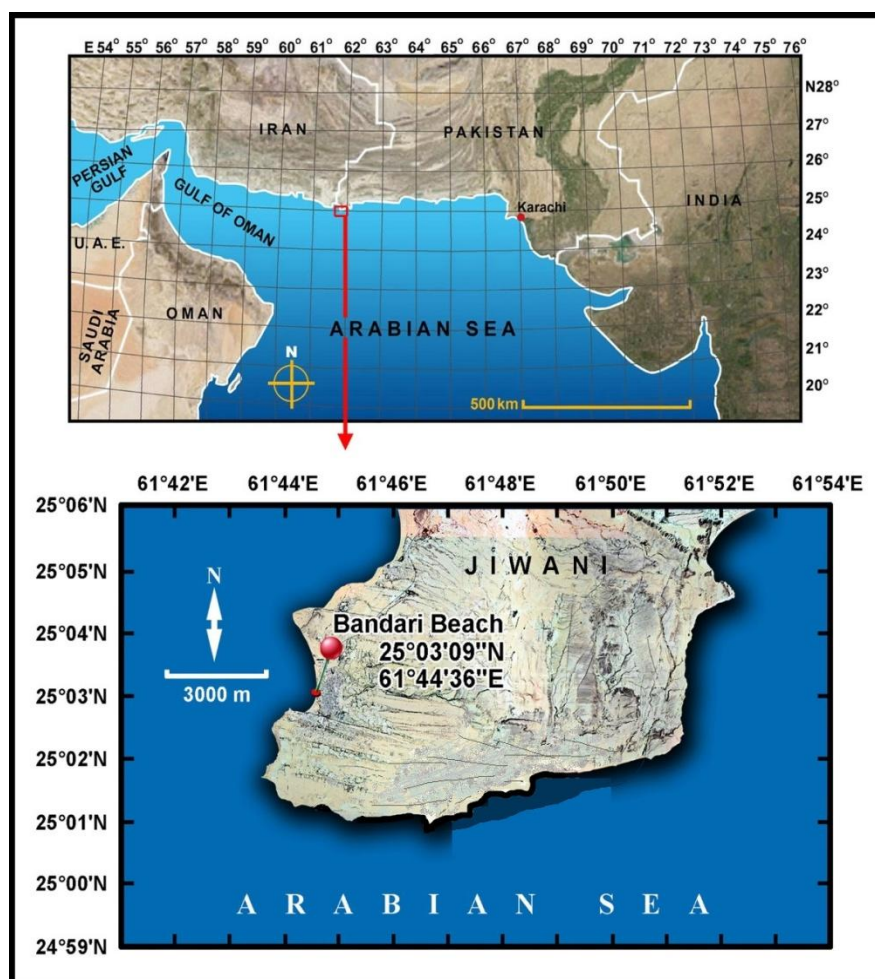
**Keywords:** Marine biodiversity, Asteroidea, new record, *Aquilonastra*, Makran Coast

## 1. INTRODUCTION

The class Asteroidea a greatly diverse group within the phylum Echinodermata, they are typically small, flat sea stars with short arms, often pentagonal in shape. Globally they reside in diverse marine environments from polar to tropical regions and from shallow to deep waters, frequently hiding under rocks or in crevices. The class Asteroidea includes around 1900 extant species, classified into 36 families and about 370 genera (Mah and Blake, 2012). According to O'Loughlin and Waters, (2004) the family Asterinidae comprises approximately 116 species in 21 genera, although

World Asteroidea Database reports around 150 species in 25 genera. Among these, the Asterinidae family is cosmopolitan, primarily comprising shallow-water species with generally restricted distribution ranges. However, some members of this family are more widely distributed in deeper waters globally. *Aquilonastra*, a genus of small sea stars, belongs to the family Asterinidae and contains over twenty (20) reported species worldwide. O'Loughlin and Rowe, (2006) formally amended the genus *Aquilonastra*.

Previously, only three species of the genus *Aquilonastra* were recorded from Pakistan: *Aquilonastra burtoni* (Gray, 1840), *Aquilonastra lorioli* and *Aquilonastra iranica* (Mortensen, 1940). Despite the presence of these species, no comprehensive taxonomic study of the intertidal Asteroidea fauna along the Pakistan coast has been conducted to date, apart from the initial reports of these three species. This study provides comprehensive morphological characteristics and habitat information for both species *A. richmondi* and *A. iranica* collected from Bandari Beach, Jiwani Makran coast. This paper presents the first detailed taxonomic description of *A. richmondi* and the rediscovery of *A. iranica* from Bandari Beach, Jiwani, on the Makran coast. These findings represent a significant contribution, adding new records of *A. richmondi* and rediscoveries of *A. iranica* with detailed morphological and taxonomical studies from Pakistani coastal waters.



**Figure 1.** Bandari Beach, Jiwani Makran coast. (map developed by Abrar Ali, Marine Reference Collection and Resource Centre, University of Karachi).

## 2. MATERIALS AND METHODS

The fresh specimens were collected from the intertidal zone of Bandari Beach, Makran Coast, Balochistan, Pakistan. The collected specimens were fixed in 5% formalin for 24 hours and then transferred to 70% buffered alcohol for long term storage and suitable for study and handling. The dried samples have been deposited in the Marine Reference Collection and Resource Centre (MRC & RC) museum, cataloged as *Aquilonastra iranica* (Cat. No. MRC & RC-UOK-ECHI-84) and *Aquilonastra richmondi* (Cat. No. MRC & RC-UOK-

ECHI-85). Identifications of the specimens were based on morphological features, consistent with descriptions by Clark and Rowe, (1971) and other relevant studies.

### 3. RESULTS

#### Systematic

##### 3.1. *Aquilonastra richmondi*

Phylum Echinodermata

Class Asteroidea

Order Valvatida (Perrier, 1884)

Family Asterinidea (Gray, 1840)

Genus *Aquilonastra* (O'Loughlin & Waters, 2004)

*Aquilonastra richmondi* (O'Loughlin & Rowe, 2006)

**Diagnosis** (from O'Loughlin and Rowe, 2006 amended here in). Non-fissiparous *Aquilonastra* spp. Typically shows five rays but sometimes there may be six. These rays vary from broad to narrow at their base, tapering to a narrowly rounded distal end. Mean of radius upto R, 25 mm; r, 12 mm. Their form is frequently asymmetrical, often displaying one ray that is noticeably shorter than the other four. A key distinguishing feature is the presence of abactinal gonopore. Pedicellariae, when observed, are usually located on the upper rays and within the interradial. Two to three short, thick valves, which are not significantly differentiated from the adjacent spinelets, characterize these structures.

**Material examined.** Fresh specimens were collected from the intertidal zone at Bandari Beach (25°03'09"N, 61°44'36" E), Makran coast, during low tide (-0.06m) at 3:39 pm on December 02, 2021.

#### Detailed Morphological Description of *Aquilonastra richmondi* (O'Loughlin & Rowe, 2006)

**Dimensions and Coloration:** The specimen is 35/10 mm in length (R/r) and weighs 0.2 grams. Its coloration is brown, spotted with green, maroon, and white.

**Abactinal Surface:** The abactinal plates are closely covered, with their nearer edges projecting. The spinelets are subpaxilliform (Figures 2B and 3A). Few spinelets are present near the secondary plates, numbering 0–2 per space. Predominantly, a single large papula is present per space. The spinelets themselves are short, tapering, roundly pointed, and subsacciform, not outwardly pointed.

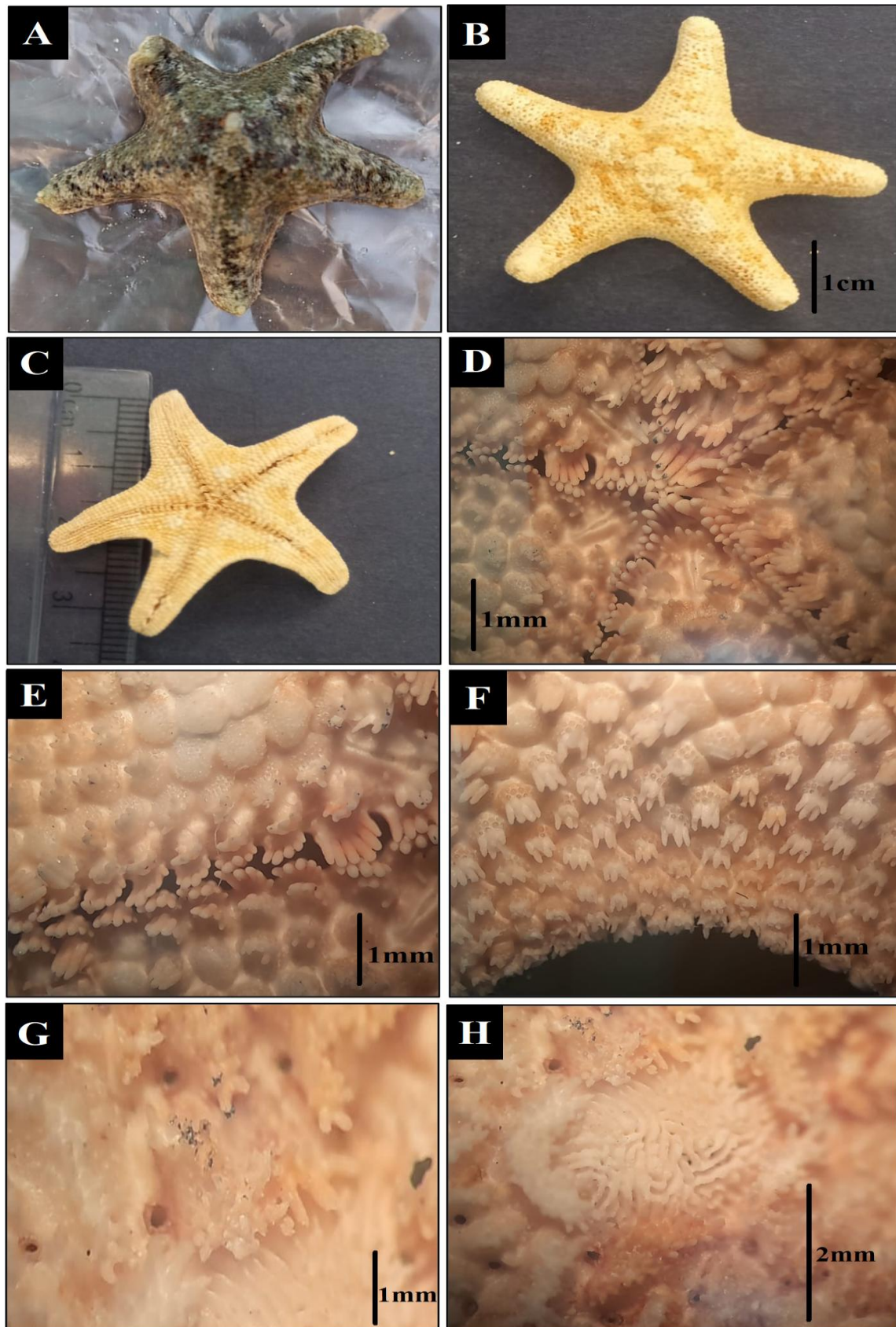
**Marginal Plates:** The inferomarginal plates bear approximately 14 spinelets each, which are thin proximally and thicken laterally (Figure 2F).

**Actinal Spination:** Spines per actinal plate up to: oral 8, (Figure 2D); suboral 4, (Figure 2D); furrow 7, (Figure 2E); subambulacral 5, actinal interradial 4–5, (Figure 2G). The interradial spines are distinctly thick, wrinkled, and conical (Figure 3E).

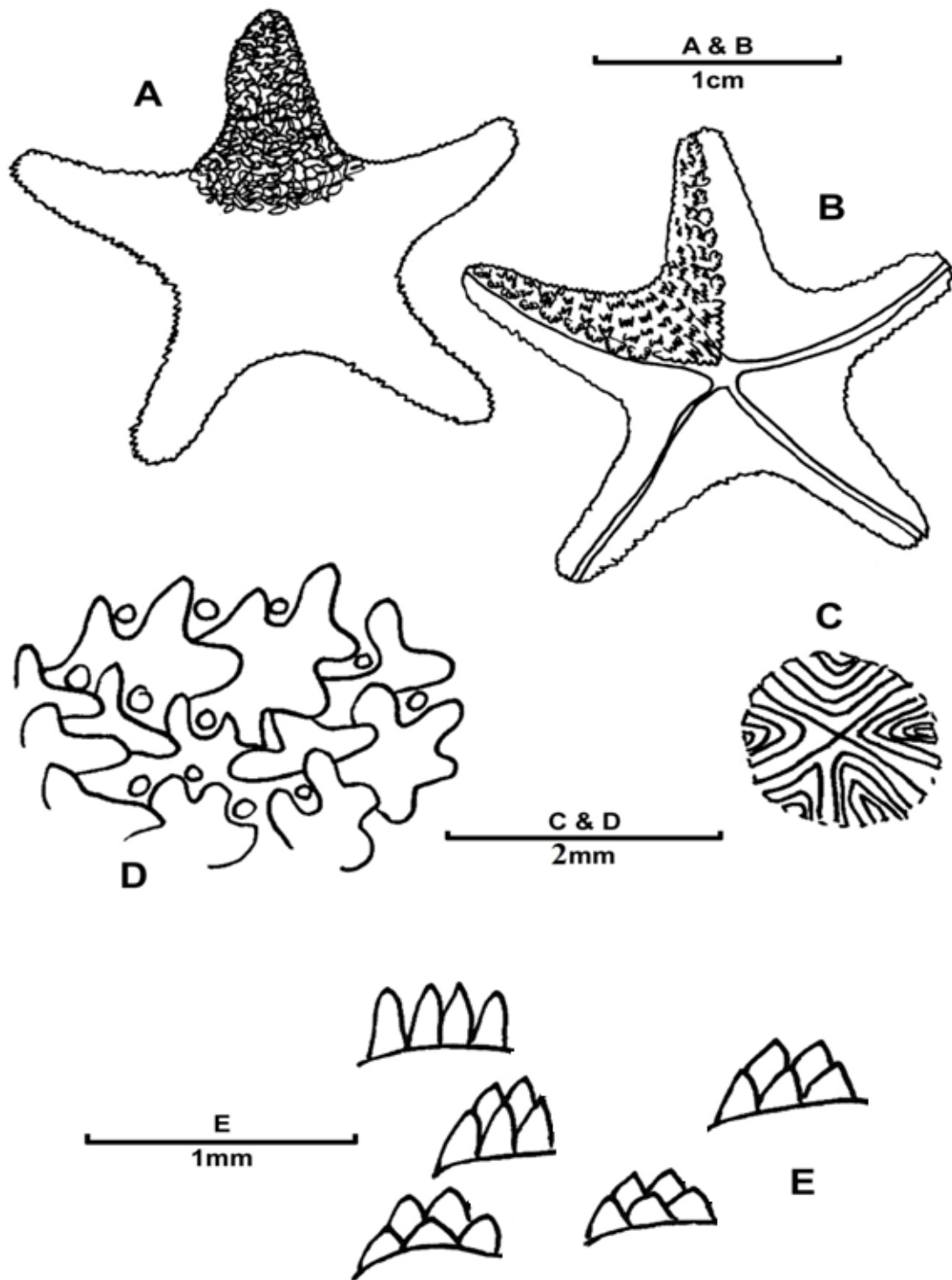
**Distribution:** Arabian Sea, East Africa, Kenya, Tanzania, Comoros, Madagascar, Mauritius, and South Africa (O'Loughlin and Rowe, 2006) and now first time reported from Pakistan coast (Northern-Arabian Sea).

**Habitat:** The specimen was collected from the intertidal zone, where it was found under rocks and partially buried in sand.

**Remarks:** Morphologically, our specimen aligns well with other *Aquilonastra* species. We meticulously compared our collected specimens with those described by O'Loughlin and Rowe, (2006). While the number of spines matched their descriptions, we observed a slight difference in coloration. O'Loughlin and Rowe, (2006) reported specimens as sharply mottled with green, maroon, pale brown, pink, white, and black or variably mottled with red, pink, orange, white, grey, and blue. In contrast, our specimen displayed a brown base with distinct green, maroon, and white spots.



**Figure 2.** *Aquilonastra richmondi* (O'Loughlin and Rowe 2006): A. live specimen; B. abactinal view; C. actinal view; D. Oral and sub oral spines; E. furrow spines; F. actinal, inferomarginal plates; G. abactinal plates; H. madreporites.



**Figure 3.** *Aquilonastra richmondi* (O’Loughlin and Rowe 2006): A. abactinal view; B. actinal view; C. madreporite D. abactinal plates; E. actinal spines.

### 3.2. *Aquilonastra iranica* (Mortensen 1940)

Phylum Echinodermata

Class Asteroidea

Order Valvatida (Perrier, 1884)

Family Asterinidea (Gray, 1840)

Genus *Aquilonastra* (O'Loughlin & Waters, 2004)

*Aquilonastra iranica* (Mortensen, 1940)

**Diagnosis** (from O'Loughlin and Rowe 2006, amended herein). Non-fissiparous *Aquilonastra* spp. Typically possess five rays, which are notably long, broad at their base, and taper to a rounded distal end. Mean of radius upto R, 35 mm; r, 15 mm (Mortensen, 1940). A distinctive feature is the presence of abactinal proximal interradial pedicellariae, characterized by pairs of tooth-like, differentiated valves. Additionally, abactinal gonopore are present.

**Material examined.** One specimen collected from the intertidal zone at Bandari Beach (25°03'09" N, 61°44'36" E), Makran coast, during low tide (-0.06m; 3:39 pm), on December 02, 2021.

#### Detailed Morphological Description of *Aquilonastra iranica* (Mortensen, 1940)

**Dimensions and Coloration:** The specimen measures R/r = 45/12 mm in length and weighs 0.2 grams. Its coloration is predominantly grey, with maroon, blue, and grey spots; the oral side presents a lighter, uniform hue.

**General Morphology:** This non-fissiparous specimen possesses five long rays that are initially broad, conical, and rounded laterally. The abactinal surface (Figures 4B and 5A) is somewhat convex.

**Abactinal Surface:** Secondary plates are absent. The spinelets are short, thick, and taper to a subsacciform shape. Spinelets on the lateral interradial plates consist of 4-6 rotated spinelets. On the abactinal plates, spinelets are arranged in small clusters of up to 4 per cluster, or in diagonal single or double series.

**Marginal Plates:** The inferomarginal plates (Figure 4F) are larger than the superomarginal plates, with up to 6 spinelets per superomarginal plate (Figure 4G).

**Actinal Surface:** The actinal surface (Figures 4C and 5D) is smooth. The crescent-shaped actinal plates (Figure 4G) covered with tufts of 2 to 5 coarse spinelets (typically four). These spinelets are particularly well-developed around the anus.

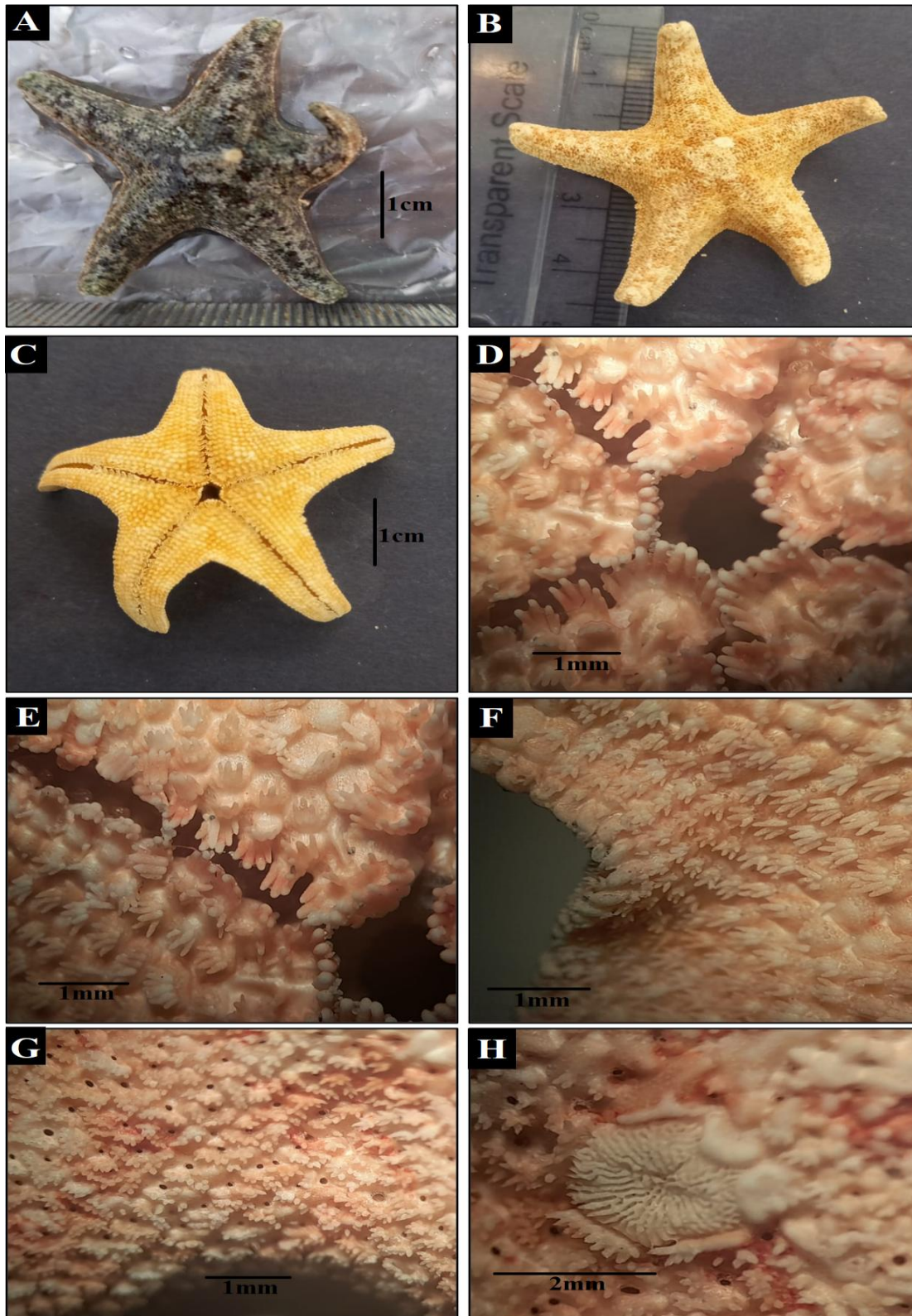
**Actinal Spination:** Spines per actinal plate up to: oral 8, (Figure 4D); suboral 5, (Figure 4D); furrow 7, (Figure 4E); subambulacral 9, actinal interradial 5, (Figure 4F). The interradial spines are long and conical (Figure 5E).

**Distribution:** This species is distributed across the Arabian Sea, with notable occurrences off the coast of West Pakistan (O'Loughlin and Rowe, 2006) and throughout the Persian Gulf (Mortensen, 1940; Pourvali, 2015; Adeli, 2022).

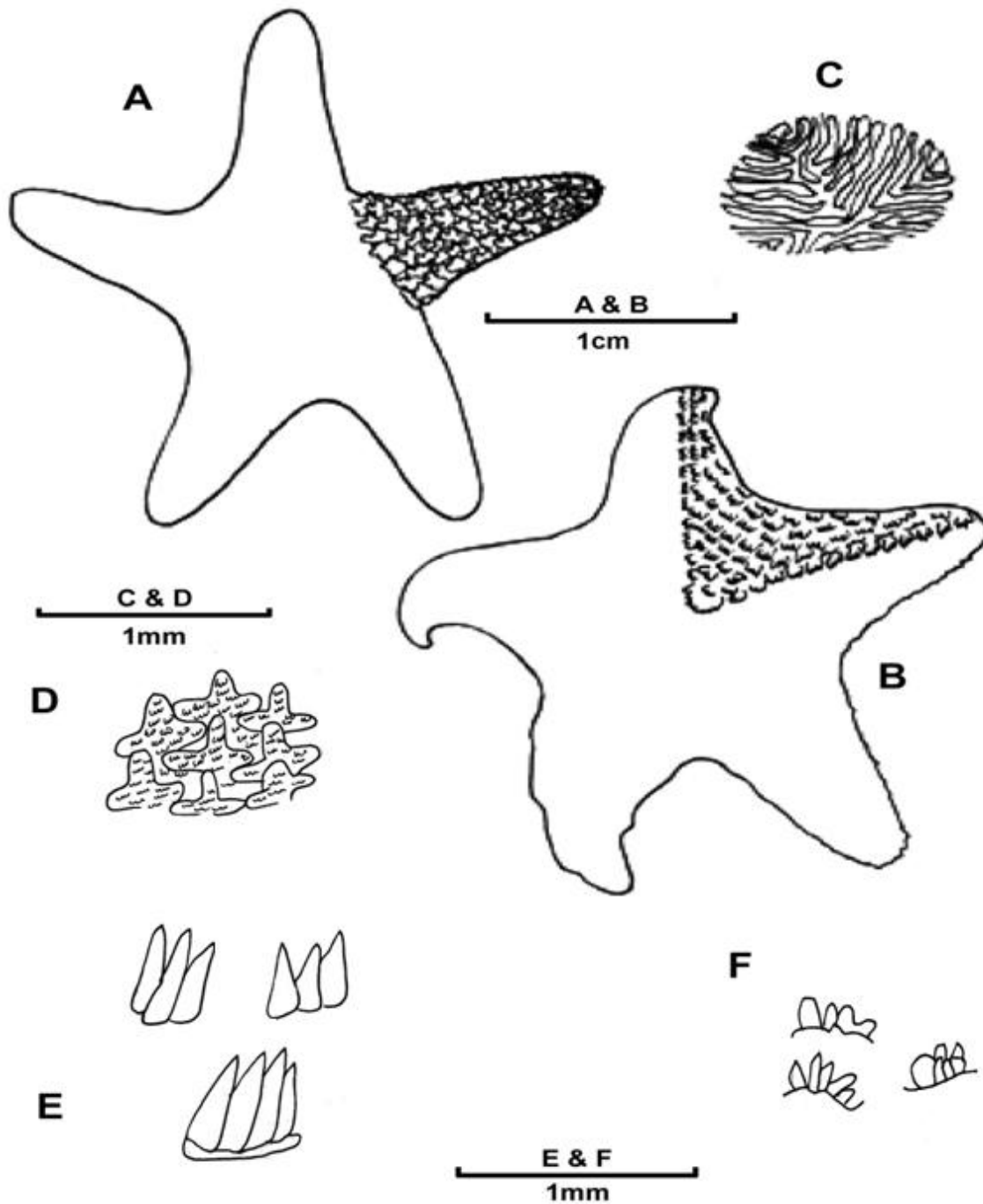
**Habitat:** The specimen was collected from the intertidal region, found beneath a rock.

**Remarks:** *Aquilonastra iranica* bears a morphological resemblance to *A. burtoni* in terms of arm shape and convexity. The arms are triangular, broad at the base, and somewhat larger than those found in other species within the family Asterinidae, notably *A. lorioli* and *A. burtoni* (Ghory and Tahera, 2023). While the number of spines matched their descriptions, we observed a slight difference in the coloration of our specimen. Otherwise, all other taxonomical characters are like those O'Loughlin and Rowe (2006) reported in specimens as sharply mottled with green, maroon, pale brown, pink, white, and black, or variably mottled with red, pink, orange, white, grey, and blue. In contrast, our specimen displayed a brown base with distinct green, maroon, and white spots. However, Ghory and Tahera (2023) do not mention the coloration of fresh, alive specimens; they described the colour of preserved specimens as creamy

white. Thus, we compared the detailed taxonomy with O'Loughlin and Rowe (2006). This study provides the first illustrated morpho-taxonomic information for this species in Pakistan, marking our initial attempt to document its taxonomic characters.



**Figure 4.** *Aquilonastra iranica* (Mortensen 1940): A. live specimen; B. abactinal view; C. actinal view; D. Oral spines; E. furrow spines; F. actinal, inferomarginal plates; G. actinal and superomarginal plates; H. madreporites.



**Figure 5.** *Aquilonastra iranica* (Mortensen 1940): A. abactinal view; B. actinal view; D. abactinal plates; D. madreporites; E. abactinal spines, F. actinal spines.

We compared our specimen with descriptions provided by Mortensen, (1940); O’Loughlin and Rowe, (2006); Pourvali, (2015); Adeli et al., (2022). Consistent with these publications, our specimen exhibits a grey coloration with maroon, blue, and grey spots, aligning with the previously described grey with red or blue-grey spots. Furthermore, the actinal spine counts of our specimen are consistent

with those described by O'Loughlin and Rowe, (2006) and Pourvali, (2015) which represents a significant diagnostic character. However, it is noteworthy that Adeli et al., (2022) reported a different number of actinal spines for this species.

#### 4. CONCLUSIONS

This study significantly contributes to understanding *Aquilonastra* diversity along the Pakistan coast. It provides the first detailed taxonomic description of *Aquilonastra richmondi* and confirms the rediscovery of *A. iranica* from Bandari Beach, Makran Coast. Prior to this study, only three *Aquilonastra* species were formally documented in Pakistan, indicating a significant gap in the comprehensive taxonomic understanding of intertidal Asteroidea fauna in the region. Our morphological analyses, encompassing detailed descriptions of abactinal and actinal spination and plate structures, are consistent with existing literature for both species. While minor color variations were noted in *A. iranica* specimens compared to previous descriptions, these differences do not preclude identification, given the consistency in key morphological characters, particularly the number and arrangement of actinal spines. The collection and deposition of these specimens in a recognized museum repository enhance the scientific foundation for future research. These findings not only expand the known distribution range of *A. richmondi* but also underscore the importance of continued taxonomic efforts to fully catalogue the marine biodiversity of Pakistani coastal waters. This research provides a crucial baseline for future ecological and phylogenetic studies on this diverse group of sea stars.

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#### Author Contributions

Conceptualization, sampling and data collection, paper review: Qadeer Mohammad Ali. Taxonomic analysis, identification and corresponding to the expert for confirmation of species, writing - original draft preparation: Quratulan Ahmed. Writing- original draft preparation, literature searching and illustrations: Iqra Shaikh. Writing - review and editing: Levent Bat. All authors read and approved of the final manuscript.

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#### Conflict of Interest

The authors declare that there are no conflicts of interests.

#### Informed consent

Not applicable.

#### Ethical approval & declaration

In this article, the animal regulations are followed as per the ethical committee guidelines of The Marine Reference Collection and Resources Centre, 75270, Karachi, Pakistan; the authors observed the new records of *Aquilonastra richmondi* (O'Loughlin & Rowe, 2006) and detailed taxonomy of *Aquilonastra iranica* (Mortensen, 1940) from Jiwani Makran Coast Balochistan, Northern Arabian Sea. The Animal ethical guidelines are followed in the study for species observation, identification & experimentation.

#### Data and materials availability

No data additional to the sources cited were used for the research described in the article.

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