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Short Communication

Intertidal aggregation of Feather Stars (Echinodermata: Crinoidea) on the South Saurashtra Coastline of Gujarat State, India

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ABSTRACT

The Gujarat shoreline is 1,600 km long and harbors a wide variety of marine biota in tidepools along its south Saurashtra coastline. Rocky shoreline outcrops at Fort St. Anthony of Simbor support a rich diversity of Echinodermata, especially feather stars (class Crinoidea: order Comatulida). One such outcrop, about 350 meters long and characterized by many small to large rock pools and shallow sediment pools filled with turbid Gulf water, is dominated by dense beds of feather stars, tentatively identified as *Tropiometra carinata* (Lamarck 1816). These feather stars occur in diverse intertidal habitats and attach to a variety of substrates, including rock, sediment pool, emergent flat rock, undersides of rock in the rock pool, and in rock caves and crevices. In this communication, we provide a pictorial description of this feather star aggregation as an initial survey toward understanding the local community ecology of this crinoid.

Keywords: Crinoid aggregation, community ecology, intertidal, Gujarat coast

INTRODUCTION

While studying the marine life of the south Saurashtra coastline, Gujarat, India, with special emphasis on echinoderms, an area, very rich with a group of eye-catching animals, was observed in the intertidal tidepools. These animals were crinoids, members of the phylum Echinodermata, which also includes sea stars, sea urchins, and sea cucumbers. Crinoids have a cup-shaped, pentamerous symmetrical body with flexible arms that bear slender side branches called pinnules, which give the arms a feather-like appearance (Hess 2011). Crinoids are suspension feeders; their pinnules bear numerous, fine, finger- or threadlike tube feet that flick passing detritus and microorganisms into a groove lined with cilia, which carry the captured particles down the pinnule and arm to the mouth (Meyer 1982). Unlike other Echinodermata, both the mouth and anus lie on the upper surface of the central body. The great majority of living crinoid species, and the only species that occur in shallow (<100 m) waters, are called feather stars. Unlike many deep-sea crinoids, and most fossil species, which support the central body on a segmented, anchoring stalk, feather stars lose the stalk following their planktonic larval stage. They retain only the topmost unit, called the centrodorsal, which usually bears hook-like segmented appendages called cirri for anchoring to the substratum. Feather stars display a wide range of patterns and colors, and may occur in great numbers (Messing 1994). Although occasionally reported on sediment substrates (Stevens and Connolly 2003, Messing et al. 2006), feather stars chiefly colonize hard substrates such as boulders, rocks, dead and living scleractinians, wrecks, sponges, and gorgonians (Zmarzly 1984, Messing 2007). There are 673 currently accepted extant crinoid species worldwide, of which 561 are feather stars in 19 families (C. G. Messing, personal communication), although new species continue to be discovered (Obuchi and Fujita 2017, Messing 2020). Samuel et al. (2017) listed 70 species (2 stalked, 68 feather stars) in the crinoid fauna of India.

The coastline of Gujarat state is 1,600 km long and can be divided into three main geographical parts: the Gulfs of Khambhat and Kachchh, and the Saurashtra coastline. Sastry (2004) reported a total of 37 species of Echinodermata from the Gujarat

coast, of which only four species were Crinoidea. Thus, it was a surprise to find an intertidal feather star garden at Fort St. Anthony of Simbor on the Saurashtra coastline.

MATERIAL AND METHODS

During the survey of intertidal marine life of south Saurashtra coastline, we came across this location. Simbor has unique coastal characteristics in terms of substrate and biotic diversity. The coastal stretch is 'L' shaped. Whole intertidal belt is clearly divided into two parts, a sandy beach, and rocky outcrops. Vertical zonation patten is not clearly distinguishable, its mostly submerged area open during low tide. Sandy area was predominated by *Uca* sp. crab and *Diopatra* worm colonies. Fort St. Anthony of Simbor (20°45′ N, 71°09′ E) lies on small Pânikota Island at the mouth of the Sahil river at the bay of Simbor (Fig. 1). Fort St. Anthony of Simbor has a flat rocky outcrop about 350 m long with small to large tidepools of turbid Gulf water. Extensive photography was done without disturbing the animals and their natural habitat and position. photographs of Echinoderms and their habitats were done by Nikon- W300 waterproof underwater digital camera.

RESULTS AND DISCUSSION

While investigation of intertidal marine life of south Saurashtra coastal area, a huge feather star aggregation observed at the intertidal area of Fort St. Anthony Simbor. Gujarat has semidiurnal tide. At study site, crinoids are submerged at 2-3m deep during hightides and they are exposed up to 4-5 hours during low tide. Sahil river's freshwater runoff may keep low salinity of this area which support the high abundance of feather star. It's just our assumptions. The further study on this in progress. Flat rocky outcrop of the study site has a small to large tidepools of turbid Gulf water (Fig. 2) that support a great diversity of echinoderms specially feather star. The feather stars observed in this intertidal environment have been tentatively identified as *Tropiometra carinata* (Lamarck 1816) (family Tropiometridae) based on the robust form with ten arms, posture and color patterns (Clark 1947, Torrence et al. 2012), although it is not certain if all specimens seen belong to a single species. In the tidepools we observed a dense bed of feather stars (Fig. 3). The recorded depth range of *T. carinata* is from "the low tide mark" or "shoreline" to 55 m (Clark 1947). However, Clark (1917) noted that, at Buccoo Bay, Tobago, "at the lowest tides some individuals are probably out of the water, in part at least, for a short time", as the same thing we also observed here (Fig. 5A). Here, the rocky outcrops have many habitats such as rock caves/crevices, sediment shallow pool, barnacle bed and zoanthid bed. The feather stars are mostly attached to rocks and underneath rocks in the rock pools (Fig. 4A). Few were observed at the edges of the rockpool (Fig. 4B); few were seen in the sediment

Figure 1. Map of the study area (left) and satellite image showing Fort St. Anthony of Simbor (right) (Courtesy Google Maps).

Figure 2. Coastal characteristics of the intertidal area of Fort St. Anthony of Simbor. A- Rocky intertidal area, B- Emergent flat rock, C- Flat rocky tidepool, D- Small to large tidepools with tiny caves and crevices.

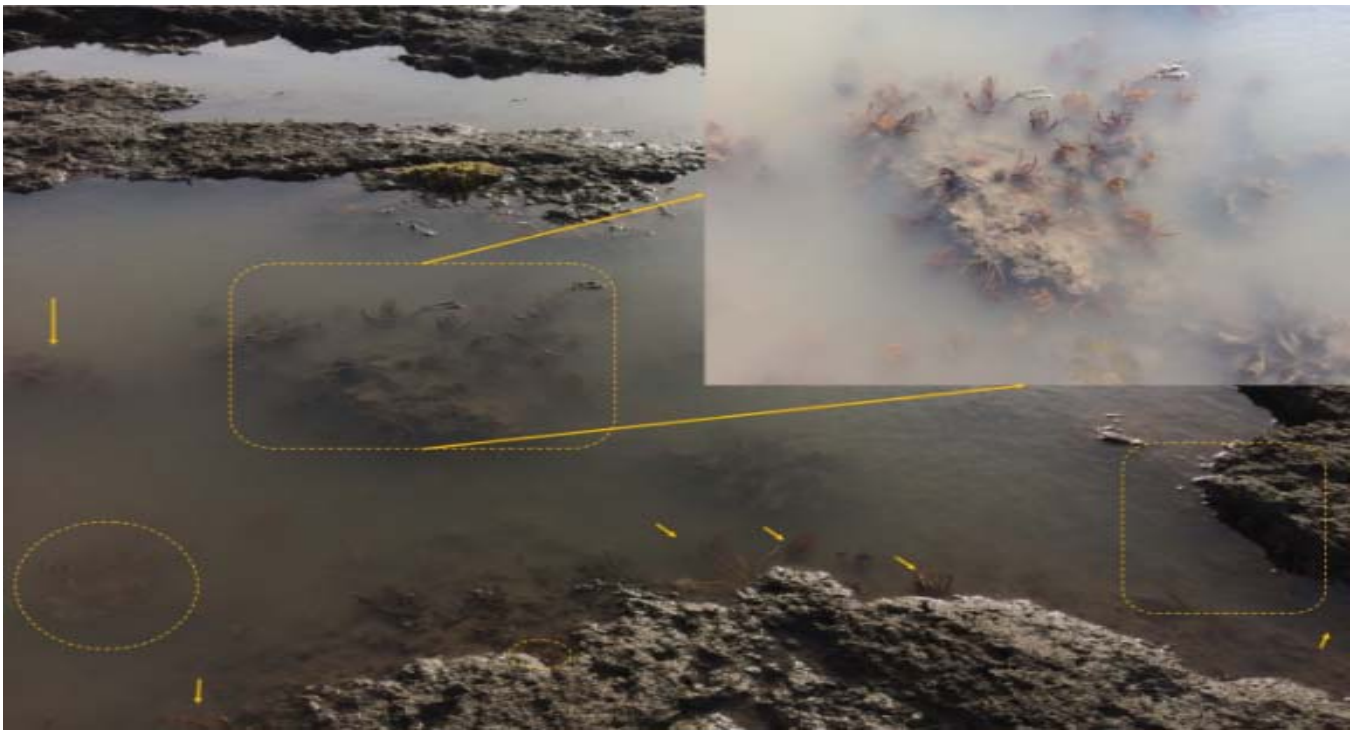

Figure 3. Tidepool with dense intertidal bed of feather stars at Fort St. Anthony of Simbor. Arrows, square, and circle indicate dense groups of feather stars. Inset at upper right is an enlargement of the feather star bed outlined at left of center.

Figure 4. Intertidal feather star habitat at Fort St. Anthony of Simbor. A- Feather stars attached to rock in the middle of the tidepool. B- Dense bed of feather stars attached along the edges of the tidepool

shallow pool, on the emergent flat rock (Fig. 5A) most of them observed at aboral position. The open tidal flat near the low tide mark is abundantly cover by feather stars. Few were seen with attached in the rock caves and crevices (Fig. 5B) and uniformly arranged in a row in the flat rocky tidepool (Fig. 5C). A few rock pools have a crowd of feather stars in their centers (Fig. 5D).

Present report is about a pictorial description and presence of a feather star garden in an intertidal habitat of the Saurashtra coastline. It was an initial survey toward understanding the local community ecology of this crinoid. Primary observation on the habitat of feather star explained with the help of photographs. These feather stars occur in diverse intertidal habitats and attach to a variety of substrates, including rock, sediment pool, emergent flat rock, undersides of rock in the rock pool, and in rock caves and crevices.

CONCLUSIONS

The lack of feather stars in intertidal habitats may contribute to their being ignored relative to other echinoderms. Comprehensive studies of the biodiversity of this region are not done earlier and intertidal feather stars have not previously been reported here. This article reports the discovery of an intertidal habitat at Simbor dominated by dense aggregation of feather stars. It is the only place along the south Saurashtra coastline where such a community has been found. This represents an

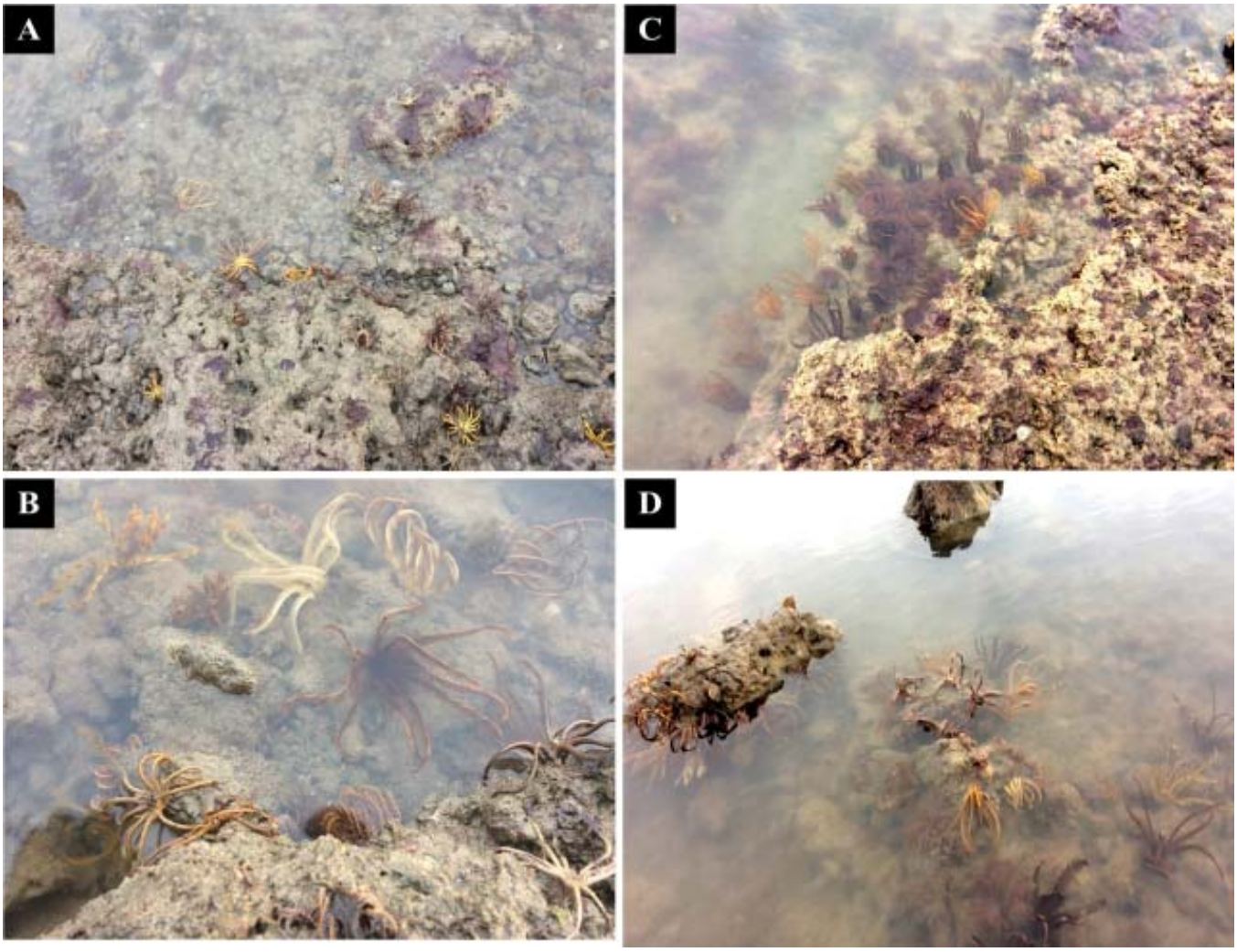

Figure 5. Intertidal habitat and dense aggregation of feathers star at Fort St. Anthony of Simbor. A- Feather stars on emergent rock, B- Feather stars in caves/cervices of the small tidepool, C- Feather stars uniformly arranged in a row in a flat rocky tidepool, D- Dense bed of feather stars in the rockpool

important contribution to knowledge about the ecosystems along the Simbor coast. Additional studies on the diversity, distribution patterns, and ecology of these feather star assemblages are underway.

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