Occurrence of abnormal echinoderms from the intertidal zone of Saurashtra coast, Gujarat, India

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Abstract: - Present communication is about occurrence of abnormal echinoderms in an intertidal area of the Saurashtra coastline of Gujarat state. Specimens of abnormal echinoderms were collected from the intertidal zones of Okha (22˚ 28′ N, 69˚ 40′ E), Veraval (20^0 55′ N, 70^0 20′ E) and Diu (20° 42′ N, 70° 53′ E) of Saurashtra coastline. Three abnormal echinoderms were noted from the intertidal area. Among them two were asteroids species, *Echinaster purpuresus* and *Aquilonastra* sp. and one was ophiuroid specie *Amphipholis squamata*. Primary observations of abnormal echinoderms occurrence are described. *A. squamata* is the commonly observed species along the Indian coastline but its abnormal four arm form is the first-time record from the Gujarat coastline. In present study we observed four arm *E. purpuresus*. All these echinoderm species in abnormal form was observed from the intertidal region. The previous records of all abnormal echinoderms species from India were collected from the subtidal zones. It is believed that environmental conditions, habitat structure, pollution are the key factors to induce an abnormal form.

Keywords: - Echinoderms, intertidal, abnormal, Saurashtra coast

1 Introduction

Echinoderms consist of a significant group of marine organisms which involve sea star, feather star, brittle star, basket star, sand dollar, sea urchin and sea cucumber. Echinoderms are the most evolved invertebrate with primitive characters such as radial symmetry, regeneration, autotomy, and asexual reproduction [1]. Pentamerism is the basic characteristic of echinoderms [2]. Difference in a pentameric structure is a rare phenomenon in a 5-armed echinoderm [3]. In echinoderms, for holothurians and echinoids pentamerism rays or ambulacra seems to be a fixed attribute but in case of ophiuroids and asteroids is not so definitely fixed [4]. Most of the echinoderms has generally five arms, more or less than five arm individuals consider as abnormal [5]. Arms breakdown also occur due to autotomy or injury specially when they are in agitated, some of redevelop the lost arm and in this process extra number of arms formed [1]. Globally, largest record on occurrences of abnormal sea stars have been reported from India, 13 species (Table 1) of sea star noted as abnormal form [6]. Apart from India only few reports found on the occurrence of abnormal echinoderms. Cosmopolitan echinoderm species *Amphipholis squamata* found in an abnormal form [3]. Abnormal ray formation noted in *Protoreaster nodosus* from Indo-Pacific region [7] and in *Archaster angulatus* from the Indian Ocean and western Pacific [8]. The present study describes occurrence of abnormal forms of echinoderms along the Saurashtra coastline of Gujarat state.

2 Material & method

Intertidal echinoderm diversity survey was conduct at Saurashtra coastline of Gujarat state during low tide period. During the field survey, Abnormal echinoderms Sample were collected from the intertidal zone of the Okha (22˚ 28´ N, 69˚ 40´ E), Veraval (20^0 55´ N, 70^0 20´ E) and Diu (20° 42´ N, 70° 53´ E) coast of Saurashtra coastline (Fig.1). Filed photography of live specimens were done by Nikon- W300 waterproof underwater digital camera and iPhone 5S camera. Voucher specimens of were collected and preserved in 5% formalin. Specimens were identified using the monograph of shallow water Indo-West Pacific echinoderms [9].

3 Result

Taxonomic position of the recorded abnormal echinoderms.

Echinaster purpuresus

Phylum : Echinodermata

Subphylum : Asterozoa

Class : Asteroidea

Superorder : Spinulosacea

Order : Spinulosida

Family : Echinasteridae

Genus : Echinaster

Species : *Echinaster purpuresus*

Aquilonastra sp.

Phylum : Echinodermata

Subphylum : Asterozoa

Class : Asteroidea

Superorder : Valvataacea

Order : Valvatida

Family : Asterinidae

Genus : *Aquilonastra*

Species : *Aquilonastra* sp.

Amphipholis squamata

Phylum : Echinodermata

Subphylum : Asterozoa

Class : Ophiuroidea

Superorder : Ophintegrida

Order : Amphilepidida

Family : Amphiuridae

Genus : *Amphipholis*

Species : *Amphipholis squamata*

During the diversity assessment of intertidal Echinoderms from different places of the Saurashtra coastline, we observed three Echinoderms species in abnormal form (Table 2). Amongst them two were asteroids species, *Echinaster purpuresus* and *Aquilonastra* sp. and one was ophiuroid specie *Amphipholis squamata*. *E. purpuresus* restricted to Okha, while *Aquilonastra* sp. and *A. squamata* were observed from various localities of Saurashtra coastline but the rare abnormal form of *Aquilonastra* sp. observed at Diu and *A. squamata* at Veraval. Among these three species, *E. purpuresus* was found with two different forms. One had four arm rays instead of five and another one had irregular unusual pattern of arm rays (Fig.2). *Aquilonastra* sp. found with bifurcation in single arm near to tip portion (Fig.3). *A. squamata* observed with only four arms instead of five and disc shape was square instead of round (Fig.4). *E. purpuresus* with four arms observed only once but the irregular unusual form observed several times. However, abnormal forms of *Aquilonastra* sp. and *A. squamata* only observed once. Both these species *A. squamata* and in *E. purpuresus* clearly

lack of penatmeism, while, *Aquilonastra* sp. had pentameric structure with five arms but one with bifurcated tip. Occurrence of abnormality is a rare and inheritable phenomenon. Abnormality might be due to environmental perturbations on the metamorphosis of larvae or unusual redevelopment of arms [3-4].

4 Discussion

Present description is about occurrence of abnormal echinoderms in an intertidal area of the Saurashtra coastline of Gujarat state. Primary observation of abnormal echinoderms occurrence described. All these three echinoderm species as in an abnormal form is the first time noted from the Gujarat. Among these echinoderms, *A. squamata* is the commonly observed species along the Indian coastline but its abnormal four arm form is the first-time record from the Gujarat coastline. Six-armed *E. purpuresus* recorded from Nancowry (Nicobar) and noted unequal arms pattern in *E. purpuresus* due to regeneration process [1]. In present study, we observed four arm *E. purpuresus*. Salinity stress might induce abnormal metamorphosis in asteroids species [10-11] while as *A. squamata* survive in broad range of salinity [12]. Morphological abnormalities existence is lesser advantageous for individual's survival and this occurrence of abnormalities can be an indicator of environmental effects [13]. Teratological incomplete development leads to three or four arms formations during the metamorphosis, which was constant observations in *Patiria miniata* [10,14], *Asterina gibbosa* [15] and *Echinaster spinulosus* [16]. Very few literatures were available which supports abnormal ray or ambulacral formation in asteroids. Among them, one was about arm split direction, if arm split vertical direction, a dual consequence producing a distally forked arm [17] and partial cuts of disc usually heal or sometimes a greater number of arms raised instead of usual ones [18].

5 Conclusions

Three abnormal echinoderms species from the intertidal area of Saurashtra coast are observed for the first time from Gujarat state of India. In present study, all these abnormal echinoderm species were observed at the intertidal region. Intertidal habitats have extreme environmental condition compared to subtidal zones. That is a rare sighting of abnormal forms in the intertidal region which has no previous reports. Previous records of all abnormal echinoderms species from India were collected from the subtidal zones. The environmental conditions, habitat structure, pollution are the key factors to induce an abnormal form. More research is desirable in a particular aspect such as climate condition, habitat structure, environmental effect, and regeneration pattern of arms in the echinoderm species. There is also a need of molecular approach for supportive data of occurrence of abnormality in echinoderms.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

Author's contribution

Both the authors are contributed equally for a manuscript.

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Table 1. List of the previously recorded abnormal echinoderm species from India (Galván-Villa, C.M., & Solís-Marín, F.A., 2021).

Sr. no.	Species name	Refences
1	*Anthenea pentagonula*	[19]
2	*Asterina lorioli*	[1]
3	*Astropecten indicus*	[1,20-21]
4	*A. karankawai*	[22]
5	*Echinaster purpureus*	[1]
6	*Goniodiscaster vallei*	[19]
7	*Linckia laevigata*	[1]
8	*L. multifora*	[1,19]
9	*L. columbiae*	[23]
10	*Nardoa galatheae*	[1]
11	*Pentaceraster regulus*	[1, 24]
12	*Pisaster ochraceus*	[23]
13	*Protoreaster linckii*	[1,25-26]

Table 2. List of recorded abnormal echinoderms during present study.

Sr. no.	Class	Family	Species name
1.	Asteroidea	Echinasteridae	*Echinaster purpuresus*
2.		Asterinidae	*Aquilonastra* sp.
3.	Ophiuroidea	Amphiuridae	*Amphipholis squamata*.

Fig.1 Map of the study area (Courtesy Google earth).

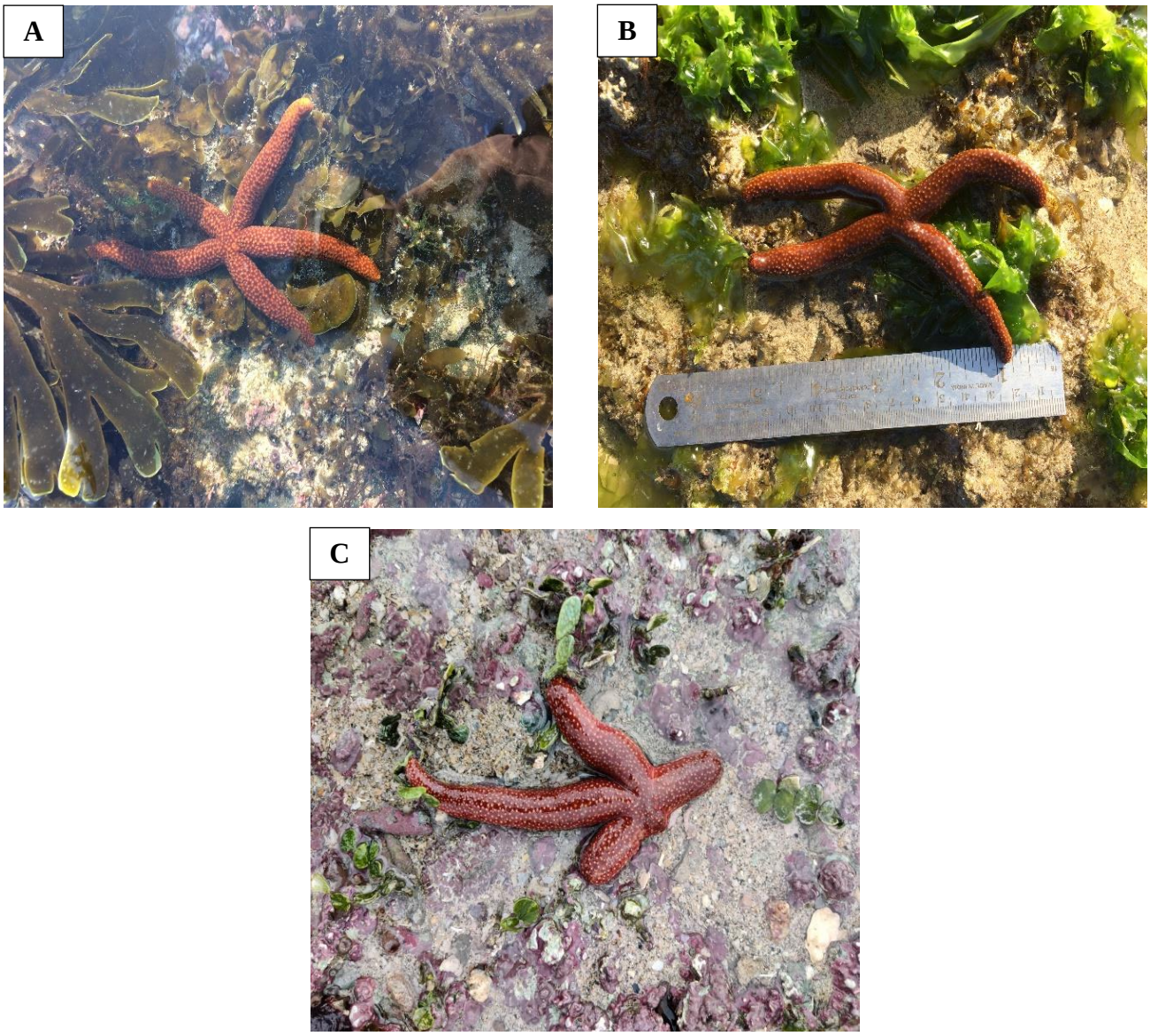

Fig.2 A- Normal form of *Echinaster purpuresus*, B- Abnormal *E. purpuresus* with four arms, C- Unusual arm development structure of *E. purpuresus* (photo taken by Zalak sabapara).

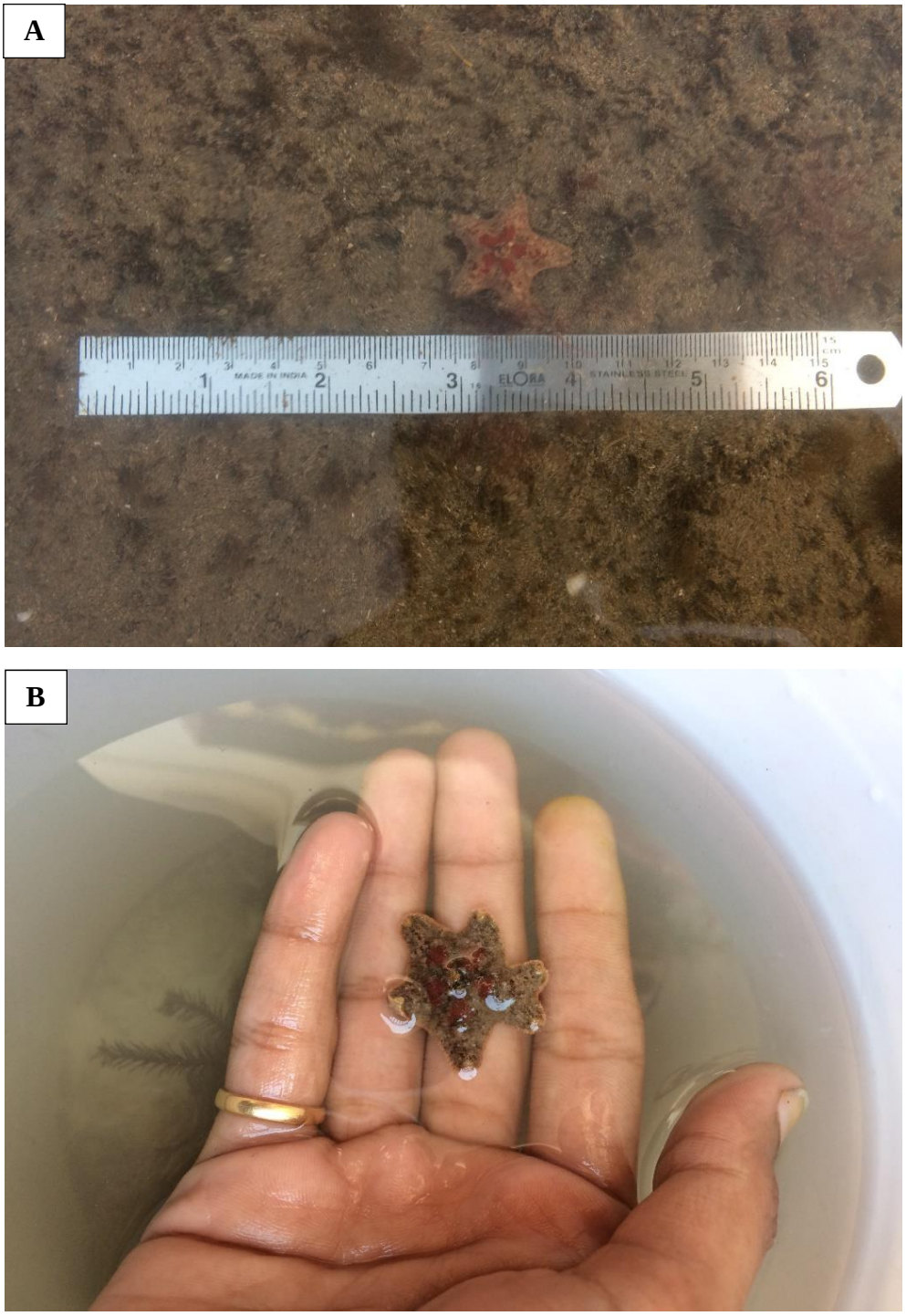

Fig.3 A- Normal form of *Aquilonastra* sp., B- Abnormal *Aquilonastra* sp. with bifurcate tip.

Fig.4 A- Normal form of *Amphipholis squamata*, B- Abnormal *A. Squamata* with four arms.