



Existence of Abnormal Sea Stars of Two Species, *Astropecten indicus* and *Astropecten polycanthus* Found in the Coastal Waters of Pakistan

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ABSTRACT

Starfish (*Astropecten*) are the most important and well-known marine invertebrates. Starfish are remarkably diverse and mostly found in submerged habitats. It proved difficult to identify *Astropecten* species, even though many species are flourishing as planktotrophs. They have symmetrically extended long or short rays from a center disk and are regular pentagonal, flattened, free-living stars. It has also been discovered that asteroids contain abnormalities in the shape of their bodies, such as an odd number of arms in normally pentamerous species but sometime predator damage recovery is usually the cause of these oddities. The present study provides the first report on the evidence of aberrant *A. indicus* and *A. polycanthus* species that were collected from Karachi's Clifton Sea view coast during the continuing study's collection attempts.

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INTRODUCTION

Sea stars are members of the class Asteroidea, phylum Echinodermata, Kingdom Animalia. Asteroids usually have five arms that radiate from the central disks and every one of them has tube feet or podia that protrude along the arm's underside grooves (Fenner, 2009). They are widely distributed in the Antarctic, Pacific, Atlantic, and Indian Oceans, where they primarily inhabit wave-exposed intertidal zones of coastal waters, sea stars are most diverse in coastal locations (Freeman, 2005). According to Christensen (1970), they are most common in tropical and subtropical areas, particularly in the Indo-Pacific.

There are roughly 370 genera and 1890 species among the 36 families that make up the group of sea stars or starfishes belongs to the class Asteroidea (Mah and Blake, 2012). Sea stars are usually pentagonal and flattened. These are free-living, symmetrically radiating creatures with long or short arms that originate from a central disc, having a mouth at the lower or ventral surface is referred as the oral surface, and the upper surface, where the anus is present, is known as the aboral surface. Orally, a notable

groove known as ambulacral groove that runs the length of each arm reaching from the area around the mouth to the arms tip (Chamundeeswari *et al.*, 2013). Sea stars play important ecological roles as predators, scavengers, and prey items in both the intertidal and subtidal zones of the marine ecosystem (Menge, 1986). Sea stars are noticeable and prosperous animals and they can go months without eating and consume nearly every kind of marine life that they come across. The genus *Astropecten* of seastars feeds on a broad range of food, including fish, sipunculids, pennatulids, polychaetes, crabs, and sediments (Jangoux and Lawrence, 1982; Wells and Lalli, 2003). Thus, they can be significant predators of other invertebrates, such as clams, barnacles, and other associated marine life, which makes them ecologically significant. Sea stars are reported to be preyed upon by a variety of echinoderms, including fish, birds, and crabs. Because their calcified bodies are tough to chew and not very nutritious, they often feed on the tips of their arms (Fell, 1962).

In principal echinoderms are pentamerous, the majority of asteroids only have five limbs. While some asteroids, such as *Acanthaster planci* and *Luidia maculate*, invariably have more than five arms (James 1999). Some asteroids do, however, have more than five arms. A typical formation during development may result in fewer or more arms than five in some asteroids, such as *Pentaceraster regulus* and *Protoreaster linckii*. Asteroids have also been found to exhibit anomalies in body shape, such as an unusual arm count in species that are typically pentamerous. Hotchkiss (1979) asserts that these anomalies are typically the result of predator damage regeneration. The current

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study generates the initial report on the evidence about the existence of aberrant *A. indicus* and *A. polycanthus* species that were gathered from the Clifton Sea view coast of Karachi during the collection attempts of ongoing study.

MATERIALS AND METHODS

Study area

Sea view, another name for Clifton Beach, is situated along the Arabian Sea in Clifton, Karachi, Pakistan. It is a well-liked leisure area in Pakistan that extends from Karachi to Ormara in Balochistan. The beach is a component of the Karachi South district's broader Clifton neighborhood. Similar to other coastal locations, this area features a diverse range of habitats for different animal species. Clifton sea view is an important site for marine and coastal species because of its closeness to the Arabian Sea. Though these habitats are impacted by the area's urban development, they nevertheless play a vital role in Karachi's coastal ecosystem.

Sample collection

The study was conducted from October 2022 to November 2023 and specimens were collected by hand picking, once in a month at regular intervals from the exposed area during the low tide. Collected samples were brought back into the laboratory, where the specimens were washed with filter sea water to remove the attached mud and other particles, then samples were freezed at -4 °C for species identification and further analysis. Specimen identifications were done by the study of morphological characteristics like surface of body, shape of arms and shape of madreporite under the Olympus microscope through available taxonomic Keys (Tahera, 1996; Adeli *et al.*, 2022). In each collection the lengths of the each arm R (from the mouth center to the tip of arm in mm), Disc diameter (from one end of arm base to the other end of interradius) by using Vernier Caliper and weight of each Sea star were measured in g by electronic balance.

RESULTS AND DISCUSSION

The abnormal forms of two species of *Astropecten* (*Astropecten indicus* (N=7) and *Astropecten polyacanthus* (N=5) were observed from the collection (Fig. 1). *A. indicus* and *A. polyacanthus* are the common sea stars found in the sandy and muddy intertidal region of tropical coastal areas mainly in Indian Ocean. Tahera (1996) was the first to describe two species of *Astropecten* along the coast of Pakistan, *A. indicus* and *A. polyacanthus*, commonly found in Pakistan's coastal waters, particularly in the Northern

Arabian Sea and during present study both species were collected in the subtidal area of Karachi's, sandy Clifton Sea view waterfront.

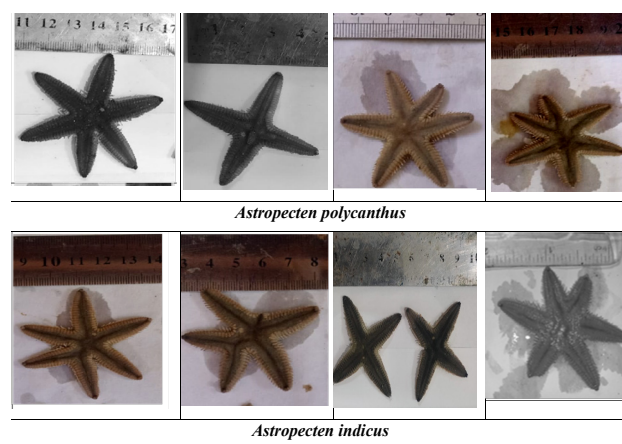


Fig. 1. Abnormal forms of *Astropecten indicus* and *Astropecten polyacanthus* found during the Oct. 2023 to Nov. 2023 from Clifton sea view Karachi.

According to taxonomic feature; *A. indicus* has closely packed small, regular arranged Paxillae/inner superomarginal spine and outer supero marginal spine on superomarginal plates/ whereas in *A. polyacanthus* had one row consecutive supero marginal spine without any gap. The supero marginal spines were reduced after the ones on proximal supero marginal plates. In *A. indicus* adambulacral plates had two series of spines with same length and width whereas in *A. polyacanthus* Adambulacral spines were larger than the furrow spines and middle furrow spines were larger than others (Tahera, 1996; Adeli *et al.*, 2022).

Because the both species of sea star typically abides by the pentamerism rule, the interradial area of a normal animal bears a L shape (90°). The coding method was used to number each asteroidal arm; for example, arm one is the arm left side of the madreporite, and then next counts clockwise in serial order. The interradial region of the four-armed species had a V shape rather than a L; this was less evident in the six armed specimens (Fig. 1). Teratological incomplete development is the cause of the four or three arms that arise during the metamorphosis. This is typically in line with the findings of Clark and Rowe (1971) on *Patiria miniata*, Marsh *et al.* (1986) on *Echinaster spinulosus*, Allain (1972) on *Asterina gibbosa* and *A. indicus*. However, Watts *et al.* (1983) provide evidence that excessive salinity during early growth may be the origin of ray number aberrations in asteroids. Both injury and autonomy, particularly when disturbed, were the causes of the odd or atypical forms that were

displayed. *A. indicus* and *A. polycanthus* usually have five arms but both with six arms (Fig. 1) were found in the present observation.

The both species having six arms have extra arms that regenerate from any normal arm. Most abnormalities in the morphometry from the medriporide to the right side of the ram have been observed in the second arm. It was also observed that although none of the aberrant specimens showed abnormality in the first arm of all the specimens of both species as located first left to madreporite, but in three specimens having abnormal situation in the fifth arm, that noticed carefully as significant due to having madreporite between them. The unusual or abnormal forms with additional arm were display (Y) shape in structure of ambulacra groove. However, all the originated/additional arms were observed smaller than their originator arm (Table I).

Table I. Arms length, disc diameter and weight of abnormal sea stars of two species (*A. indicus* and *A. polycanthus*) found during the collection from the Karachi, Clifton Beach.

S. No	Weight (g)	Disc dia (mm)	Arm length					
			First (cm)	Second (cm)	Third (cm)	Four (cm)	Fifth (cm)	
<i>A. indicus</i>								
1	4	2.3	2.3	1	2.3	2	2.5 (2*)	
2	3.5	2.4	2	2.3 (1.7*)	2.1	2.5	2.3	
3	3.2	2.1	1.8	1.3	2 (1.5*)	1.5	2	
4	4	2.5	1.9	2 (1.4*)	2.5	2.2	1.6	
5	2.5	2.3	1.7	1.7	1.9 (1.8*)	1.9	1.8	
6	3.4	2.4	2.3	2.1	2.3	2		
7	3.2	2.2	1.8	1.5	1.8	1.9		
<i>A. polycanthus</i>								
1	2.8	2.4	2.1	2.2	2.1	2.3	2.1 (2.0*)	
2	4	2.5	1.9	2 (1.4*)	2.5	2.2	1.6	
3	2.5	2.3	1.7	1.7	1.8	1.9 (1.9*)	1.8	
4	3.1	2.2	1.7	1.5	1.9	1.8		
5	3.3	2.4	2.2	2.1	2.3	2.1		

Only a small number of observations of the aberrant forms of sea stars have been made worldwide (Hotchkiss, 2000). *A. indicus*, with six-armed starfish, and a few more unusual sea stars from the Gulf of Mannar region have been also reported by James (1999), and Chamundeeswari *et al.* (2013).

The idea that pentamerism has rigid control is supported by the huge number of strictly pentamerous starfish families, which can only produce five arms, however occasionally an uneven arm number is also seen. This author experimentally observed selective breeding in aberrant ray numbers and produced only five-rayed offspring, not four-rayed ones, as demonstrated by Lawrence and Kumatsu (1990) demonstrated that the control of ray number is quite accurate in five-rayed species. This is evident from the ambulacral grooves that the basic plan is pentamerous but the few studies support the anomalous ambulacral grooves and rays, but there is no appropriate literature regarding asteroids' abnormalities. According to Hyman (1955) distally forked arm is typically the consequence of a twofold out growth when an arm is split vertically. Although partial disc incisions usually heal, occasionally one or even two arms may protrude from the wound closure site (King, 1900). According to Hotchkiss (2000), the five hydrocoel during metamorphosis do not cause the double ambulacral groove. As the basic pentamerous structure can be seen in all six arm specimens, the current results indicate that deviations from pentamerism are not a heritable characteristic. The presence of four arms indicates abnormalities during the larval developments, while the presence of more than five arms may be the result of environmental perturbations on the metamorphosis of larvae. Further study is needed to understand the reason behind the abnormality in sea stars.

DECLARATIONS

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Statement of conflict of interest

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