

New Occurrence of Abnormal Sea Star, *Astropecten indicus* from Mudasalodai, South East Coast of India

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Abstract

A marine invertebrate of starfish is a most familiar one. It was mainly occur on the seabed and diversity of starfish is remarkable ones. *Astropecten* sp is not easily identified organism while a number of species a long-lived planktotrophic larval stage. As a rule of pentamerism, *Astropecten indicus* strictly produces only 5 arms but some time the number was lesser than or greater than five and shows its abnormality. The reason may be of regeneration of plate systems which is responsible for forming the whole organs during larval metamorphosis or regenerating the lost plate systems in the disc in the later stages or due to environmental factors or may be of mutation.

Keywords: Brittle stars, *A. indicus*, Abnormal arms, Existence research

Introduction

Sea stars or starfishes are the class Asteroidea of phylum Echinodermata consisting of 1890 species with 36 families and approximately 370 genera [1]. They are flattened, mostly pentagonal free living star-like with five (sometime more) long or short rays radiating symmetrically from a central disc. The lower surface is generally called as oral surface (where mouth is present) and the upper side (where anus is present) is known as aboral surface. Orally, a remarkable furrow line in each arm known as ambulacral groove extending from the peristome to the tip of the rays. These grooves are formed by series of plates or ossicles known as ambulacral plates which has ambulacral pores between it through in which podia held. Presence of endoskeleton (flexible nature and formed of separated ossicles) is the important feature in this lower group of invertebrate. The skeletal arrangement allows for the extension of a comparatively large coelomic cavity from the central disc into the arms, which serves to hold gonads and pyloric caecae. Gonads radially arranged, arms occupied by digestive glands [2]. Asteroids are not having head, brain, anterior and posterior regions. They use sensory cells for identification of food and movements. Presence of water vascular system is another important feature in this group which assists most of the functions such as locomotion, respiration, food gathering and excretion. They use papule a very transparent retractile structure for respiration. Pedicellariae are pincer-like organ forms variety of structures from simple modified spines to highly specialized opposing hooks in some species capture prey by detecting their presence, usually small fish or shrimp-like crustaceans on which the sea star feeds. The shape of pedicellariae is an important characteristic for asteroid taxonomy. Sexes are separate, some undergoes hermaphroditism and life cycle includes Bipinnaria and Brachiolaria larvae. Some sea stars brood their young, where females hold their fertilized eggs in a brood space under the arm in the stomach or incubate them in the gonads. In some cases, young ones develop internally and escape through gonopores. Asexual reproduction is another method of development that involves either fission or regeneration of entire animal from arm parts. Sea stars play vital role in maintaining benthic community due to their predatory activities and some of them act as key species [3]. Hence, they used as model organism in the area of community structure and feeding ecology [4,5]. This group of invertebrate are the only successive organisms which has the ability to thrive in various depth ranges from shallow intertidal zone to deepest region and in all the marine ecosystems. Asteroids have the feature of regeneration in which the damaged organs

can be regenerated quickly. Echinoderms as a rule are pentamerous and therefore most of the asteroids have only five arms. However, some of the asteroids like *Luidia maculate* and *Acanthaster planci* and others always have more than five arms but in the case of *Pentaceraster regulus* and *Protoreaster lincki* the number of arms may be less than five or more than five due to freak formation at the time of development [6]. Members belonging to the families Ophidiasteridae, Echinasteridae and some others break their arms either due to injury or by autotomy, especially when they are disturbed. Sometimes, such specimens regenerate more number of arms during regeneration. The sea star *A. indicus* is a member of order Paxillosida, Family Astropectinidae. *Astropecten* species are commonly called as comb star or sand star and are found in intertidal and subtidal sandy environments. The species of *Astropecten* are generally found either partially or completely buried within the sediment, but when foraging, they roam over the sediment surface where they are voracious predators of many infaunal invertebrates, particularly molluscs and crustaceans. Arm are usually five in numbers, above or below the normal arm count are abnormal. Abnormality is not an inheritable character but it is the outcome of environmental perturbations on the metamorphosis of larvae and/or abnormal regeneration of arms [7]. The present study produces the preliminary report on the abnormal *A. indicus* caught as by-catch from Mudasalodai, southeast cost of India.

Materials and Methods

Study area

Mudasalodai is a renowned landing centre, located near Parangipettai Marine Biological station (11°29'N 79°46'E), south east coast of India (Fig.1). About 200 mechanised boats (trawlers) and non-

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mechanised have been engaged for fishing activities. Trawlers were operated for more than half day and approximately 400 families are involving in fishing activities.

This study was conducted from October 2009 to November 2010 and specimens were collected every month at regular intervals from the trash fish of Mudasalodai landing centre by trawlers. Collected samples were immediately brought back into the laboratory, where they were washed with tap water to remove the adhered mud and other particles and all were preserved in 5% formalin for further analysis. Specimen identifications were done by following the standard identification monograph of [8]. In each collection the lengths of the arm R (from the mouth center to the tip of arm in mm), r (from mouth center to the end of interradius) and arm breadth br (at the base of arm) of the sea stars were measured using calipers and weight of the specimen was taken by electronic balance.

Taxonomical description

Astropecten indicus Doderlein 1888

Synonyms: *Astropecten indicus*, *Astropecten koehleri*, *Astropecten pleiacanthus*.

Characteristic features: Arms 5, R/r ranged between 11-44/3-13mm and br: 4-12mm. No anus instead involuted cone like structure at disc centre. Paxillae regularly arranged along the dorso-lateral arm with single row of dark stripes between it. Supero-marginal plates mostly 22, well developed and without spines but bearing alternatively arranged simple granules throughout. Infero-marginal plates with single series of spines and plates were extended to the adambulacral. Two actinal plates were observed at the interradial region. Inter actinal region with spines. Ambulacral groove bordered with two rows of spines and adambulacral spines larger than the furrow spines. Tube feet pointed arranged in a single row on either side of the ambulacral ridge (Fig. 2).

Results

Totally 637 specimen of *A. indicus* were collected from the landing centre and among the 637 individuals, only six of them had the abnormal arm numbers (3 specimen from four armed, 2 from six armed and 1 from seven armed) (Fig. 3).

Size of abnormal individuals

Weight: Weight of the sea star samples were ranged from 3.0 to 5.0gms (Table 1). The low weight 3.0gms recorded for the four armed specimen during the month of July and high weight 5.0 was recorded for six armed during the month of March.

Discussion

A. indicus is a common sea star found in the sandy and muddy intertidal region of tropical seas. The size and weight for the abnormal *A. indicus* was ranged from 35 to 17mm and 3.0 to 5.0gm respectively. Amongst 637 specimens were collected during the study period, all the *A. indicus* have had 5 arms and only six of them with abnormal arm counts.

Sea star *A. indicus* usually follow the rule of pentamerism so the inter-radial region has the L shape (90°) in normal animal. Each arm of asteroids was coded according to the Carpenter system i.e, the arm opposite the madreporite is arm A and one counts clockwise in alphabetical order [9,10]. In the case of four armed specimen the inter-radial region was V shape instead L, the same was more reduced to six and seven armed specimen. All abnormal specimens did not follow the carpenter system but for the convenience, we recognised the arm C and D where the madreporite exist in-between it and arm opposite to madreporite as arm A. Here, not even single specimen had arm A at its appropriate position and hence it was difficult to recognise its carpenter system and where the excess arm arose. In the case of seven armed specimen, we have mentioned second and third arms as B1 and B2 because both ray was originated at the place of ray B and moreover, the B2 was arise from the arm B1. Inter-radii of these arms contained 2 pairs of larger and distinct interangular superomarginal plate and these were prominent along proximally and smaller towards distal.

The large number of strictly pentamerous families of starfish support the interpretation that there is “rigid control” of pentamerism, so such families can generate only five arms, sometimes, the irregular arm number also can be observed. Lawrence & Kumatsu showed that the control of ray number is very precise in 5-rayed species and this author experimentally observed the selective breeding in aberrant ray number and produced only 5-rayed offspring and not four rayed ones [11]. It is evident that there has been recurrent independent evolution of the multiradiate condition. Hotchkiss reported that the changes of salinity also responsible for sea stars to have four rays [10]. This author also acknowledged that the failure of the 4-rayed starfish to develop fifth rays after metamorphosis is consistent with the “synchronic hypothesis” that the pathway to form the rudiments of the five primary rays operates for only a short time, switches off and does not recur. Any primary rays that did not form during metamorphosis are not expected to form later [13-15].

There is no proper literature for asteroids abnormality but few literatures supports the abnormal ambulacral grooves and rays. Hyman stated that if an arm is split vertically, a double outgrowth usually results producing a distally forked arm [2]. Partial cuts through the disc generally heal, but sometimes on or even two arms may grow out from

S.No	Size (R) in mm							r mm	br (mm)							Weight (gms)
	A	B	C	D	E	F	G		A	B	C	D	E	F	G	
For 4 arm specimens																
1	24	23	22	22				6	7	7	8	7				3.3
2	19	19	17	19				6	7	7	7	6				3.0
3	23	22	22	23				7	8	8	9	8				3.4
For 6 arm specimens																
4	30	30	31	31	31	31		11	9	8	9	9	9	9		4.5
5	26	33	35	32	30	28		12	10	11	11	12	11	11		5.0
For 7 arm specimen																
6	A	B1	B2	C	D	E	F		A	B1	B2	C	D	E	F	
	22	17	17	20	20	22	21	8	6	5	4	6	6	6	5	4.7

Table 1: The arm size R, r and br for four rayed, six rayed and seven rayed samples.

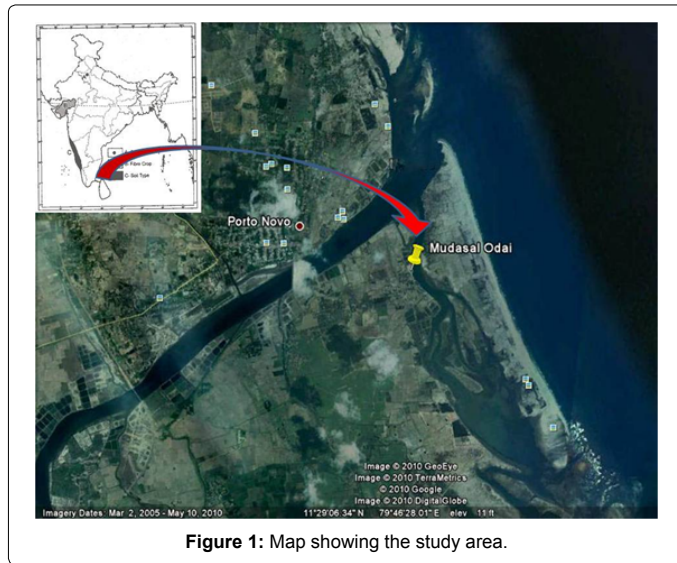


Figure 1: Map showing the study area.

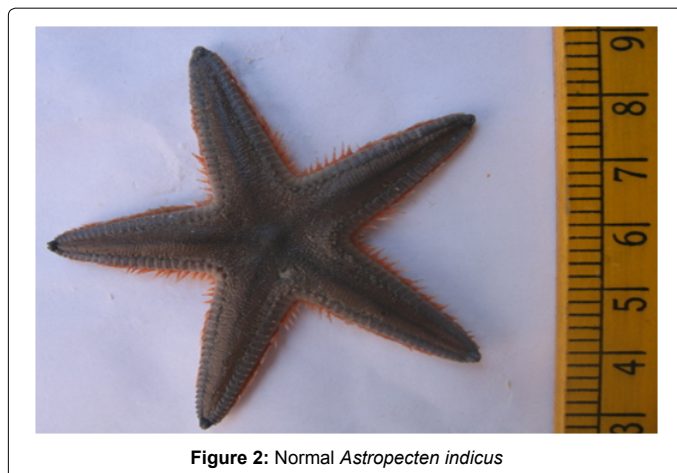


Figure 2: Normal *Astropecten indicus*

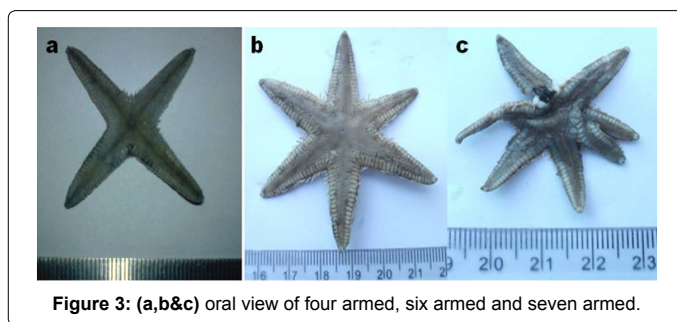


Figure 3: (a,b&c) oral view of four armed, six armed and seven armed.

the site of wound closure [12]. Hotchkiss stated that, double ambulacral groove dose not arise from the five hydrocoel after metamorphosi [10].

From the reviews and literatures, we deduce that sea star *A. indicus*, belonging to five rayed family Astropectinidae and have only five rays. From this study we observed 6 abnormal *A. indicus* during the study period and the seven armed specimen observed first time in southeast coast of India. Further study is needed to understand the reason behind the abnormality in sea stars.

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