Studies on Starfish (*Astropecten indicus*, Doderlin) Growth Measurement

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ABSTRACT

While assessing starfish abundance through underwater visual censuses is relatively easy, estimating the individual size could prove to be both time-consuming and difficult without a direct handling of the organism. . Here novel and practical metrics for the estimation of asteroid size and weight from field measurements were proposed for common *Astropecten indicus* (Doderlein, 1888). The novel morphological metric characters proposed as a proxy to estimate size and weight in sea stars, minimizes the operator's impact on asteroid specimens in the field and represents a rapid and reliable method.

Key Words: Starfish, Growth, *Astropecten indicus*

Both in intertidal and sub-tidal zone in Marine ecosystem (Sloan, 1980; Menge, 1982), seastars are considerable components of marine benthic communities due to their ecological roles as predators, scavengers, and prey items (Jangoux, 1982; Menge, 1982; Ganmanee *et al.*, 2003). Members of the seastar genus *Astropecten* are feeding on a wide variety of prey such as crustaceans, polychaetes, sipunculids, pennatulids, ascidians, fish, and sediments (Sloan, 1980; Jangoux, 1982; Wells and Lalli, 2003). They are most abundant in subtropical and tropical regions, especially in the Indo-Pacific (Christensen, 1970).

While assessing starfish abundance through underwater visual censuses is relatively easy, estimating the individual size (e.g. total length and total weight, which require the collection of the specimen and its weighing, under dry condition in the laboratory), could prove to be both time-consuming and difficult without a direct handling of the organism. A thorough scrutiny of the literature reveals that several methods are used to evaluate starfish size and these consist in measuring, with vernier calipers, the length of 1) the maximum tip-to-tip diameter (arm-span) (Barker & Nichols 1983; Gaymer *et al.* 2004; Tuya & Duarte 2012) the radius from the center of the disk to the tip of the longest arm (Penney & Griffiths 1984; Gaymer & Himmelman 2002; Ganmanee *et al.* 2003; Gaymer & Himmelman 2008); 3) the radius from the edge of the disk to the end of a normal arm on the opposite side (Minchin 1987); 4) a normal arm (Scheibling & Lauzon-Guay 2007; Urriago *et al.* 2011); 5) the mean linear distance from the tips of each arm to the opposite inward pointing angle (Sommer *et al.* 1999; Temara *et al.* 1999); 6) the major radius (Campbell *et al.* 2001); 7) the longest arm (Bernstein *et al.* 1981). A critical examination of the seven metrics above listed reveals that some of them were not clearly described by the authors (e.g. the definition of major radius and normal arm) and that some contain a certain degree of subjectivity so that the reader cannot grasp exactly how the measurements were done and how to reproduce them. Here novel and practical metrics for the estimation of asteroid size and weight from field measurements were proposed for common *Astropecten indicus* **(**Doderlein, 1888**)** (Fig. 1A).

Material Methods

Five species of *Astropecten sp* were distributed along the east coast of Bay of Bengal. Their growth represent the nature of the ecosystem. Specimens were collected from Bakkhali beach, (21.563267R"N, 88.259439R"E) in the month of March,2015,For characterizing the growth of Star fish(*Astropecten indicus* (Doderlein, 1888)), dependable criteria should be established. Starfish wet weight (sfw), Starfish Arm Length (**sal)**, Star fish arm breadth (**sab**), Star fish arm Terminal/Occular plate (**sat)** and Mouth Angle Plate Length(**apl**) were recorded.

Mentioned variables were measured in Digital Balance and Digital Slide calipers. Principal Component Analysis (PCA) and Cluster Analysis, utilizing R- software were performed. Scatter plots were constructed in MS excel and trend lines are explained with the help of Scilab software.

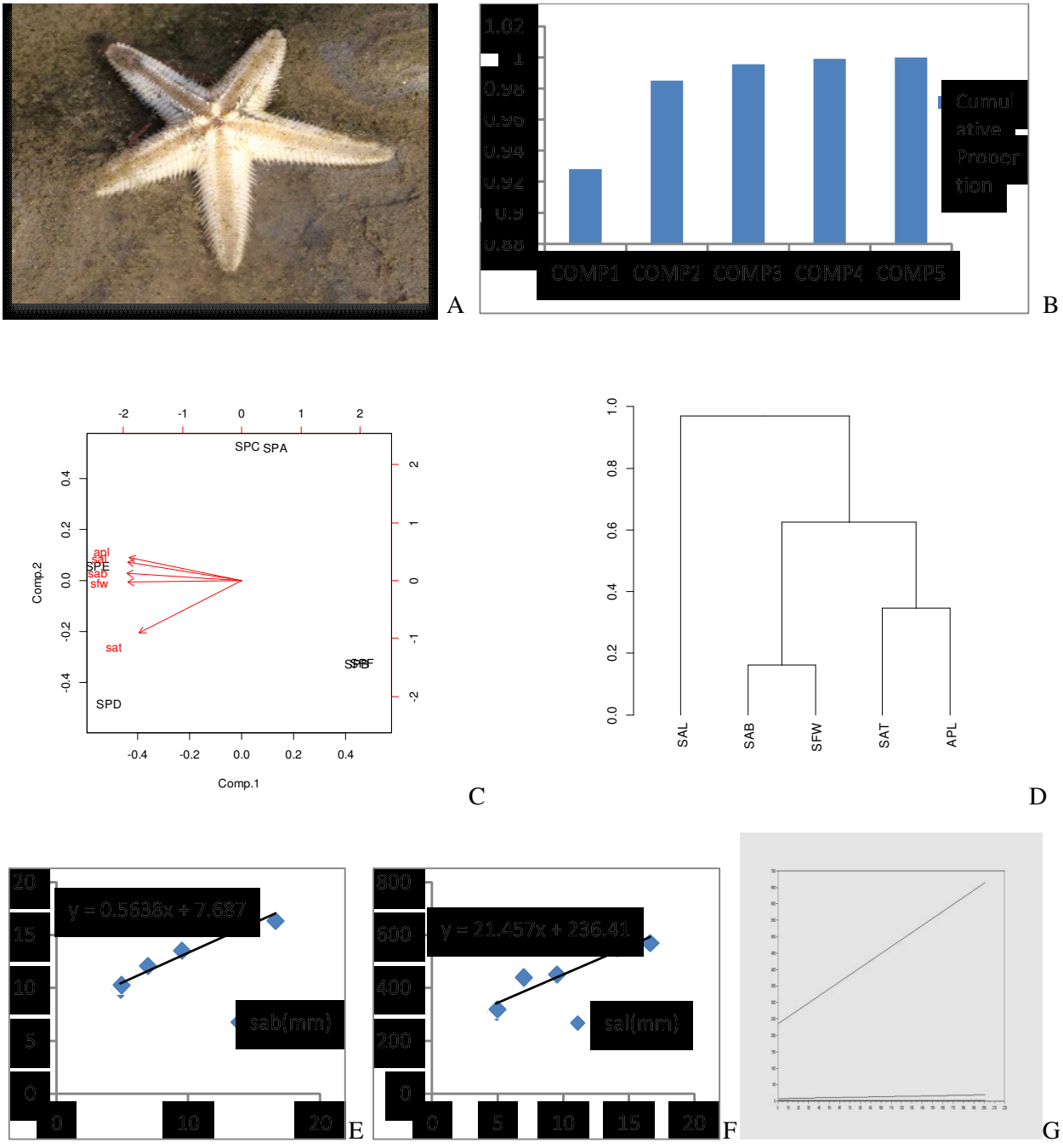

Fig.1 showing A) *Astropecten indicus*,B) Bar plot of the cumulative variances explained by the components ,C) Bi plot of the first two principal components, D) Graph clustering of all variables ,E)&F) Scatter plot of **sab** and **sal,** G)Trend line of **sab** and **sal**

Results

In our study, all components were positively correlated with each other(1B). Lowest correlation was observed with **sat**(1C)**.** But **sat** sites are regarded as site of arm growth and regeneration. Strong correlations between **sal, sab** and **apl** support them as prime component reflecting Asteroid growth. Cluster analysis revealed strong relation ship in between **sal, sab** and **sfw**(1D).Scatter plot of **sab** (1E) and **sal**(1F) against **sfw** find positive trend, but only differences in slope and scale (1G).

Discussion

The weight-length relationships showed a negative allometry, confirming that organisms invest more in length than in weight, as has been observed for other species of *Astropecten* (Ventura, Junqueira & Fernandes, 1994, Guilherm e&Rosa,2014). The genus *Astropecten* is a good benthic sampler as it has a generali diet, considering as a tool for comparative studies of sand-bottom communities (Wells *et al.*, 1961).

In this study, focus was on size-weight relationships of common Indian asteroid species. Results confirm, as previously suggested by indirect evidence (Alves *et al.* 2002; Micael *et al.* 2011; O'Gorman *et al.* 2010,), that , values for **sal** and **sfw**, which jointly define the body size of the individuals, are strongly correlated between themselves. In contrast, the hypothesis tested both **apl** and **sab** were strongly correlated with **sal** and weakly with **sfw**. Though **sat** did not show strong positive correlation because that is involved in arm growth.

Therefore, morphometric variables like **sal**,**sab** and **apl**, may constitute a practical and reliable method to estimate body size in starfish directly in the field, without taking **sfw**, which demands physical handling.

In conclusion, the novel morphological metric characters proposed as a proxy to estimate size and weight in sea stars, minimizes the operator's impact on asteroid specimens in the field and represents a rapid and reliable method.

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