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MORPHOMETRIC ANALYSIS ON HORSESHOE CRABS FOUND IN AND AROUND THE COAST OF BALASORE, ODISHA, INDIA

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ABSTRACT A study was conducted to know the occurrence, and morphometric variations of Tachypleus gigas, commonly known as the horseshoe crab, in the coastal regions surrounding Dublagadi Beach of Balasore district. A total of 134 horseshoe crab specimens were observed comprising of single males, gravid females, and paired male-female individuals. Among these, 56 samples underwent detailed morphometric analysis, focusing on parameters such as Total length (TL), Prosoma length (PL), Opisthosoma length (OL), Carapace length (CL), Carapace breadth (CB), and Telson length (TeL). Correlation and linear regression analyses were employed to elucidate relationships among these morphometric variables. The study also investigated the occurrence of T gigas in the study area, covering different estuaries such as Balaramgadi, Bahabalpur and, Kasafala Sea Beach. By combining morphometric data and, species occurrence records this research provides a holistic understanding of horseshoe crab ecology and its significance in the local ecosystem. This information will thereby facilitating informed conservation strategies and management efforts aimed at safeguarding this ecologically important species in the region.

KEYWORDS : Horseshoe Crabs, Morphometric Parameters, Conservation, Odisha

INTRODUCTION

The horseshoe crab (HSC), often referred to as a living fossil, is a remarkable marine creature that has inhabited Earth's ocean for over 450 million years, originating during the Palaeozoic era, notably in the Ordovician period, alongside fellow ancient arthropods such as trilobites and mollusks. Limulus polyphemus is found in the United States & is called as Atlantic horseshoe crab (Smith, 2016), T. tridentatus is found in Japan, Taiwan, and China & is called as the Chinese horseshoe crab, T.gigas & C. rotundicauda found in India, Indonesia, Malaysia, Philippines, etc. & T. gigas is called as indo-pacific horseshoe crab & C. rotundicauda is called as mangrove horseshoe crab.

It has two compound eyes, each consisting of approximately 1000 ommatidia, along with median eyes capable of detecting visible and UV light, a single parietal eye, and rudimentary lateral eyes that become functional just before hatching. Additionally, ventral eyes near the mouth and a cluster of photoreceptors on the telson are present. Their eyes are a million time more sensitive to light at night than during the day (Palumbi 2014).

This research delves into the ecology and protection of horseshoe crabs in India, highlighting their importance and the challenges they confront. Despite their significance in ecosystems and industries, the preservation endeavors for Tachypleus gigas and Carcinoscorpius rotundicauda are still in their early stages. The research concentrates on their favored habitat, industrial applications, and dangers, underscoring the necessity for improved preservation methods (Pramanik et al., 2021).

MATERIAL AND METHOD:

Sample Collection

The sample were collected along the coastal stretch spanning from Chandipur to Kasafala Sea Beach in Balasore district, Odisha, India. The study area encompassed several locations, including Dublagadi sea beach, Kasafala sea beach, Bagda sea beach, Parikhi sea beach, Bahabalpur estuary, Budhabalanga estuary, and more. Male and female horseshoe crabs were distinguished by observing the presence or absence of monodactylus on the first pair of pedipalps, as well as by examining carapace shape and gonophores. After capturing, the morphometric analysis was done.

RESULT:

Species Occurrence:

The study conducted along the coastline from Chandipur to Kasafala, and further from Bahabalpur estuary to Balaramgadi estuary, revealed valuable insights into the occurrence of T. gigas, commonly known as the horseshoe crab.

Table-1:Number of Horseshoe Crab Reported in Different Location

Site	Dead	Alive	Entangled	Total
1. Chandipur beach	8	3	4(2 live + 2 dead) different net	11
2. Budhabalanga estuary-Bahabalpur estuary	74	9	33(3 live + 30 dead) 3 different net 19 + 10+4)	83
3. Kasafala beach	38	2	8(2 alive + 6 dead) S male, single net	40

Sampling at Chandipur Beach:

A total of 11 samples of T. gigas were collected.Among these, 8 were found dead, with 4 of them entangled in nets, indicating potential anthropogenic impact.Only 3 samples were found alive, suggesting a concerning mortality rate at Chandipur Beach.

Sampling at Kasafala Beach:

A total 40 samples of T. gigas were encountered, with a significant portion, 38, found dead. Among the deceased, 8 were entangled in nets, highlighting the detrimental effects of fishing activities on this species.The high mortality rate raises concerns about the conservation status of T. gigas populations in this area.

Sampling from Bahabalpur Estuary to Balaramgadi Estuary:

A total of 83 samples of T. gigas were documented, with the majority, 74, found dead. Out of the deceased clams, 33 were entangled in nets, indicating a recurring issue along this stretch of the coastline. The relatively high mortality rate suggests potential threats to the local T. gigas population, possibly due to habitat degradation or other environmental stressors.

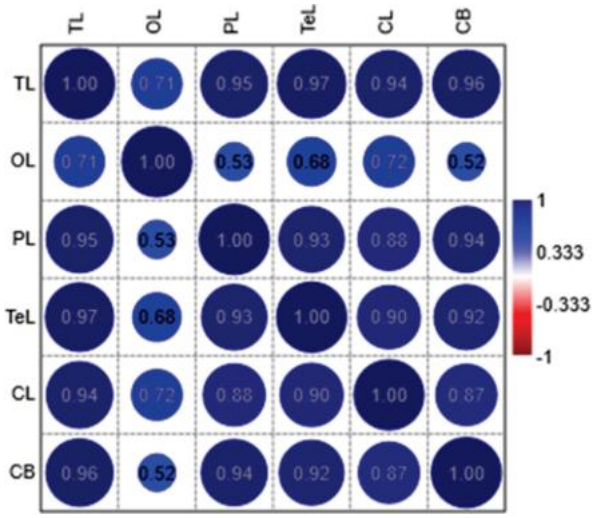

Fig:1- Morphometric Data Analysis Through Correlation

Table-2-Regression Statistics the Relation Between the Two Variables

Relation between TL-TeL		Relation between CL-TL		Relation between OL-TL		Relation between PL-TL		Relation between CB-TL	
Multiple R	0.9736	Multiple R	0.9445	Multiple R	0.7076	Multiple R	0.9488	Multiple R	0.9579
R Square	0.9480	R Square	0.8921	R Square	0.5007	R Square	0.9002	R Square	0.9176
Adjusted R Square	0.9470	Adjusted R Square	0.8901	Adjusted R Square	0.4913	Adjusted R Square	0.89837	Adjusted R Square	0.9161
Standard Error	0.5817	Standard Error	0.3791	Standard Error	0.5907	Standard Error	0.2480	Standard Error	0.4263

From The Above Linear Regression Table it was Found that
The regression equation, which predicts the TeL(Telson length) value (dependent variable) from TL(Total length) (independent variable), looks like this: y = 0.50725x + 0.7734. There is a significant linear relationship between TeL and TL, as indicated by the multiple R-value of 0.97 and the regression statistics value of 94% ,indicated by the standard error of 0.581749 is the less difference between the observed and anticipated values.

The line of the regression equation is y = 0.42754x +2.5007, which predicts the CL(Carapace length) value (dependent variable) from TL (independent variable). The regression statistics value in Table 3 shows that the variability in CL is 89%, and the multiple R-value is 0.94, indicating a strong linear relation between CL and TL. The standard error of 0.37918 tells about the average distance between the observed value and the predicted value.

The regression equation, which predicts the OL (Opisthosoma length) value (dependent variable) from TL (independent variable), is written as y = 0.23188x+ 0.32938. Table 4's regression statistics value indicates that OL's variability is 50%, and the multiple R-value is 0.70, suggesting that OL and TL have a relatively linear relationship. The standard error of 0.590726 tells about the average distance between the observed value and the predicted value.

Plotting of the TL-PL(Prosoma length) relationship on the scatter plot line of regression was the aim of this study. From TL (independent variable), the regression equation y = 0.29203x + 0.86311 predicts the PL value (dependent variable). Strong linear relationship between PL and TL is indicated by the multiple R-value of 0.94 and the variability in PL of 90%, as shown by the regression statistics value in Table 4. The standard error of 0.248007071 tells about the average distance between the observed value and the predicted value.

The line of the regression equation is y = 0.2937x + 0.9764, which predicts the CB (Carapace Breadth)value (dependent variable) from TL (independent variable). The regression statistics value in Table 4 shows that the variability in CB is 91%, and the multiple R-value is 0.95, indicating a strong linear relation between CB and TL. The standard error of 0.426394 tells about the average distance between the observed value and the predicted value.

DISCUSSION

The study of morphometric characteristics of an organism provides insight idea to understand the variation, adaptation and change in different body forms such as size, shape, and growth pattern. It helps to understand how an organism varies in its body structure irrespective of they are belonging to the same population. This will help to determine the age of adults and juveniles, sex like males and females ((Chatterji 1994; Srijya et al. 2010; Itow et al. 2004). The average size of a female is larger than that of a male. In our study we found that the average size of females i.e total length is 34.4, TEL is 16.6, CL is 17.3, PL is 9.1, OL is 7.9, CB is 16.3 which is relatively larger than the males having average body size TL = 30, TEL=14.5, CL= 15.2, PL = 7.9, OL = 6.4, CB = 14.08. By using the statistics of Pearson's correlation and Bivariate linear regression, the relationship between the total length and telson length shows a significant relation (r = 0.94) in between these body lengths.

Similarly, the relation between total length and carapace breadth are positively correlated with each other that is about 0.95 (r = 0.91). By analysing Pearson's correlation & linear regression of another body size such as OL, PL & CL concerning independent variables i.e. total length shows a significant positive correlation between each other (OL - TL, r = 0.5, PL-TL, r = 0.9, CL-PL, r = 0.89).

CONCLUSION

By studying the morphometrics of any organism gives an idea about the different forms like shapes, size, and structures of organisms, like in horseshoe crabs. In this study, the morphometric analysis provides insight and knowledge about the different forms of horseshoe crabs like juvenile and adult, male and female body forms. Males are relatively smaller than females, it shows the amplexus behaviour of this organism and the fecundity of a gravid female which lays approximately 1000 egg per reproductive cycle. There are different body aspects like total body length, prosoma length, opisthosoma length, telson length and carapace length and breadth that we have studied. All the body structures are relatively correlated with each other like increase in total body length increases its carapace length, telson length, and even carapace breadth also. Morphometrics data also gives ratio between different body length which will utilises to understand the growth pattern in both males and female and expand concept on the molting and development of horseshoe crab.

These studies gave us a thorough grasp of the morphometric traits of horseshoe crabs as well as the underlying correlations between different metrics. To comprehend the biology and ecology of these amazing animals and eventually support better management and conservation efforts, researchers and conservationists need this information.

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