



RESEARCH ARTICLE

Seasonal population patterns of *Holothuria Arenicola* Semper, 1868 from Karachi coast, Northern Arabian Sea

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ABSTRACT

The present study was carried out to assess the reproduction weight-length based growth and condition factor of *Holothuria arenicola* Semper, 1868, from January to December 2018, in Karachi coast, Northern Arabian Sea. The sex percentage was determined as 33.3% females and 66.7% males. Length of specimens ranged from 14 and 38 cm and weight of specimens ranged from 21 and 82 g. The relationship was $W = 2.408 L^{0.9482}$ ($R^2 = 0.999$) for females, $W = 0.989 L^{0.9482}$ ($R^2 = 0.998$) for males and $W = 1.234 L^{1.1565}$ ($R^2 = 0.999$) for all individual. The condition factor ranged between 0.84 and 2.62 (mean: 1.52 ± 0.70) in females and between 0.83 and 2.67 (mean: 1.43 ± 0.71) in males. The gonadosomatic index of specimens ranged between 5.50 and 10.66 (mean: 7.95 ± 1.24). The gutted weight of specimens ranged between 2.10 and 11.44 g (mean: 4.91 ± 1.77). Studies about environmental variables and characteristics are necessary in order to complement the understanding of reproduction, the length-weight relationships and condition of sea cucumber in Karachi coast.

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Introduction

Holothuria arenicola Semper, 1868 commonly called the sand cucumber and been on the IUCN Red List (DD - Data Deficient) is commercially important (Conand and Gamboa, 2013). It distributed at some localities in the Western Pacific, including the Red Sea, parts of Asia, the Indian Ocean, the

Comoros, along the Pacific coast of Central America, Caribbean and Brazil (Purcell et al., 2012). This species is found in substantially in coastal waters of Pakistan (Tahera and Tirmizi, 1995). Abundant in shallow areas but can also be found in deeper waters, under stones, in coral debris and on sand flats (Mosher, 1980).

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Relatively little information is available on the biology and ecology of these sea cucumbers belong to the class Holothuroidea in the northern Arabian Sea coasts of Pakistan. *H. arenicola* is also found from the Indo-Pacific to the tropical Western Atlantic. The species is reported from tropical Australia, Mozambique, the Red Sea, Ascension Island, Virgin Islands, Antigua, Barbados, Tobago, Belize, Bermuda, Tortugas, Jamaica, Puerto Rico, U.S. (Mosher, 1980).

Sea cucumber hunting is an important source of income for many other communities (Clarke, 2004). Although there are about 66 species of sea cucumbers in the world (Purcell, 2010), important biological parameters for most species are not known. One of these parameters is the allometric coefficient, which is obtained from length–weight relationships (Gerritsen and McGrath, 2007).

The length weight relation (LWR) is an important tool to estimate attributes of the population (Le Cren, 1951; Giacalone et al., 2010). In the literature, there are some studies about some parameters of sea cucumber such as length and weight (Kilada et al., 2000; Purcell and Tekanene, 2006; Herrero Pérezrul and Reyes-Bonilla, 2008; Kazanidis et al., 2010; Hannah et al., 2012; Siddique et al., 2014; Poot-Salazar et al., 2014; Natan et al., 2015; Aydin, 2016; Ram et al., 2016; Ahmed et al., 2016; Ahmed et al., 2018a, 2018b; Siddique and Ayub, 2019).

This study includes the length, weight, condition, gonadosomatic index, gutted weight parameters and length weight relations study on the population of *Holothuria arenicola* from Karachi coast of Pakistan.

Material and Methods

Sample Collection and Identification

A total of 81 *Holothuria arenicola* was collected from Buleji (Rocky Shore) (24°50'20.41" N, 66°49'24.15" E) of Karachi, Pakistan, the area has approximately eight hundred (800) meters long and one hundred fifty (150) meters wide shown in Figure 1 and Figure 2. Ten (10) surveys were conducted from January to December 2018 on seasonal basis, pre-monsoon (March to May), Southwest monsoon (June to September) post-monsoon (October and November) and Northeast monsoon (December to February).

Specimens were collected by hand and transferred to the laboratory in well aerated aquarium for taxonomic studies, morphological features and microscopic examinations were conducted under a microscope at 10×10 magnifications (Nikon LABOPHOT-2). Length (cm) and weight (g) of specimen were measured. Total length from mouth to anus was measured to

the flexible ruler and wet weight, gutted weight was measured to the nearest 0.01 g immediately after removing the animal from the water to avoid evisceration.

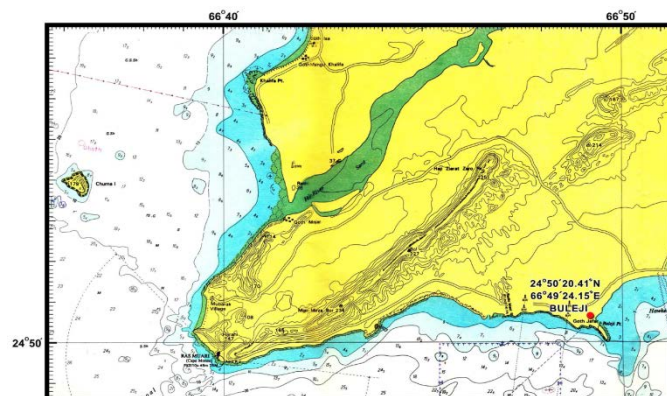


Figure 1. Study area map (Buleji) Karachi coast

Data Analysis

They were grouped according to their weight and length relationships (Chuqunova, 1963). The growth in length and weight were shown in absolute and relative growth parameters. The growth equation of the sea cucumbers equation 1 was derived from equation 2 (Le Cren, 1951).

$$W = a \times L^b \quad (1)$$

$$W = \log a + b \log L \quad (2)$$

Here, W represents the weight “ a ” and “ b ” are the coefficients of the logarithmic equation. Fulton’s condition factor is widely used in fisheries and general fish biology studies. This factor is calculated from the relationship between the weight of sea cucumbers and its length, with the intention of describing the “condition” of that individual. The formula is of the form:

$$C = \frac{W}{L^b} \quad (3)$$

where C is Fulton’s condition factor, $b=1.1565$ for males + females, $b=0.9482$ for females, and $b=1.2214$ for males. W is the weight of sea cucumbers, and L is the length. For calculating gonadosomatic index (GSI) the following formula was used:

$$GSI = \frac{\text{Weight of ovary}}{\text{Weight}} \times 100 \quad (3)$$

Statistical Analysis

Statistical analysis of data (difference between sexes, seasonal difference) was carried out using SPSS statistical package program for Mac Ver. 23.



Figure 2. *Holothuria arenicola*. (A) *H. arenicola* with its habitat on Buleji coast, (B) *H. arenicola* dorsal view, (C) *H. arenicola* (female), (D) Gonads (female), (E) *H. arenicola* (Male), (F) Gonads (Male)

Results

There were about 33.33% females and 66.66% males (sex ratio 1:2). The sex distribution of all specimens examines are shown in Table 1. The lengths of specimens ranged between 14 and 38 cm (mean: 22.97 ± 5.65). The weight of specimens varied between 21 and 82 g (mean: 46.40 ± 9.69). The condition factor ranged between 0.84 and 2.62 (mean: 1.52 ± 0.70) in females and between 0.83 and 2.67 (with average 1.43 ± 0.71) in males. The gonadosomatic index (GSI) of specimens ranged between 5.50 and 10.66 (mean: 7.98 ± 1.24). The gutted weight of specimens ranged between 2.10 and 11.44 g (mean: 4.91 ± 1.77) (Table 1). The differences between the genders were insignificant in terms

of length, weight, gonadosomatic index and gut weight in all season ($p > 0.05$, ANOVA). The differences between the genders were found significant in terms of condition in all seasons ($p < 0.05$, ANOVA).

Length-weight relationships were calculated using the data of all sea cucumber individuals. The relationship was $W = 2.40848216 L^{0.9482}$ ($R^2 = 0.999$) for females, $W = 0.9893513 L^{1.2214}$ ($R^2 = 0.998$) for males and $W = 1.23371441 L^{1.1565}$ ($R^2 = 0.999$) for all individuals. This may be due the cylindrical shape of the animal (Conand, 1989) and it means also that length dose that not grows at the same rate of the weight. Length-weight curves for males and females are drawn in Figure 3.

Table 1. The distribution of sea cucumbers of season, sex, length, weight, condition, gonadosomatic index and gutted weight

Season	Sex	N	L (cm)	W (g)	C	GSI	GtW
			min-max	(min-max)	(min-max)	(min-max)	(min-max)
			Average±SD	Average±SD	Average±SD	Average±SD	Average±SD
Pre	♀	5	17.50-27.50/21.20±4.12	36.00-58.00/42.60±9.04	2.40-2.61/2.48±0.08	6.21-8.61/7.66±1.08	3.00-4.40/3.82±0.51
Monsoon	♂	6	15.50-24.00/20.17±2.99	23.00-52.00/40.50±9.65	0.84-1.07/1.02±0.09	6.83-9.23/7.91±0.94	2.50-4.80/3.78±0.78
	♀♂	11	15.00-27.00/20.58±3.30	23.00-58.00/41.46±8.97	0.84-2.61/1.68±0.07	6.31-9.23/7.79±0.89	2.50-4.80/3.80±0.64
Southwest Monsoon	♀	12	16.00-24.50/20.42±2.48	33.00-54.00/42.25±6.01	2.34-2.67/2.47±0.09	5.50-10.37/7.01±1.36	3.10-6.10/4.03±1.00
	♂	18	14.00-33.00/22.42±6.64	21.00-71.00/45.22±16.57	0.83-1.12/1.00±0.08	5.56-9.76/7.79±1.27	2.10-9.80/4.96±2.10
	♀♂	30	14.00-33.00/21.62±5.40	21.00-71.00/44.03±13.30	0.83-2.67/1.59±0.07	5.50-10.37/7.48±1.34	2.10-9.80/4.59±1.81
Post Monsoon	♀	4	17.50-29.00/22.95±5.44	36.00-54.00/45.70±8.65	2.27-2.53/2.42±0.11	7.07-9.26/7.98±0.95	3.80-5.70/4.55±0.81
	♂	15	19.30-32.00/25.88±5.14	41.00-67.00/52.53±9.55	0.89-1.10/1.00±0.08	6.34-10.66/8.57±1.40	3.40-7.80/5.80±1.55
	♀♂	19	17.50-32.00/25.26±5.20	36.00-67.00/51.11±9.56	0.89-2.53/1.30±0.60	6.34-10.66/8.45±1.33	3.40-7.80/5.54±1.50
Northeast Monsoon	♀	6	17.50-31.80/22.60±5.59	36.00-61.00/46.33±10.44	2.36-2.62/2.48±0.95	6.83-9.50/8.13±0.97	3.50-7.40/4.87±1.49
	♂	15	14.00-38.00/24.54±7.02	21.00-82.00/48.87±16.49	0.84-1.11/0.98±0.86	7.31-10.0/8.30±0.92	2.80-11.44/5.60±2.22
	♀♂	21	14.00-38.00/23.98±6.56	21.00-82.00/48.14±14.80	0.84-2.62/1.40±0.70	6.83-10.0/8.25±0.91	2.80-11.44/5.39±2.03
All Monsoon	♀	27	14.00-38.00/23.72±6.20	21.00-82.00/47.74±9.41	0.84-2.62/1.52±0.70	5.56-10.66/8.16±1.20	3.00-7.40/4.25±1.01
	♂	54	16.00-31.80/21.43±3.96	33.00-61.00/43.74±7.80	0.83-2.67/1.43±0.71	5.50-10.37/7.50±1.22	2.10-11.44/5.24±1.96
	♀♂	81	14.00-38.00/22.97±5.65	21.00-82.00/46.40±9.69	0.84-2.67/1.48±0.70	5.50-10.66/7.98±1.24	2.10-11.44/4.91±1.77

Note: GW: Gonad weight; gutted weight: GtW.

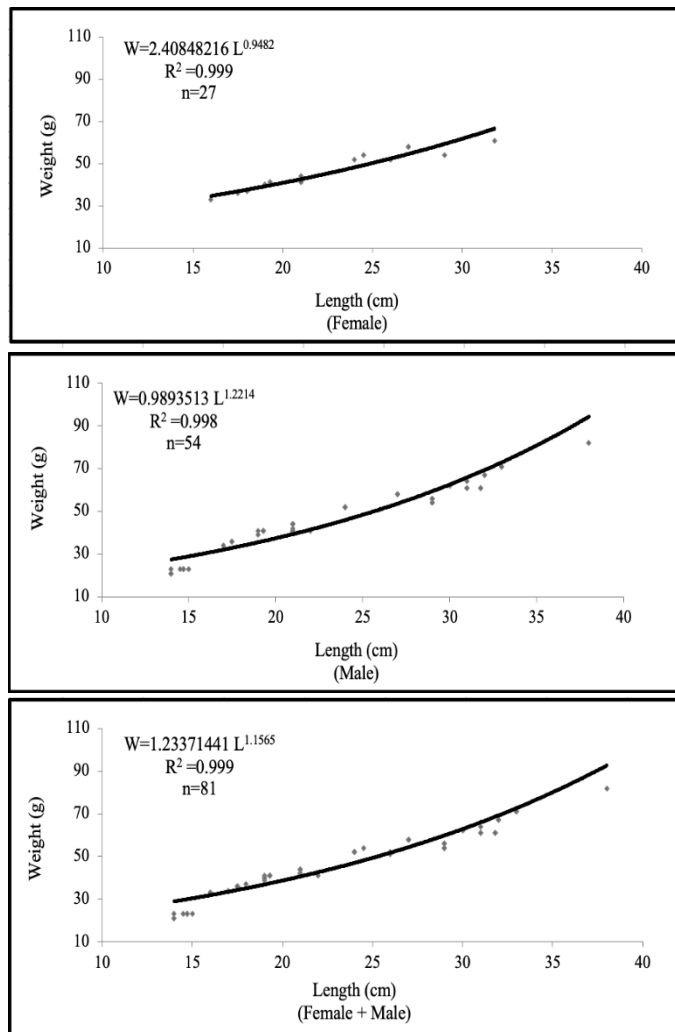


Figure 3. Length–weight relationships in female, male and all individual of sea cucumber

The condition factor and GSI distribution according to season and sex of sea cucumber are shown in Figure 4 and Figure 5, respectively.

The gutted weight–length and gutted weight–weight curves for females, males and all individuals according to sex of sea cucumber are drawn in Figure 6 and Figure 7, respectively.

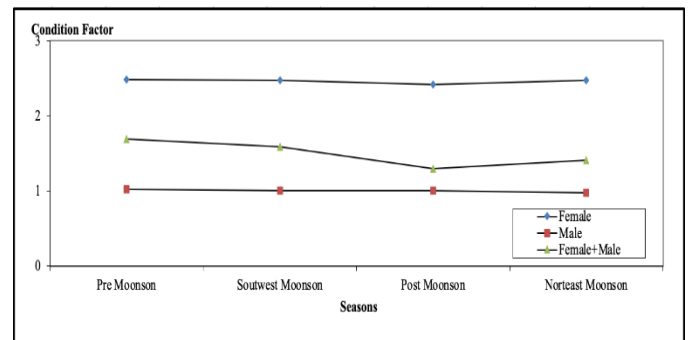


Figure 4. Condition factor according to season and sex of sea cucumber

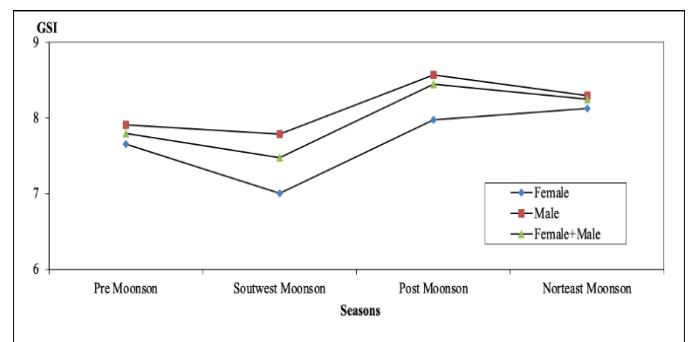


Figure 5. GSI according to season and sex of sea cucumber

Discussion

The comparison of the length weight relationships parameters, L_{max} , W_{max} , gutted weight (GtW), gonadosomatic index (GSI) and condition factor (C) of sea cucumber species showed in Table 2. The slope (b) of length weight relation values calculated for Buleji were higher than literature (Razek et al., 2010; Ahmed et al., 2018). The b value was lower than Siddique et al. (2014, 2015). The L_{max} value was lower than Ahmed et al. (2018) while W_{max} values was lower than Ahmed et al. (2018) and Siddique et al. (2014, 2015) (Table 2). The b values in fish is species specific and varies with sex, age, seasons, physiological conditions, growth increment and nutritional status of fish (Bagenal and Tesch, 1978). Variations in fish growth in terms of length and weight can be explained as an adaptive response to different ecological conditions (Balik et al., 2009).

In this latest study conducted in the Karachi coast, it was reported that sea cucumber species such as *H. atra* and *H. arenicola* show rapid and seasonal growth characteristics (Ahmed et al., 2020). Allometric growth has been determined when the data are examined. As a general assumption, species grow isometrically, but commercial sea cucumber does not show isometric growth. *H. arguinensis* allometric growth has also been reported (González-Wangüemert et al., 2016). Therefore, comparing growth rates from different commercial species should be carefully evaluated.

Table 2. Comparison of sea cucumbers same parameters from different studies

Specimen	Sex	Location	a	b	R ²	Lmax (cm)	Wmax (g)	GtW	GSI	C	References
<i>H. arenicola</i>	♀♂	Manora	0.000	2.157	0.913	-	-	-	-	-	Siddique et al., 2014
	♀♂	Buleji	0.003	1.855	0.691	-	-	-	-	-	
<i>H. arenicola</i>	♀♂	Manora	0.001	2.137	0.886	41.6	375.0	21.70	8.80	-	Siddique et al., 2015
	♀♂	Buleji	0.003	1.813	0.687	37.6	352.0	12.50	6.30	-	
<i>H. arenicola</i>	♀♂	Sunehri/Buleji	0.760	1.370	0.880	48.0	136.0	-	-	-	Ahmed et al., 2018
<i>H. arenicola</i>	♀	Egypt	7.410	0.8473	0.9484	-	-	-	-	-	Razek et al., 2010
	♂		47.935	0.8372	0.8572	16.50	-	-	-	-	
<i>H. arenicola</i>	♀	Buleji	2.408	0.9482	0.999	38.00	82.00	4.25	8.16	1.52	This study
	♂		0.989	1.2214	0.998	31.80	61.00	5.24	7.52	1.43	
	♀♂		1.233	1.1565	0.999	38.00	82.00	4.91	7.95	1.48	

The mean values of length of sea cucumber of pre monsoon, southwest monsoon, post monsoon, northeast monsoon were 20.58±3.30 cm, 21.62±5.40 cm, 22.56±5.20 cm, and 23.98±6.56 cm, respectively. The mean of weight of sea cucumber of pre monsoon, southwest monsoon, northeast monsoon, post monsoon was 41.46±8.97 g, 44.03±13.30 g, 48.14±14.80 g, and

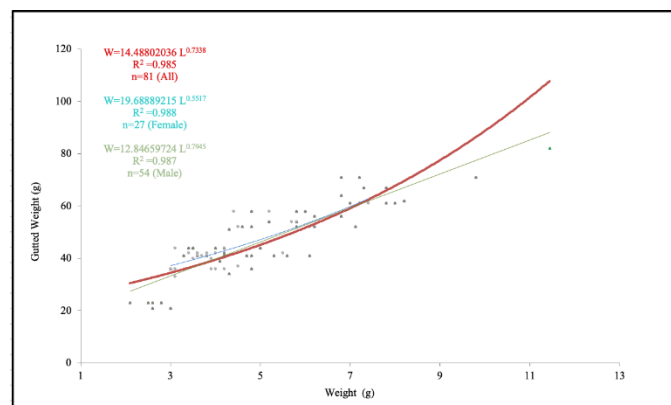


Figure 6. The gutted weight–length curves for females, males and all individuals

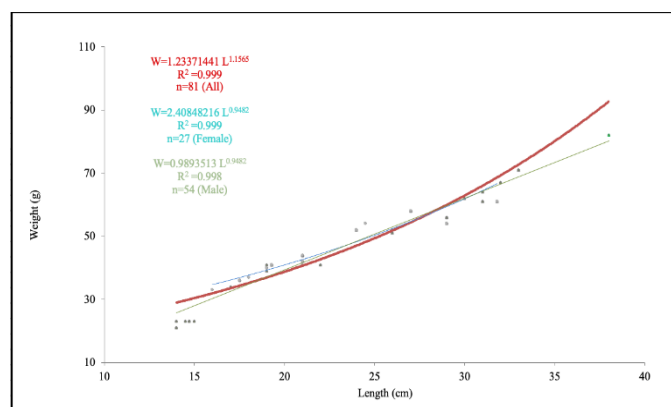


Figure 7. The gutted weight–weight curves for females, males and all individuals

51.11±9.56 g, respectively. While the highest length average was observed in northeast monsoon, the highest weight average was determined in post monsoon. The lowest length and weight average were determined in pre monsoon (Table 1).

Gutted weight value of this study was lower than the value of Siddique et al. (2015). The results of gonadosomatic index

value are in agreement with some earlier reports (Siddique et al., 2015). LWR and C parameters offer valuable information for understanding the biology and ecology of fish in terms of predicting the average weight corresponding to a known length group (Froese, 2006).

The lowest C value (1.30) was found in the post monsoon, while the largest C value (1.68) was found in the pre monsoon. The higher GSI value (8.45) was found in the post monsoon, while the lower GSI value (7.48) was seen in the South monsoon (Figure 4 and Figure 5).

Conclusion

This study provides knowledge on certain biological aspects of *Holothuria arenicola*, which can be utilized for effective management measures (monitoring and hunting) in order to avoid the over exploitation of this species. Studies about environmental variables and characteristics are necessary in order to complement the understanding of the length-weight relationships and condition of sea cucumber in Karachi coast.

Acknowledgements

This study was written while at home quarantine during the COVID-19 pandemic.

Compliance with Ethical Standards

Authors' Contributions

QA, SB and QMA performed the research, analyzed the data and helped to draft the manuscript; QA and SB conceived and designed the work and wrote the manuscript. All authors contributed to and approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical Approval

For this type of study, formal consent is not required.

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