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- RESEARCH ARTICLE-

Seasonal Variation in the Length-Weight Relationships and Condition Factor of Four Commercially Important Sea Cucumbers Species from Karachi Coast- Northern Arabian Sea

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Abstract

Length-weight relationships and condition assessment are a common practice in fisheries analyses; however, such information is unknown for most sea cucumber species. The present study investigated length-weight relationships and relative condition indices of four commercially important sea cucumbers: *Holothuria arenicola*, *Holothuria atra*, *Holothuria pardalis* and *Holothuria verrucosa*. Additionally, the seasonal variations obtained between three climatic seasons (pre-monsoon, monsoon and post-monsoon) were analyzed. The results showed that the four species grow allometrically, with negative allometric *b* values ranging from 0.84 to 1.74. There were significant differences of length-weight relationships between climatic seasons for *H. arenicola* and *H. atra*. The lower *b* values were observed during post-monsoon and the higher *b* values during monsoon in three of the four species. During the post-monsoon, the condition of the bigger individuals of *H. arenicola* and *H. atra* was lower than that of the small individuals. The differences in length-weight relationships of *H. pardalis* and *H. verrucosa* were not significant between climatic events. The higher temperatures occurred during monsoon and the lower during post-monsoon, but these data only showed a significant correlation with the relative condition factor of *H. arenicola*. Best condition of the individuals of *H. arenicola* occurred at temperatures between 22 to 31°C. Studies about environmental variables and characteristics of the substratum type are necessary in order to complement the understanding of the length-weight relationships and condition of these species.

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Introduction

Length-weight relationships are commonly used in fisheries biology to convert length measures into weight and to determine the growth characteristics related to those variables. Data analysis on length-weight relationships and condition indices is one of the standard methods more employed in fishery biology and widely discussed in many papers of fish (Le Cren, 1951; Froese, 2006).

Sea cucumbers fisheries are an important source of income for many otherwise resource-limited communities (Clarke, 2004), principally in Asia. Although worldwide about 66 species of sea cucumbers are harvested (Purcell, 2010), important biological parameters are unknown for most species. One of these parameters is the allometric coefficient, which is obtained from length–weight relationships and can be used to convert length distributions into weights for biomass estimates (Gerritsen & McGrath, 2007). Biomass estimates are utile to assess the status of sea cucumbers stocks (Purcell, 2010).

In the scientific literature, there are some works about allometric coefficients and condition indices of sea cucumbers (Sang, 1963; Conand, 1989; Purcell and Tekanene, 2006; Herrero-Pérezrul and Reyes-Bonilla, 2008; Purcell et al., 2009; Kazanidis et al., 2010; Hannah et al., 2012; Purcell and Agudo, 2013; Poot-Salazar et al., 2014; Prescott et al., 2015; Natan et al., 2015; Aydin, 2016; Ram et al., 2016), but in the most species, this information is unknown.

Total 19 sea cucumber species have been recorded from coastal waters of Pakistan, seven of which are important commercially (Purcell, 2010; Purcell et al., 2013; Purcell et al., 2014). Neither traditional fishery of these echinoderms is exist in Pakistan nor studies on them. Only a few studies are exists (Ahmed & Ali, 2014; Siddique et al., 2014; Haider et al., 2015; Ahmed & Ali 2016; Ahmed et al., 2018). Ahmed et al. (2017) have worked on the heavy metals concentration in Holothurians from the northern Arabian Sea coasts of Pakistan. Thus the biological information on the commercially important species is necessary for management of worldwide sea cucumbers current fisheries.

The goal of our study was to investigate the seasonal variability (pre-monsoon, monsoon, and post-monsoon) of length-weight relationship and the relative condition factor of four commercially important sea cucumbers species: *Holothuria arenicola* Semper, 1868, *Holothuria atra* Jaeger, 1833, *Holothuria pardalis* Selenka, 1867 and *Holothuria verrucosa* Selenka, 1867 in the coastal waters of Karachi, Pakistan.

Material and methods

Field procedures

Two rocky shores Buleji coast (24°50'20.41" N, 66°49'24.15" E) and Sunehri (24°52'33.49" N, 66°40'40.20" E) were selected (Figure 1). Specimens were collected by hand-picking through forceps at low tide from intertidal zone. Collected specimens were kept alive in water filled containers. Specimens were transported to the laboratory and shifted in well aerated aquaria.

For taxonomic studies and identification, morphological features were examined and microscopic studies were conducted. Ossicles were taken from three positions (dorsal and ventral body walls, and tentacles), wet mounts were prepared by placing a small piece of skin tissue on slide and adding few drops of 3.5% bleach, the slides were then rinsed with drops of distilled water. The slides were examined under a microscope at 10x10 magnifications (Nikon LABOPHOT-2). Microphotography was also performed through digital camera (Fujifilm 16 MP).

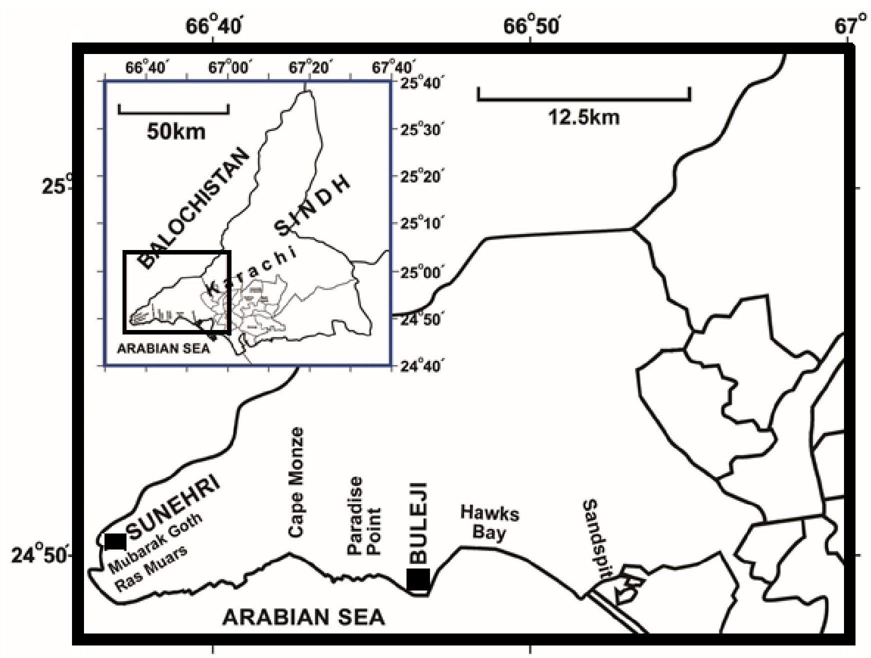

Figure 1. Study area Map. The red squares indicate the localities where the sea cucumbers *H. arenicola, H. atra, H. pardalis* and *H. verrucosa* were collected.

Length (cm) and weight (g) data were collected for each sea cucumber after allowing the sea cucumber to relax in water for 5 min. Total length from mouth to anus was measured to the flexible ruler. Wet weight was measured to the nearest 0.01 g immediately after removing the animal from the water to avoid evisceration.

Data analysis

We compared size frequency distributions between Holothurians from Sunehri and Buleji using the Kolmogorov-Smirnov non-parametric test (Sokal and Rohlf, 1997), discriminated by species.

Length-weight relationships were computed for specimens using general regression method (Ricker, 1973). Growth curves for population were also calculated by the same method used by Ricker (1975). In order to describe relative changes in sea cucumbers morphology we used the allometric equation $y = ax^b$, where a and b are parameters, x is the body length (L) and y the wet weight (W). Parameters were calculated by species with non-linear regression analysis, which is a good tool in allometric studies (Ebert and Russel, 1994). The loss function was evaluated with Marquardt's compromise algorithm (Marquardt, 1963), which minimizes the sum of squares (SSQ) of the difference between sample weights and pseudo-weights (Gayanilo and Pauly, 1997). Convergence was reached at 50 iterations in each regression. Student’s *t*-test was conducted to test the hypothesis of isometry ($b = 3$). Allometric growth occurred when either $b > 3$ (negative) or $b < 3$ (positive).

We analyzed sea cucumbers condition by the relative condition factor K_{rel} (Le Cren, 1951) as follows:

$$K_{rel} = \frac{W}{W'}$$

Where W is the weight of an individual sea cucumber and W' is the predicted mean weight for the same sea cucumber as calculated from a composite of length-weight regression throughout the range of the species:

$$W' = aL^b$$

Seasonal variations in the length-weight relationships were evaluated through one-way analysis of covariance (ANCOVA), using season (pre-monsoon, monsoon and post-monsoon) as the main factor $\log_{10}$ weight as the dependent variable and $\log_{10}$ length as the co-variable. Separate analyses were done by specie. The assumptions of homogeneity of the slopes (parallelism test) and linear relationship between the dependent variable and the covariate were tested. When the parallelism assumption was not met, a separate slope model was used as an alternative. When significant differences were found, multiple comparisons were performed using Tukey tests (HSD) (Zar, 1984; Sokal and Rohlf, 1997). In order to detect seasonal variation (pre-monsoon, monsoon and post-monsoon) in the b and K_{rel} values, we focused on variation in condition with the help of a log K_{rel} vs log L plot (Froese, 2006). All statistical analyses were considered significant at $p<0.05$ and highly significant at $p<0.001$.

Results

A total of 302 sea cucumbers were identified, measured and weighted, 53 *H. arenicola*, 30 *H. atra*, 157 *H. pardalis* and 62 *H. verrucosa*. The total lengths ranged from 12.0 to 48.0 cm (mean 22.6 ± 6.9 cm) for *H. arenicola*, from 12.0 to 34.0 cm (mean 19.1 ± 5.6 cm) for *H. atra*, from 4.0 to 16.0 cm (mean 8.7 ± 3.1 cm) for *H. pardalis* and from 5.0 to 19.0 cm (mean 11.6 ± 3.2 cm) for *H. verrucosa*. Weights ranged from 16.0 to 136.0 g (mean 59.2 ± 29.6 g), 15.0 to 104.0 g (mean 38.6 ± 21.2 g), 5.0 to 27 g (mean 12.9 ± 4.3 g) and from 8.0 to 32.0 g (mean 16.1 ± 3.9 g), for *H. arenicola*, *H. atra*, *H. pardalis* and *H. verrucosa*, respectively. The size frequency distributions of the four species in Sunehriare were not different from those of Buleji (Kolmogorov-Smirnov test; Table 1).

Table 1. Comparisons between size-frequency distributions and median sizes for Sunahri and Buleji sea cucumbers from Karachi, Pakistan. *df* = degrees of freedom; Kolmogorov-Smirnov test: when $D_{max} > D_{m,n,\alpha}$ reject the null hypothesis (Ho: No difference between datasets).

	Locality	n	Mode (cm)	Size range (cm)	D_{max}	$D_{m,n,\alpha}$	Median size	*df*
H. arenicola	Sunehri	27	23.0	12.0-32.0	0.241	0.374	21.0	1
	Buleji	26	multiple	14.0-48.0			23.5	
H. atra	Sunehri	19	23.0	13.0-27.0	0.502	0.515	19.0	1
	Buleji	11	14.0	12.0-34.0			16.0	
H. pardalis	Sunehri	110	8.0	4.0-14.0	0.114	0.237	8.0	1
	Buleji	47	12.0	4.0-16.0			9.0	
H. verrucosa	Sunehri	28	12.0	8.0-19.0	0.181	0.347	12.0	1
	Buleji	34	12.0	5.0-17.0			12.0	

The Students *t*-tests showed that the four species grow allometrically ($b \neq 3$, $p<0.05$), with negative allometric *b* values ranging from 0.84 to 1.74 (Table 2). No length-weight relationship showed *b* values near three (isometric value). In all cases, the relationship between length and weight was highly significant ($p<0.001$; Figure 2).

Table 2. Length-weight relationship parameters for four species of sea cucumbers collected in Karachi, Pakistan.SE: standard error; CL: confidence limit; r^2: determination coefficient; *r*: correlation coefficient; *a*: scaling constant; *b*: allometric growth coefficient; *$p< 0.001$.

Species	*a* ± SE	*b* ± SE	95% CL of *b*	r^2	*r*
H. arenicola	0.76 ± 0.19	1.37 ± 0.08	1.22-1.53	0.88*	0.94
H. atra	0.22 ± 0.05	1.74 ± 0.07	1.59-1.89	0.95*	0.97
H. pardalis	2.04 ± 0.10	0.86 ± 0.02	0.81-0.90	0.93*	0.97
H. verrucosa	2.05 ± 0.28	0.84 ± 0.05	0.73-0.95	0.83*	0.91

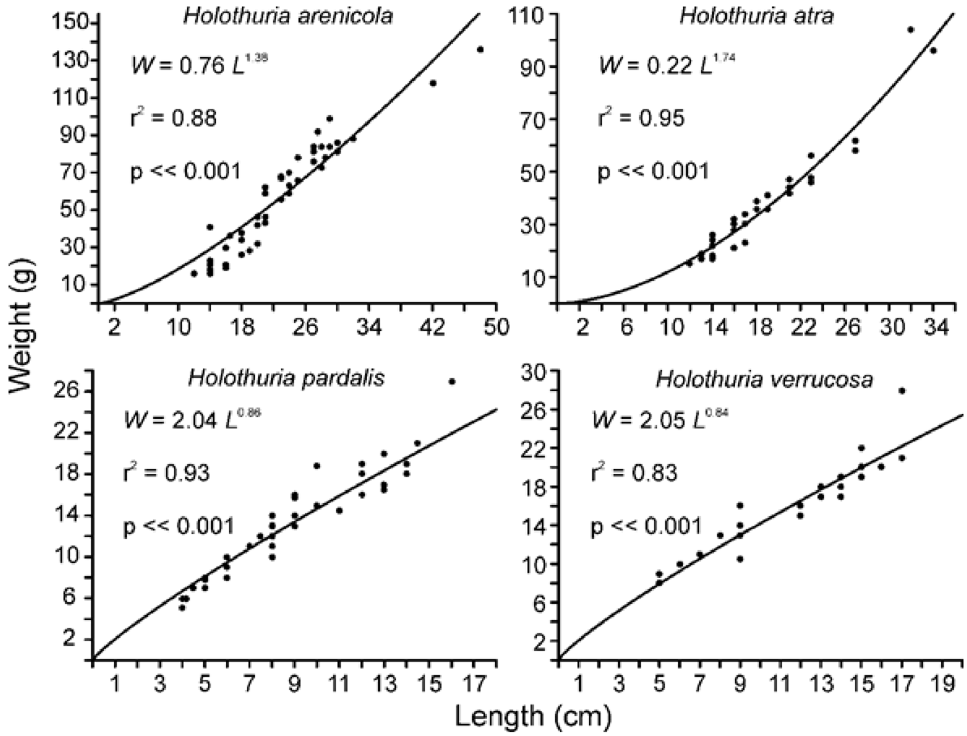

Figure 2. Length-weight relationships of four sea cucumbers species with commercial value collected in Karachi, Pakistan. *W*: weight; *L*: length; r^2: determination coefficient.

For the four species, the lower *b* values occurred during post-monsoon and the higher *b* values during monsoon (Table 3). There were significant differences in the length-weight relationship of *H. arenicola* between pre-monsoon, monsoon and post-monsoon (Separate slopes model, $F_{2,47}$= 12.18, p<0.001). Body weight was significantly higher during post-monsoon than during pre-monsoon and monsoon, when $Log_{10}\,L$ was used as a covariate (Tukey test, p< 0.001) (Figure 3a). According to the log K_{rel} vs log *L* plot, during post-monsoon, large individuals had a lower condition than small individuals; but during pre-monsoon and monsoon, they had a higher condition (Figure 3b).

Table 3. Length-weight relationships discriminated by climatic event for the four species of sea cucumbers collected in Karachi, Pakistan. SE: standard error; CL: confidence limit; r^2: determination coefficient; *a*: scaling constant; *b*: allometric growth coefficient; *p< 0.001.

Species	Climatic event	*a* ± SE	*b* ± SE	95% CL of *b*	r^2
H. arenicola	Pre-monsoon	0.10 ± 0.04	1.97 ± 0.12	1.73 – 2.22	0.95*
	Monsoon	0.10 ± 0.09	2.09 ± 0.36	1.24 – 2.94	0.87*
	Post-monsoon	2.38 ± 0.66	1.06 ± 0.08	0.89 – 1.22	0.91*
H. atra	Pre-monsoon	0.15 ± 0.07	1.85 ± 0.15	1.50 – 2.19	0.93*
	Monsoon	0.09 ± 0.06	2.00 ± 0.21	1.45 –2.56	0.94*

	Post-monsoon	0.48 ± 0.12	1.49 ± 0.08	1.32 – 1.67	0.97*
H. pardalis	Pre-monsoon	2.16 ± 0.11	0.83 ± 0.02	0.79 – 0.88	0.95*
	Monsoon	1.42 ± 0.32	1.05 ± 0.12	0.78 – 1.33	0.93*
	Post-monsoon	1.86 ± 0.19	0.89 ± 0.04	0.80 – 0.98	0.91*
H. verrucosa	Pre-monsoon	1.87 ± 0.37	0.87 ± 0.08	0.72 – 1.03	0.83*
	Monsoon	0.94 ± 0.38	1.15 ± 0.16	0.81 – 1.50	0.82*
	Post-monsoon	3.04 ± 0.53	0.67 ± 0.07	0.52 – 0.83	0.87*

The climatic event also had a significant effect on the length-weight relationship of *H. atra* (one-way ANCOVA, $F_{2,26}$= 7.32, p<0.05; Figure 4a), and again body weight was significantly higher during post-monsoon than during pre-monsoon and monsoon, when $Log_{10}L$ was used as a covariate (Tukey test, p<0.001). The log K_{rel} vs log L plot showed that large individuals had a higher condition than small individuals during the pre-monsoon but lower during monsoon and post-monsoon, however, these tendencies only were statistically significant during the post-monsoon (Figure 4b).

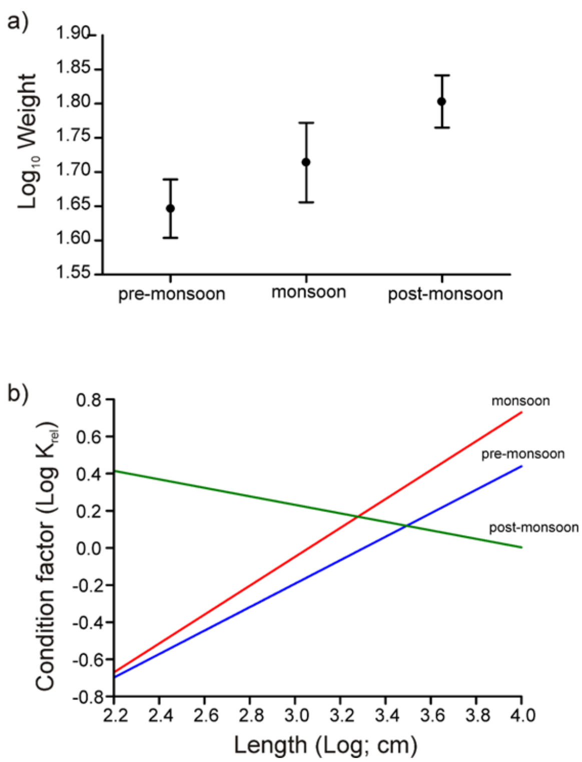

Figure 3. *Holothuria arenicola*. a) Log_{10} mean weight (vertical bars denote 0.95 confidence intervals) and b) Log-log plot of condition vs length calculated from the weight-length relationship of data taken during pre-monsoon (r^2 = 0.51; p < 0.05), monsoon (r^2 = 0.58; p < 0.05) and post-monsoon (r^2 = 0.52; p < 0.05) in Karachi, Pakistan.

Analysis of covariance found no significant difference in the length-weight relationships between climatic events for *H. pardalis* ($F_{2,153}$= 3.00, p= 0.05) and *H. verrucosa* ($F_{2,58}$= 0.44, p=

0.64). The log K_{rel} vs log L plot showed large specimens of *H. pardalis* had the higher condition than small specimens. In the case of *H. verrucosa*, small specimens had higher condition than large specimens (Figure 5).

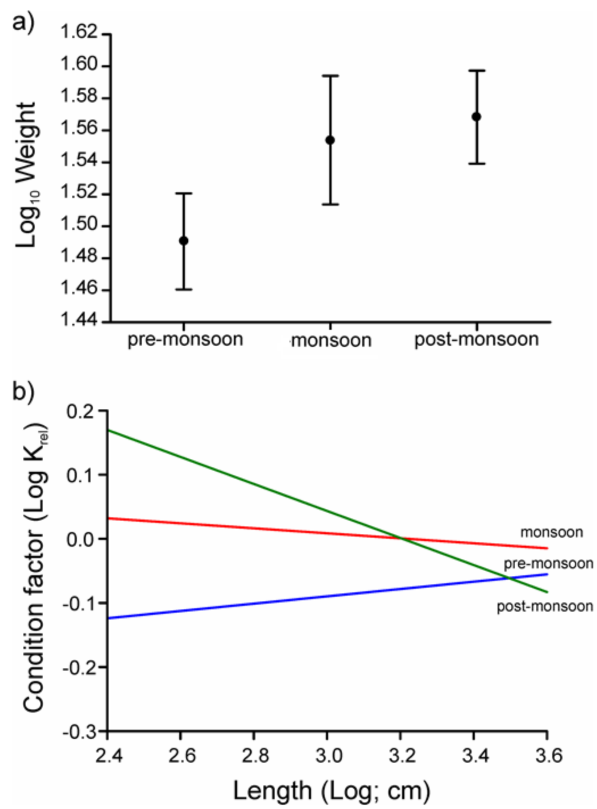

Figure 4. *Holothuria atra*. a) Log_{10} mean weight (vertical bars denote 0.95 confidence intervals) and b) Log-log plot of condition vs length calculated from the weight-length relationship of data taken during pre-monsoon (r^2 = 0.01; p = 0.77), monsoon (r^2 = 0.01; p = 0.87) and post-monsoon (r^2 = 0.36; p < 0.05) in Karachi, Pakistan.

The water temperature in the study area was higher during monsoon than during pre-monsoon and post-monsoon (Figure 6a). Only in *H. arenicola*, a significant negative correlation (r = 0.34, p< 0.05; Figure 6b) between temperature and K_{rel} was found.

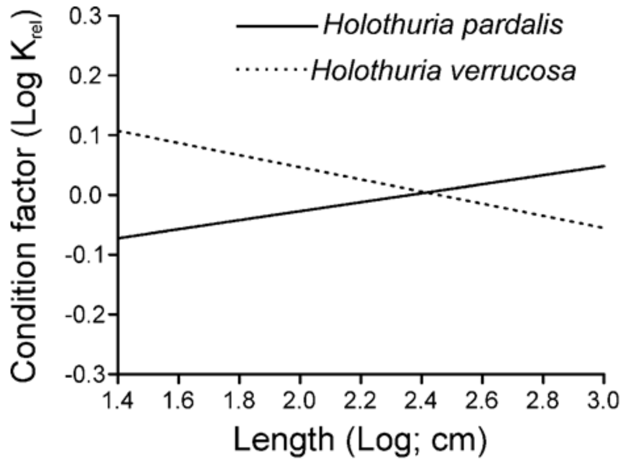

Figure 5. Log-log plot of condition vs length calculated from the weight-length relationships of data taken during collection period in Karachi, Pakistan.

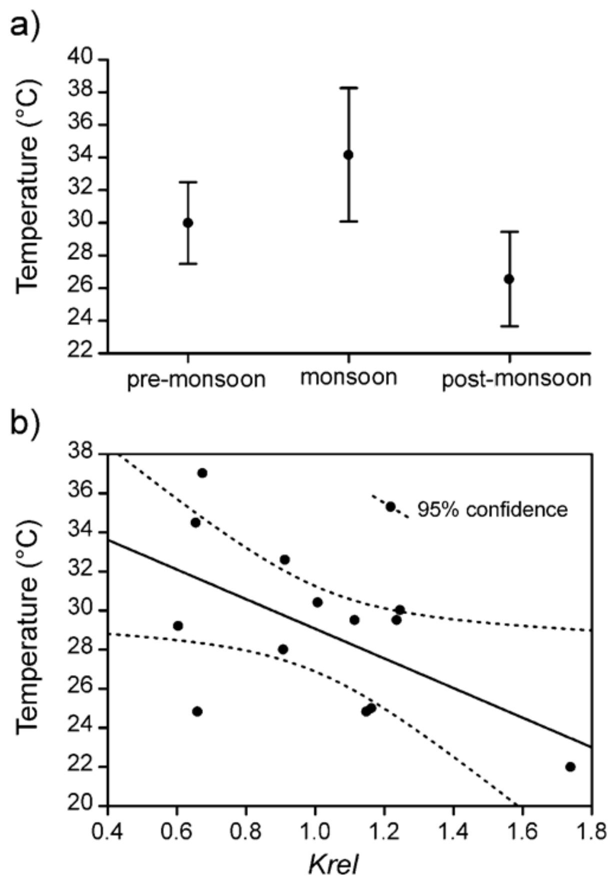

Figure 6. a) Mean temperature taken during pre-monsoon, monsoon and post-monsoon in Karachi, Pakistan; b) Log-log plot of condition vs length calculated from the weight-length relationships of data taken during collection period in Karachi, Pakistan.

Discussion

In our study, larger specimens of *H. arenicola* were registered than in the Mediterranean Sea on the Egyptian coast (length range: 5.0-21.0 cm; Abdel Razek et al., 2010), even longer than in Karachi, Pakistan in 2011 and 2012 (length range: 2.7-41.6 cm; Siddique et al., 2014). The presence of smaller specimens of *H. arenicola* in Egyptian waters might be due to the over exploitation done by fishing (Abdel Razek et al., 2007); occur the same with *Holothuria nobilis* (Selenka, 1867) on the Great Barrier Reef, where the average weight of specimens significantly reduces on fished reefs compared to reefs closed to fishing (Uthicke & Benzie, 2000).

The mean size of *H. atra* adult specimens was higher than mean size found by other authors for this same species (Conand, 1989: 13.3 cm; Ebert, 1978: 13.0 cm; Edwards, 1908: 16.37 cm); however, its mean weight was lower than that found by these authors. The lower weights may be due to that the fact the specimens from coastal waters of Pakistan in this study correspond to the small form of this species (Lee et al., 2014; Chao, 1993). According to Chao et al. (1994), the small form of *H. atra*is abundant in intertidal and shallow water habitats. In addition, it is possible that the specimens collected in the two rocky shores Sunehri and Buleji coast might be reproducing asexually (Chao, 1993), but there is no data available on this fact in Pakistan.

Mean length of *H. pardalis* was lower than the average body length reported of adult specimens for this species (roughly 12 to 25 cm; Purcell et al., 2012). Furthermore, 57% adult and 43% juvenile of *H. pardalis* were collected in our study, indicating that the habitat types of the Sunehri and Bulejicoasts (rocky shores) are conducive for both. In India, the habitat of adult individuals of this same species is different from that of the juveniles (Gadhavi et al., 2014).

H. verrucosa was recently recorded for the first time from the coastal areas of Pakistan (Ahmed et al., 2016), its mean size and weight were 11.6 cm and 16.1 g, respectively, but no information on sizes is currently available for comparison with our results.

In the four species, growth was negative allometric ($b< 3$) this shows that large specimens changed their body shape to become more elongated (Froese, 2006). Namely, length increment was faster than weight increment. This type of growth occurs in many species of sea cucumbers (Table 4), and *H. pardalis* and *H. verrucosa* were for the first time recorded.

Because deposit-feeding sea cucumbers ingest sediments high in organic matter in the natural environment (Slater & Carton, 2009), the lower *b* values that occurred during post-monsoon in the four species of this study, likely to be due to an effect the climatic event on the food availability and quality of sediment. It has been shown that the grain size in marine sediments of Malaysia, can be higher during post-monsoon than pre-monsoon and that this can affect the content of organic matter in the sediment (Kamaruzzaman et al., 2010).

Therefore, an indicator of fatness or general “well-being” is utile in this case, such as the relative condition factor (K_{rel}), which indicated that during the post-monsoon, the condition of the bigger individuals of *H. arenicola* and *H. atra* was lower than that of the smaller individuals. These findings indicate a possible diminishing of the content of organic matter in the sediment during the post-monsoon, which can be affecting the “well-being” of the bigger sea cucumbers.

In the particular case of *H. arenicola* in Buleji, the higher gonad index values occur during summer (monsoon) and the lower during winter (post-monsoon) (Siddique et al., 2014), coinciding in this study with the higher K_{rel} values and lower K_{rel} values, respectively. These results suggest that the reproduction of *H. arenicola* could be in synchrony with the abundance of food.

The temperature also plays an important role in the reproductive events and the abundance of food (Morgan, 2000), but only data of *H. arenicola* showed a significant negative correlation with the relative condition factor K_{rel}. The higher temperatures occurred during monsoon and the lower during post-monsoon, but the better condition of the individuals of *H. arenicola* occurred at temperatures between 22 to 31°C.

Table 4. Parameters from the length-weight relationships recorded for different sea cucumbers species.

Species	a	b	References
Actinopyga echinites	1.31	1.96	Purcell et al., 2009
	0.76	1.38	Purcell et al., 2009
Actinopyga lecanora	0.0096	1.626	Prescott et al., 2015
	0.44	1.53	Purcell et al,. 2009
Actinopyga mauritiana	0.075	1.999	Prescott et al., 2015
	4.64	1.67	Purcell et al., 2009
	3.26	1.11	Purcell et al., 2009
	0.887	2.002	Trianni andTenorio, 2011
Actinopyga miliaris	0.0101	1.482	Prescott et al., 2015
	19.47	1.2	Purcell et al., 2009
	7.30	0.93	Purcell et al., 2009
Actinopyga palauensis	27.18	1.23	Purcell et al., 2009
	5.40	1.05	Purcell et al., 2009
Actinopyga spinea	10.96	1.41	Purcell et al., 2009
	1.00	1.36	Purcell et al., 2009
Apostichopus japonicus	0.081	2.945	Lee et al., 2014
Bohadschia vitiensis	0.0197	2.064	Prescott et al., 2015
B. vitiensis, B. argus	0.0059	1.905	Prescott et al., 2015
Bohadschia koellikeri	0.0021	1.12	Prescott et al., 2015
Bohadschia argus	0.0003	1.49	Prescott et al., 2015
Holothuria arenicola	0.0033	1.855	Siddique et al., 2014
	0.76	**1.38**	**This study**

Holothuria atra	0.767	2.635	Prescott et al., 2015
	0.0038	2.13	Conand, 1989
	0.009	1.921	Eriksson, 2006
	0.22	**1.74**	**This study**
Holothuria coluber	0.0933	1.591	Prescott et al., 2015
Holothuria edulis	0.0203	1.336	Prescott et al., 2015
Holothuria fuscogilva	0.0011	1.689	Prescott et al., 2015
	119.28	0.9	Purcell et al., 2009
	30.60	0.75	Purcell et al., 2009
	0.0011	2.407	Conand, 1989
	0.0002	2.62	Purcell and Tekanene, 2006
Holothuria fuscopunctata	0.00043	2.50	Conand, 1989
Holothuria lessoni	0.37	2.41	Purcell et al., 2009
	2.15	1.20	Purcell et al., 2009
Holothuria mammata	0.71	1.75	Aydin, 2016
Holothuria nobilis	0.318	2.426	Kandan, 1994
	0.0017	2.34	Conand, 1989
Holthuria pardalis	**2.04**	**0.86**	**This study**
Holothuria polii	0.69	1.77	Aydin, 2016
Holothuria sanctori	3.22	1.18	Aydin, 2016
Holothuria scabra	1.77	1.88	Purcell et al., 2009
	1.19	1.26	Purcell et al., 2009
	1.107	1.87	Natan et al., 2015
	0.0033	2.178	Al-Rashdi et al., 2007
	0.1229	2.6526	Agudo, 2012 (cultured sandfish)
	0.0017	2.277	Conand, 1989
	0.0714	2.84	Pitt and Dinh, 2004
Holothuria tubulosa	0.69	1.74	Aydin, 2016
	6.87	1.005	Kazanidis et al., 2010
Holothuria verrucosa	**2.05**	**0.84**	**This study**

Holothuria whitmaei	0.9345	1.927	Prescott et al., 2015
	235.54	0.65	Purcell et al., 2009
	20.12	0.82	Purcell et al., 2009
Isostichopus badionotus	4.4	1.5	Poot-Salazar et al., 2014
	0.14	2.6	Poot-Salazar et al., 2014
Isostichopus fuscus	1.1421	1.8321	Herrero-Pérezrul and Reyes-Bonilla, 2008
Pearsonothuria graeffei	0.0738	2.495	Prescott et al., 2015
Parastichopus californicus	0.1313	2.310	Hannah et al., 2012
	0.0026	2.0	Humble, 2005
Parastichopus parvimensis	0.4	1.83	Chávez et al., 2011
Stichopus chloronotus	0.0372	2.275	Prescott et al., 2015
	0.6	2.02	Purcell et al., 2009
	0.71	1.37	Purcell et al., 2009
	0.009	1.917	Eriksson, 2006
Stichopus herrmanni	0.0621	1.515	Prescott et al., 2015
	5.71	1.63	Purcell et al., 2009
	7.85	0.97	Purcell et al., 2009
Stichopus horrens	0.0392	1.773	Prescott et al., 2015
Stichopus regalis	0.0024	2.112	Ramón et al., 2010
Stichopus variegatus	0.0004	2.49	Conand, 1989
Thelenota ananas	0.4356	0.935	Prescott et al., 2015
	15.91	1.44	Purcell et al., 2009
	3.42	1.13	Purcell et al., 2009
	0.0013	2.241	Conand, 1989
Thelenota anax	0.1851	1.393	Prescott et al., 2015

The differences of the length-weight relationships of *H. pardalis* and *H. verrucosa* were not significant between climatic events, but large specimens of *H. pardalis* had a better condition than that of the small specimens and vice-versa in specimens of *H. verrucosa*. Therefore, although both small and large sea cucumbers share the same habitat in the coastal waters of Karachi, Pakistan, size distribution before collecting them could be different perhaps by the characteristics of substratum type. This type of studies has been conducted for *Holothuria scabra* in Solomon Islands, where it was shown that size distribution was a function of substratum type and depth (Mercier et al., 2000).

Conclusion

The commercially important sea cucumbers found in Coastal waters of Pakistan, grow allometric, form negative, namely, length increment is faster than weight increment. Variations of the parameter b and the relative condition factor K_{rel} that occur between climatic pre-monsoon, monsoon and post-monsoon seasons, indicate changes in the environmental variables of the habitat, which also could have relation with the life history of species, such as the reproductive period and the content of organic matter in the sediments.

Studies about environmental variables and characteristics of the substratum type, as well as the relationships of these with sizes distribution of the sea cucumbers are necessary for understanding the biology and ecology of the species distributed from Karachi coast- Northern Arabian Sea.

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