International Journal of Science, Environment and Technology, Vol. 3, No 3, 2014, 1193 – 1204

ISSN 2278-3687 (O)

BIOMETRIC RELATIONSHIPS OF THE MOTHER OF PEARL OYSTER (*Pinctada margaritifera var erythraensis*) FROM DONGONAB BAY, RED SEA

Elamin M. Elamin[1*] and Sheikh Eldin M. Elamin[2]
[1]Fisheries Research Centre, Red Sea Station, Port Sudan
[2]Department of Fisheries, Faculty of Marine Science and Fisheries, Red Sea University
E-mail: sheikhelamin@hotmail.com (*Corresponding Address*)

Abstract: Dongonab Bay is the largest bay in the Red Sea. Large quantities of mother of pearl oyster spat can be collected from it. This study was conducted at Dongonab Bay to determine length-weight relationships of *Pinctada margaritifera var erythraensis* cultured in two systems (hanging, and bottom) beside data collected from wild oysters.
The results showed that each of the following parameters: shell length, shell height and shell thickness yielded highly significant ($p < 0.01$) correlation with each of the following total weight, shell weight and soft wet weight. These highly significant correlations indicated that parameters can be determined with high accuracy based on the derived equations.
Keywords: *Pinctada*, Oyster, Biometric, Dongonab Bay, Red Sea.

Introduction

The Red Sea is known for its unique beautiful marine and coastal environments and the diversity of species inhabiting them. Towards the beginning of the 19th century the Sudan pearl fishery launched an ambitious programme in Dongonab bay (Mahmoud and Ahmed, 2010). Crossland (1911) made a physical description of Dongonab and Farah (2007) described some environmental characteristics of the bay. Interest in mother of pearl oyster (*Pinctada margaritifera* var *erythraensis*) was due to Crossland (1919, 1931and 1957); Nasr (1982 and 1984); Farah (1991and 1992) and Elnaim (1992). The oysters are valued for their shells which are exported to Europe where the lustrous nacre is mainly used in manufacturing of large buttons for women's fashion, knife handles, jewelry, ornaments, inlay work and poultry feed (Farah, 1992). Live oysters are used for artificial pearl culture in Dongonab Bay (Crossland, 1931). Oyster shells ranks after to trochus and shrimp in economic importance.

This paper intended to establish the relationships between the three morphometric measurements (Total length, height and thickness) versus total weight, shell weight and soft wet weight of the mother of pearl oyster from Dongonab Bay.

*Received May 12, 2014 * Published June 2, 2014 * www.ijset.net*

Materials and Methods

Study area:

Dongonab Bay lies about 176 km north of Port Sudan. Its total area is 305 km^2, and the width varies from 3.2 to 14.5 km (Fig. 1).

Collection of specimens:

Oysters from hanging (230) and from bottom (242) systems (cultured in the vicinity of Gulf Pearl Company Oyster Farm), and (121) from the wild were measured. Stinking organisms were removed from the specimens by a brush. The total weight "TW", soft wet weight "SWW" and shell weight "SW" of each specimen was obtained in gm using a digital balance. Anterior posterior length "L" (from the greatest horizontal distance between the anterior and the posterior margins of the shell taken parallel to the hinge line); dorsoventral height "H" (from hinge line to the furthermost edge of the non nacreous border excluding growth processes) and thickness "TH" (the maximum distance between the external surfaces of a closed oyster) following Hynd (1955). Measurements were taken by stainless steel calipers (Fig. 2).

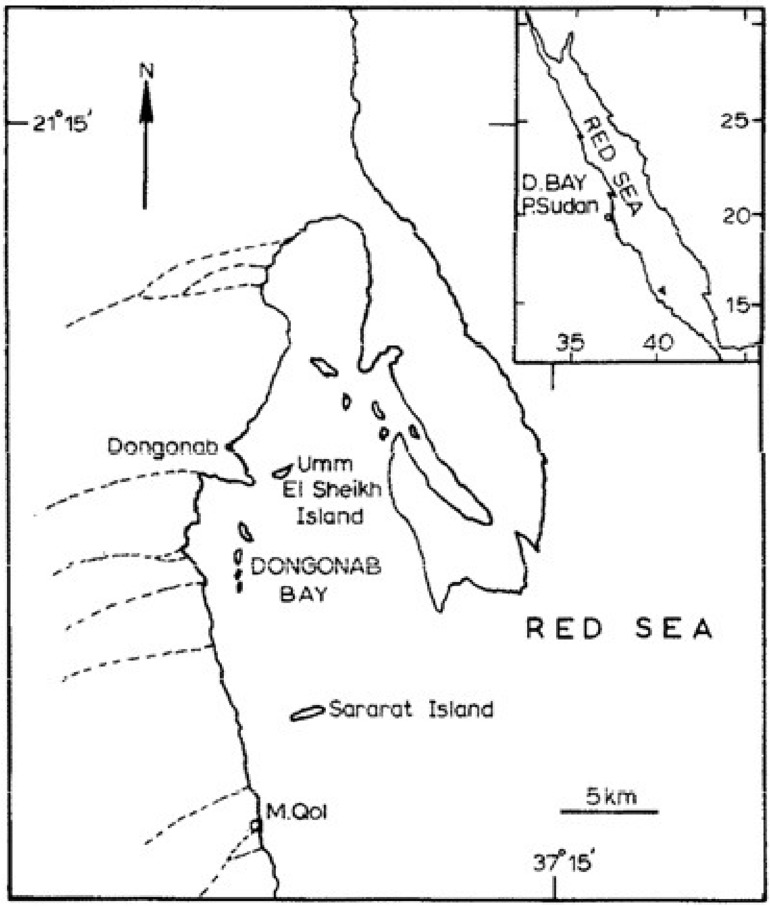

Fig. 1. Map showing the study area at Dongonab Bay (Nasr, 1982).

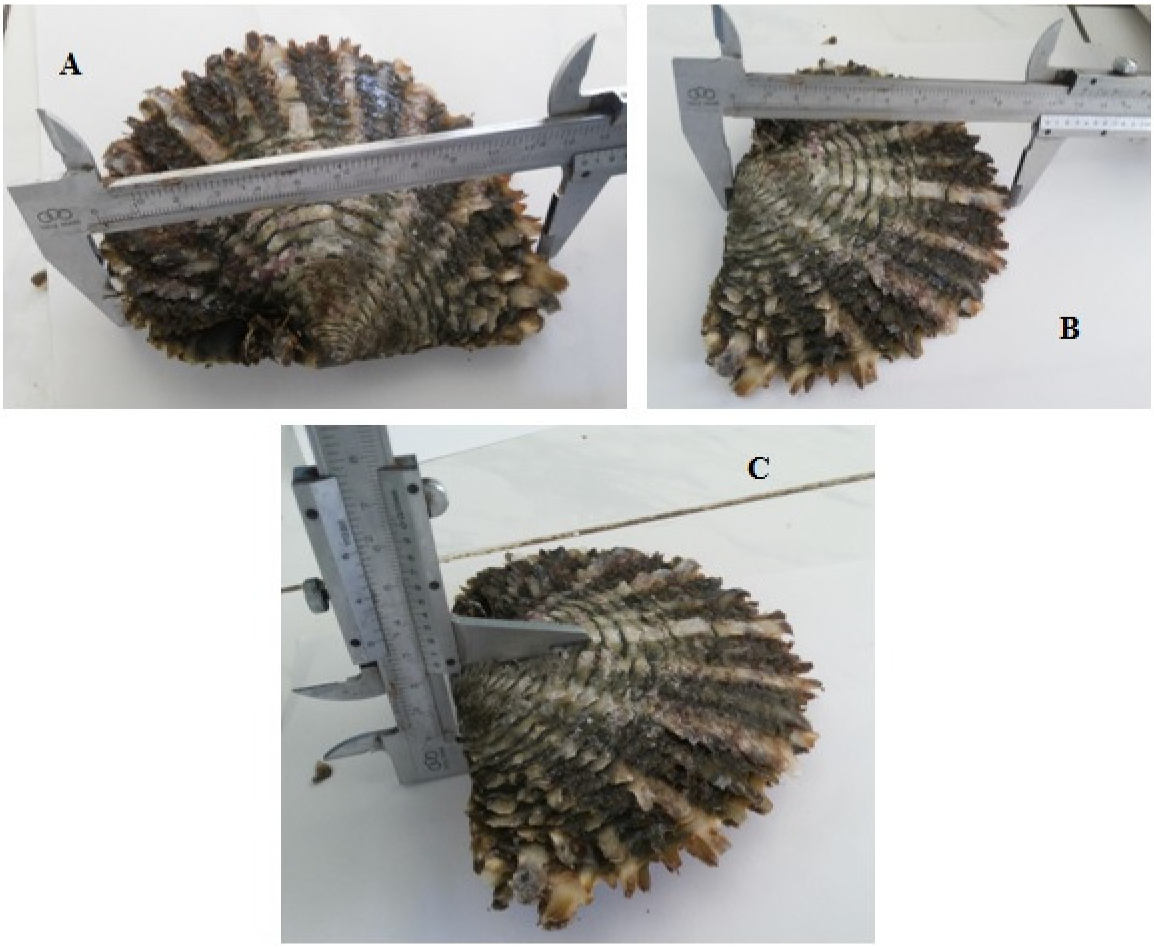

Fig. 2. Photo showing the morphometric measurements of *Pinctada margaritifera var erythraensis* (A=Shell length, B= Shell height and C= Shell thickness)

Biometric relationship:

The study of length weight relationship was based on the equation:

$$\mathbf{Y = a\,X^{b}}$$

where:

Y = total weight or shell weight or soft wet weight (gm).

X = shell height or shell length or shell thickness (cm).

a and b are constants.

The relationships were computed using the Microsoft excel 2007 programme.

Statistical analyses:

Measurements from the three localities were compared using one way ANOVA and LSD.

Regression analysis was used to show the significance of correlation.

Mode of growth (isometric or allometric) was determined isometric if (b) value = 3 and allometric if (b) value ≠ 3.

Results

The range of lengths or weights was consistently higher in wild specimens compared with hanging and bottom specimens. The ranges were similar in hanging and bottom except for SWW. The mean of lengths or weights was higher in wild specimens followed by hanging and then bottom specimens (Table 1).

The least significant difference (LSD) revealed that there was a highly significant differences between all biometric measurements means of oysters for the hanging culture, bottom culture and wild ($p< 0.001$).

Table 1. Biometric measurements Length (L), Height (H), thickness (TH) total weight (TW), shell weight (SW) and soft wet weight (SWW) of *P. margaritifera var erythraensis* from Dongnab bay.

Character	Parameter	Specimen collected from		
		Hanging culture	Bottom culture	Wild
L	Min-Max cm	4.00-15.40	4.00-15.40	7.60-17.70
	Mean ± SD	10.63±2.95	9.02±3.00	12.61±2.43
H	Min-Max cm	4.20-15.40	4.20-15.40	7.10-17.90
	Mean ± SD	10.43±3.07	8.82±3.23	12.34±2.58
TH	Min-Max cm	1.10-4.70	1.10-4.70	1.70-5.40
	Mean ± SD	2.94±0.96	2.48±1.07	3.77±0.87
TW	Min-Max gm	8.66-640.00	8.66-640.00	69.00-1418.00
	Mean ± SD	235.19±146.64	161.10±159.85	401.38±251.50
SW	Min-Max gm	5.59-477.00	5.59-477.00	51.00-1128.00
	Mean ± SD	176.22±114.32	125.11±124.23	300.18±196.47
SWW	Min-Max gm	1.84-87.60	1.84-80.00	13.00-162.00
	Mean ± SD	37.42±19.79	21.19 ±17.79	55.42±33.89

Biometric relationships:

The regression analysis (Table 2 and Figs. 3 to 11) showed highly significant correlation ($p<0.001$) between the various correlates. The mode of growth showed positive or negative allometric growth ($b\neq3$).

Table 2. The values of intercept (a*)* and slope (b*)* for biometric relationships of cultured and wild oysters at Dongonab bay.

Correlates	Location	a ± SE	b ± SE	Mode of growth	r
TW *vs.* L	Hanging	0.075 ± 0.006	3.304 ± 0.033	+ve allometric	0.987**
	Bottom	0.073 ± 0.006	3.323 ± 0.039	+ve allometric	0.984**
	Wild	0.178 ± 0.053	2.992 ± 0.119	-ve allometric	0.918**
TW *vs.* H	Hanging	0.093 ± 0.007	3.243 ± 0.031	+ve allometric	0.988**
	Bottom	0.113 ± 0.008	3.163 ± 0.034	+ve allometric	0.986**
	Wild	0.220 ± 0.034	2.936 ± 0.062	-ve allometric	0.975**
TW *vs.* TH	Hanging	7.571 ± 0.400	2.983 ± 0.049	-ve allometric	0.966**
	Bottom	9.745 ± 0.469	2.713 ± 0.052	-ve allometric	0.958**
	Wild	13.883 ± 1.555	2.442 ± 0.085	-ve allometric	0.935**
SW *vs.* L	Hanging	0.035 ± 0.003	3.496 ± 0.036	+ve allometric	0.986**
	Bottom	0.034 ± 0.003	3.536 ± 0.043	+ve allometric	0.983**
	Wild	0.104 ± 0.032	3.084 ± 0.123	+ve allometric	0.917**
SW vs. H	Hanging	0.043 ± 0.003	3.437 ± 0.032	+ve allometric	0.989**
	Bottom	0.056 ± 0.005	3.357 ± 0.042	+ve allometric	0.982**
	Wild	0.135 ± 0.024	3.010 ± 0.071	+ve allometric	0.968**
SW *vs.* TH	Hanging	4.528 ± 0.245	3.166 ± 0.050	+ve allometric	0.968**
	Bottom	6.343 ± 0.352	2.869 ± 0.060	-ve allometric	0.951**
	Wild	9.072 ± 1.001	2.536 ± 0.084	-ve allometric	0.941**
SWW *vs.* L	Hanging	0.032 ± 0.003	2.908 ± 0.038	-ve allometric	0.978**
	Bottom	0.050 ± 0.004	2.641 ± 0.039	-ve allometric	0.974**
	Wild	0.026 ± 0.007	2.968 ± 0.103	-ve allometric	0.936**
SWW *vs.* H	Hanging	0.043 ± 0.005	2.813 ± 0.047	-ve allometric	0.965**
	Bottom	0.074 ± 0.007	2.496 ± 0.041	-ve allometric	0.969**
	Wild	0.047 ± 0.010	2.765 ± 0.089	-ve allometric	0.944**
SWW *vs.* TH	Hanging	2.037 ± 0.137	2.548 ± 0.062	-ve allometric	0.929**
	Bottom	2.543 ± 0.124	2.120 ± 0.053	-ve allometric	0.933**
	Wild	2.512 ± 0.365	2.239 ± 0.110	-ve allometric	0.881**

** **Correlation was highly significant at the 0.01 level (2-tailed).**

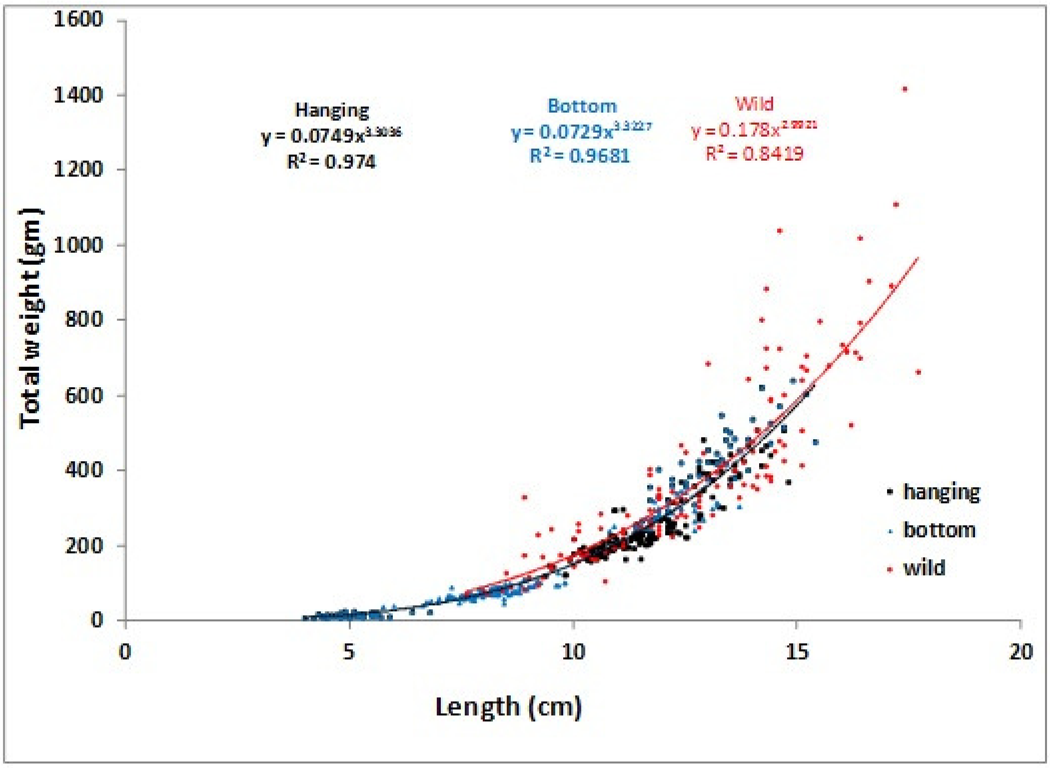

Fig. 3. Oyster length vs. total weight relationship for cultured and wild oysters

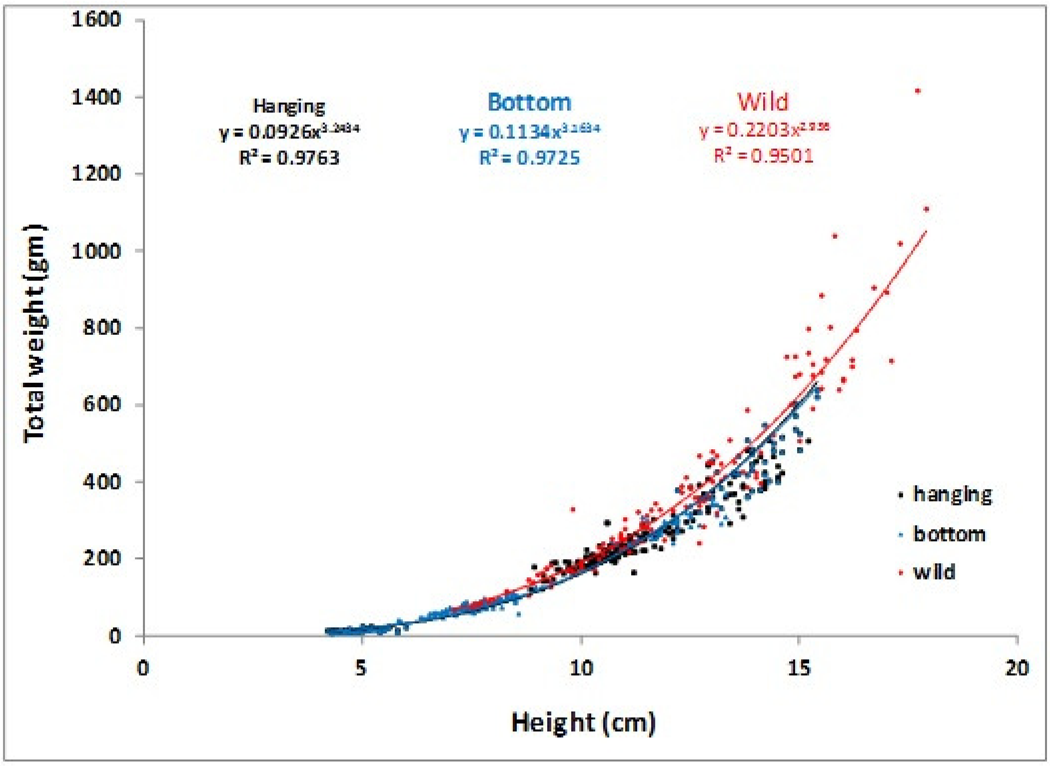

Fig. 4. Oyster height vs. total weight relationship for cultured and wild oysters

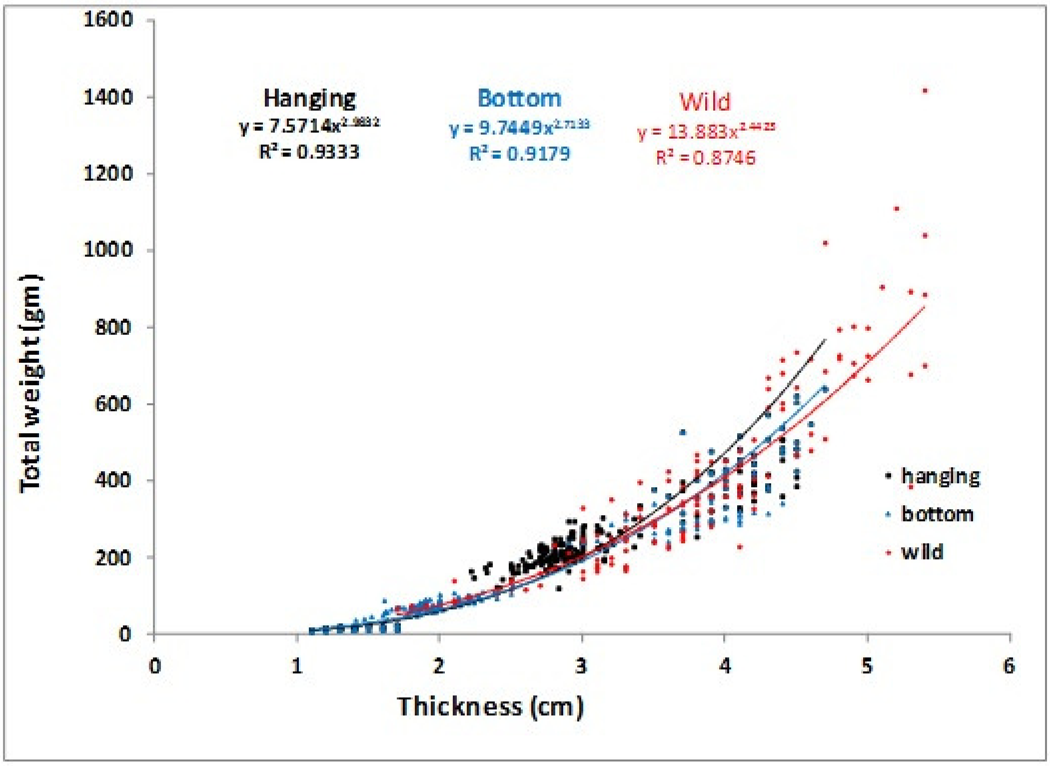

Fig. 5.Oyster thickness vs. total weight relationship for cultured and wild oysters.

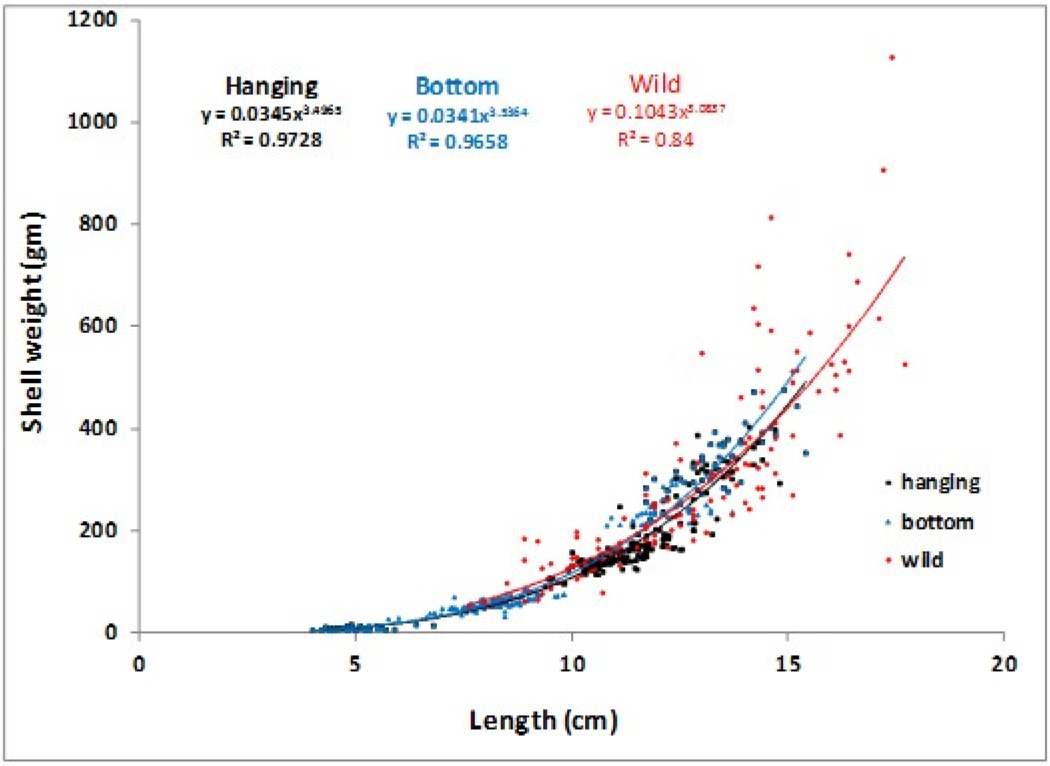

Fig. 6. Oyster length vs. shell weight relationship for cultured and wild oysters.

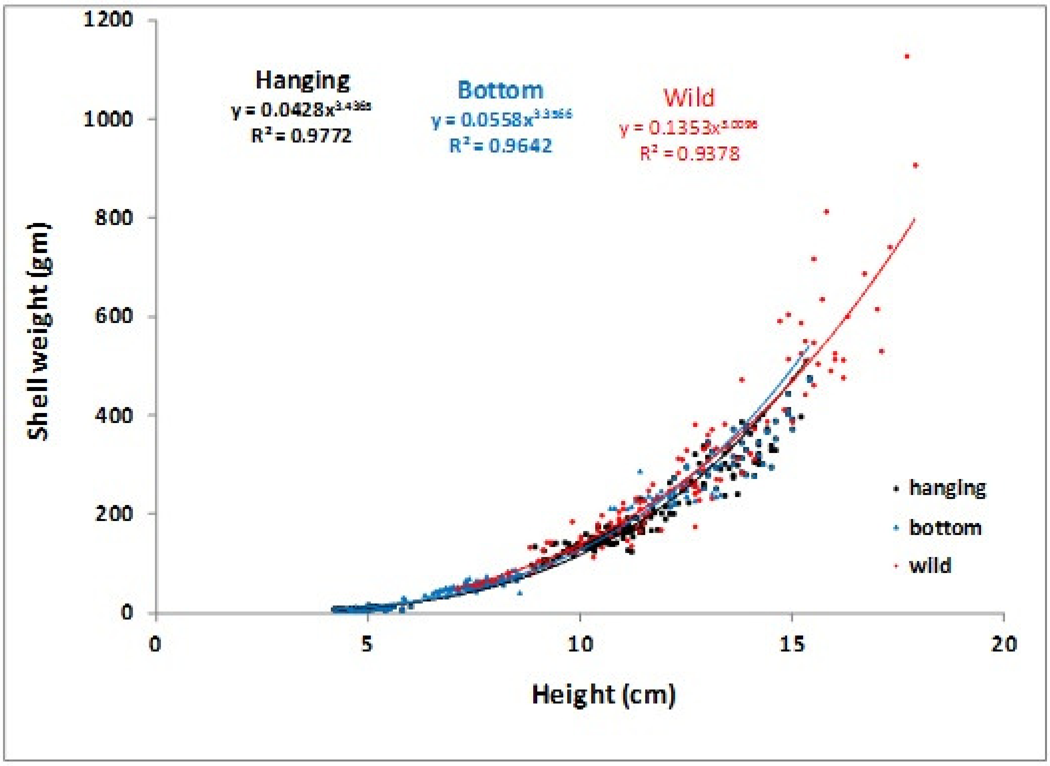

Fig.7. Oyster height vs. shell weight relationship for cultured and wild oysters.

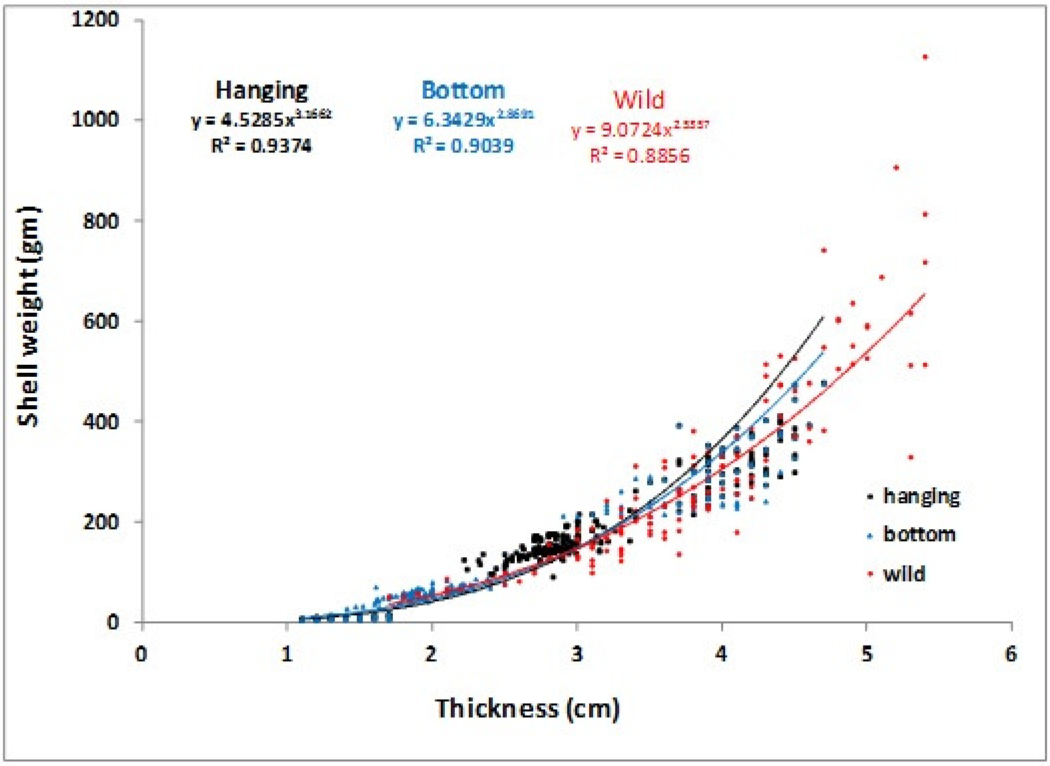

Fig. 8. Oyster thickness vs. shell weight relationship for cultured and wild oysters.

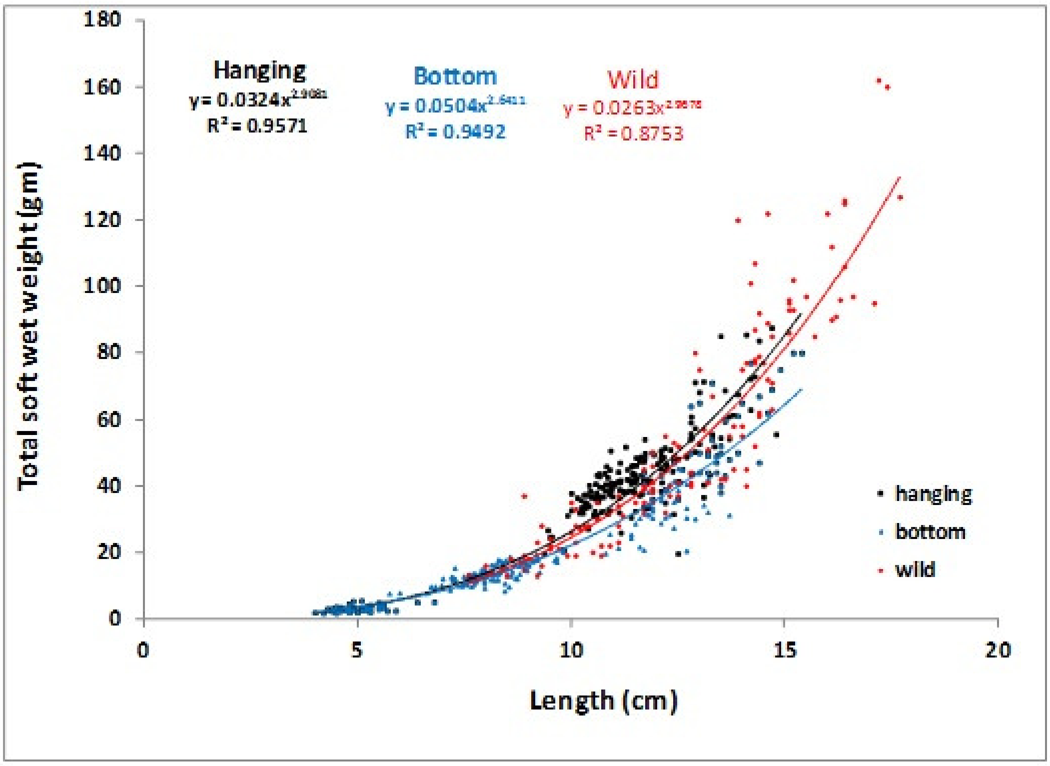

Fig. 9. Oyster length vs. soft wet weight relationship for cultured and wild oysters

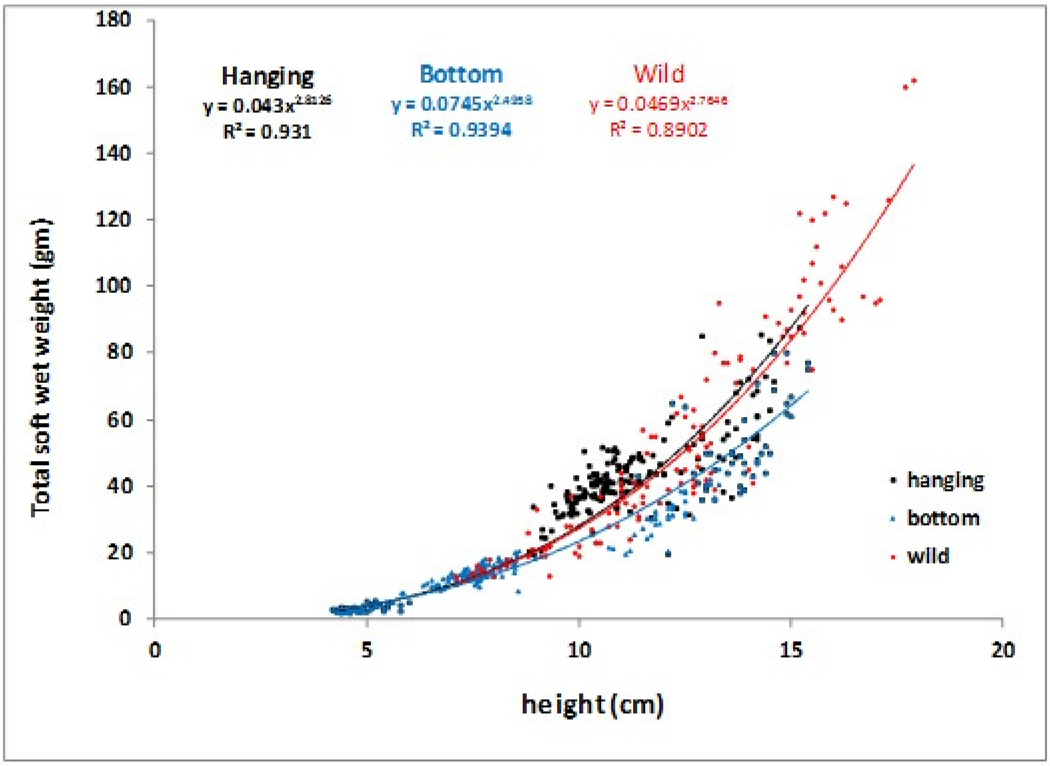

Fig.10. Oyster height vs. soft wet weight relationship of cultured and wild oysters

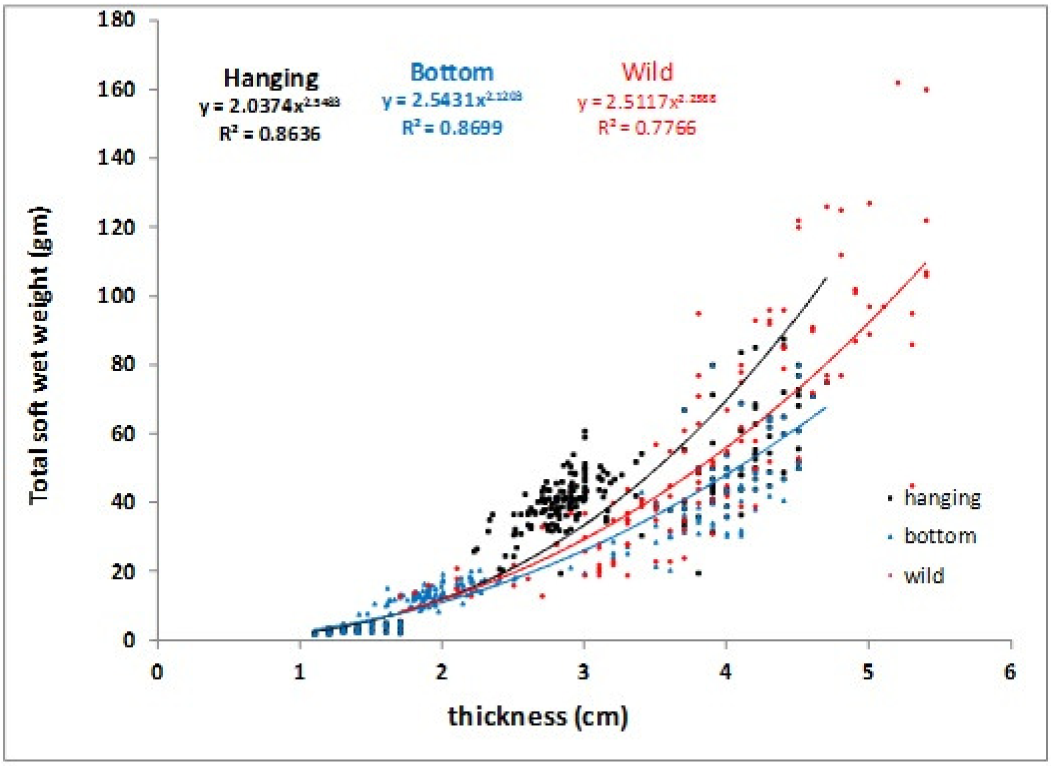

Fig. 11. Oyster thickness vs. soft wet weight relationships for cultured and wild oysters

Discussion

Length-weight relationship is an important biological parameter needed to evaluate the mode of growth of a species. It varies throughout the year in response to food availability and gonad development (Richer, 1975; Gulland, 1985), locality (Elamin, 2012). According to El-Sayed *et al*. (2011) the proper assessment and management of oyster depend on the information of length weight relationship. The present study showed that the mode of growth for *P. margaritifera var erythraensis* was positive or negative allometric growth in the different systems. The length weight relationship for the two systems and wild showed a strong positive correlation and positive allometric growth for the two systems, while for the wild was negative allometric growth. Same results of strength of relationship and negative allometric growth were achieved by El-Sayed *et al*. (2011).

In the present study the established morphometric relationships have very high correlation. The correlation coefficient (r) was ranged from 0.7766 to 0.9772 were highly significant ($p<0.001$). Values of the exponent (b) were found to exceed 3.00 for the relationships between (length, height and thickness) versus total weight and empty shell weight this indicating positive allometric growth of cultured oysters. However for wild oysters values of the exponent (b) were found less than 3.00 all relationships between (length, height and thickness) versus total weight, empty shell weight and soft wet weight, this indicating negative allometric growth. Also negative allometric growth for the relationships between (length, height and thickness) versus soft wet weight for cultured oysters. These negative allometric growth for the relationship with soft wet weight may be as documented by Park and Oh (2002) c.f. El-Sayed *et al*. (2011) that there was a very limited relationship between shells and the soft tissue for clam population which indicates that the soft tissues did not change much although the clams grow steadily.

Conclusions

Biometric relationships of oyster cultured in the hanging, bottom systems and wild oyster were established. The shell length, shell height and shell thickness can be used with high accuracy to determine the other parameters.

Acknowledgement

Authors acknowledge to Fisheries Research Centre, Red Sea Station, Port Sudan, the Faculty of Marine Sciences and Fisheries, Red Sea University and Gulf Pearl Company Oyster Farm for facilities. Special thanks to Prof Zuheir Noreldayem, Mr. Abdelmohsin Silman and Mr. Mostafah Mohamed.

REFRENCES

[1] Crossland, C. 1911. Reports on the marine biology of the Sudanese Red Sea. A Physical description of Khor Dunganab. J. Linn. Soc. Zool. 31: 265- 286.

[2] Crossland, C. 1919. Danger of pearl diving. Sudan Notes and Records II 234-308.

[3] Crossland, C. 1931. The pearl shell farm at Dongonab on the Red Sea. Sudan Notes and Records Vol. 14: 129-163.

[4] Reports on the marine biology of the Sudanese Red Sea. A Physical description of Khor Dunganab. J. Linn. Soc. Zool. 31

[5] Crossland, C. 1957. The cultivation of the mother of pearl oyster in the Red Sea. Aust. J. Mar. Freshwat. Res. 8: 111-130.

[6] Elamin, S.M. 2012. Stock Assessment And Population Dynamics of *Plectropomus pessuliferus* and *Plectropomus areolatus* in the Sudanese Red Sea Coast. Unpublished Ph.D., Universiti Malaysia Terengganu, Kuala Teremgganu, Malaysia. 297 p.

[7] Elnaim, A.G. 1992. Reprints on the Marine Biology of the Sudanese Red Sea. J. Lin. Soc. 31:86-122.

[8] El-Sayed, A.E.H.; Abdel Razek, F.A.; Abou-Zaid, M.M. and Taha, S.M. 2011. Measures of Allometric Growth of Black-lip Pearl Oyster *Pinctada margaritifera* (Linnaeus, 1758) Red Sea, Egypt. International Journal of Zoological Research 7(2): 201-211.

[9] Farah, O.M. 1991. Water characteristics of Dongonab Bay, Sudanese Red Sea. Bull. Of National Institute of Oceanography and Fisheries, Suez, Egypt, 16 (3): 81-88.

[10] Farah, O.M. 1992. Activities of the Sudan – IDRC oyster culture project. SPC Pearl Oyster Info. Bull., 5: 4-11.

[11] Farah, O.M. 2007. Some environmental characteristics of Dongonab Bay. Sudan J. of Basic Sc., Series B. Biol. Sc. 11:85-104.

[12] Gulland, J.A. 1985. Fish stock assessment. Amanual of basic methods. Marine resources service. Rome, Italy, p 293.

[13] Hynd, J.S. 1955. A revision of Australian pearl shells, genus *Pindada*. Aust. J. Mar. Freshwat. Res. 6(1): 98-137.

[14] Mahmoud, Z.N. and Ahmed, E.E. 2010. The Sudanese Red Sea From The Hills to The Hot Brines: A Bibliograph. Sudan Currency Printing Press. Khartoum. 204p.

[15] Nasr, D.H. 1982. Observation on the mortality of the mother of pearl oyster *Pinctada margaritifera* in Dongonab Bay, Red Sea. Aquaculture, 28: 271-281.

[16] Nasr, D.H. 1984. Feeding and growth of pearl oyster *Pinctada margaritifera* (L) in Dongonab Bay, Red Sea. Hydrobiologia 110: 241- 245.

[17] Richer, W.E. 1975. Interpretation of biological statistics of fish Population, Department of the environment fisheries and marine Service pacific biological station B. c. Nanaimo, p 266.