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COMPARATIVE STUDY ON *OCTOPUS VULGARIS* (CUVIER, 1797) FROM THE MEDITERRANEAN AND RED SEA COASTS OF EGYPT

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ABSTRACT

Specimens from common octopus, *Octopus vulgaris* captured from the Red Sea and Mediterranean Sea showed significant differences in four of seven morphometric measurements .These differences are sufficient to recognize the populations of this species in the two habitats. The computed length-Wight relationship and condition factor for common octopus in both areas showed that representatives of this species from the Red Sea are heavier than those captured from the Mediterranean Sea for the same length group. Moreover, the natural mortality coefficient of Mediterranean representatives was comparatively higher than for the Red Sea octopus. This shows that the environmental conditions in the Red Sea are more suitable for *O. vulgaris* than in the Mediterranean Sea.

1. INTRODUCTION

The common octopus, *Octopus vulgaris* Cuvier, 1797 has a world-wide distribution in tropical, subtropical and temperate waters of the Atlantic, Indian and Pacific oceans; and is also in both Mediterranean and Red Seas. This species is a typical inhabitant of littoral waters, existing up to the limit of the continental shelf in very shallow waters, it occurs mostly in coral reefs or rocks, but in many areas it is equally, or even more abundant, over sandy and muddy bottom or in sea grass (Mangold, 1983). *O. vulgaris* is an important species for the fisheries of many countries, being captured by various methods, but mainly by otter trawl. In the Mediterranean Sea, octopus catches from trawlers that operate on the continental shelf constitute an important part of the total landings of these ships (Belcari and Sartor, 1993). In the Egyptian Mediterranean fisheries, octopus is similarly considered an important economic species. It constitutes 3.04% and 2.74% of the total catch of Mediterranean and Red coastal waters of Egypt, respectively (Gafrd, 2004).

The aim of the present study is to compare the morphological characters of the two populations of the common octopus from both habitats, i.e. the Mediterranean and Red Seas. Moreover, to reveal some biological aspects, which determine the degrees of suitability of these habitats for *O. vulgaris* populations, such as length-weight relationship, coefficient of condition and natural mortality.

2. MATERIALS AND METHODS

Specimens were collected for the present study from the commercial catches landed at Alexandria (Mediterranean Sea) and Suez (Red Sea) during 2004. A total of 148 Mediterranean specimens and 71 Red Sea

specimens were examined. For each specimen dorsal mantle length (ML, in cm), total and gutted weight (g) and sex were recorded. The morphometric characters examined include seven measurements. Size effects were minimized in the morphometric data by comparing regressions related to the same length group using covariance analysis (Snedecor and Cochran, 1980). Length-weight relationship was determined from the relationship between dorsal mantle length and total body weight, the formula:

$TW = a\ ML^b$ was used. Calculations were made for each sex separately and also for both sexes collectively. The coefficient of condition (K) was calculated from the equation of Fulton (1902):

$$K=100\ W/L^3$$

Where W= gutted weight in grams, L= mantle length in cm.

The natural mortality coefficient "M" was calculated by the method described by Ursine (1967). Data of condition factor and natural mortality were statistically analyzed using analysis of variance (ANOVA).

3. RESULTS

3.1. Morphometric characters

The comparison of seven morphometric characters in mantle length (ML) between the Mediterranean and Red Sea common octopus are presented in (Table 1). Mantle width, arm length for male and arm length for female show no significant difference ($p>0.05$). The other morphometric measurements show high significant difference ($p<0.01$) between Mediterranean and Red Sea populations, the regression lines for these characters are shown in (Fig. 1).

3.2. Length-weight relationship and condition factor

The results of the relationship between dorsal mantle length and total body weight revealed that the growth in weight is allometrically negative for males, females and both sexes pooled from both habitats. The negative allometry found in the length-weight relationship is in good accordance with results obtained by other authors (Table 2). The mean of observed and calculated values of *Octopus vulgaris* from these two localities are given in (Table 3).

The mean values of condition factor for *Octopus vulgaris* captured from the Egyptian Mediterranean and Red waters are shown in (Table 4). The mean values of condition factors were 41.623 for males and 41.503 for females of Mediterranean octopus, increasing to 53.506 and 50.72 for males and females captured from the Red Sea. The difference in condition factor for both sexes from these two habitats was statistically tested by using analysis of variance, this test indicated that no significant difference existed as regards to the mean values of condition factor between the two sexes from the Mediterranean ($F_{1, 147} = 0.008$, $p>0.05$) and Red Seas ($F_{1, 70} = 0.704$, $p>0.05$). Moreover, there are significant differences between the two sexes mixed together collected from these two areas ($F_{1, 218}= 47.686$ $p<0.01$), i.e. males and females from the Red Sea are heavier than those from the Mediterranean Sea.

3.3. Natural mortality

Using analysis of variance to compare the natural mortality coefficient for males (M= 0.167) and females (M= 0.172) of the Mediterranean Sea revealed that, no significant difference ($F_{1, 146} = 0.381$, $p>0.05$). While the natural mortality coefficient for males (M = 0.147) and females (M = 0.173) of the Red Sea specimens showed significant difference between the two sexes ($F_{1, 69} = 7.435$ $p<0.01$). Besides, comparing the natural mortality coefficient of *O. vulgaris* from the two habitats indicated that, the natural mortality coefficient for males (M = 0.167) from Mediterranean Sea was significantly higher than that of Red Sea males (M= 0.147) captured from the Red Sea ($F_{1, 85}= 5.446$ $p<0.01$).

Table (1): Comparisons and the relationships between morphometric measurements and mantle length of *Octopus vulgaris* captured from the Egyptian Mediterranean and Red Sea.

Morphometric characters	Mediterranean Sea				Red Sea				
	Mean ± SD	a	b	r^2	Mean ± SD	a	b	r^2	F-value
In mantle length (ML)									
Mantle width (MW)	6.75±2.244	-0.121	0.996	0.995	6.90±2.201	-0.017	0.898	0.971	1.994
Head length (HL)	2.37±0.614	-0.338	0.751	0.990	2.07±0.399	-0.191	0.536	0.945	23.348**
Head width (HW)	3.98±1.099	-0.197	0.838	0.968	3.40±0.679	0.018	0.544	0.934	14.739**
Funnel length (FL)	4.23±1.213	-0.174	0.841	0.996	3.98±1.148	-0.199	0.841	0.988	22.503**
Funnel width (FW)	3.80±1.231	-0.346	0.97	0.998	3.51±1.020	-0.254	0.840	0.974	10.880**
Arm length (AL) male	47.68±16.886	0.672	1.054	0.993	48.71±18.359	0.701	1.031	0.940	0.309
Arm length (AL) female	47.29±16.904	0.665	1.057	0.991	46.84±15.570	0.732	0.984	0.991	0.005

a= interceptb= slope r^2= coefficient of determination ** Significant at 1% level.

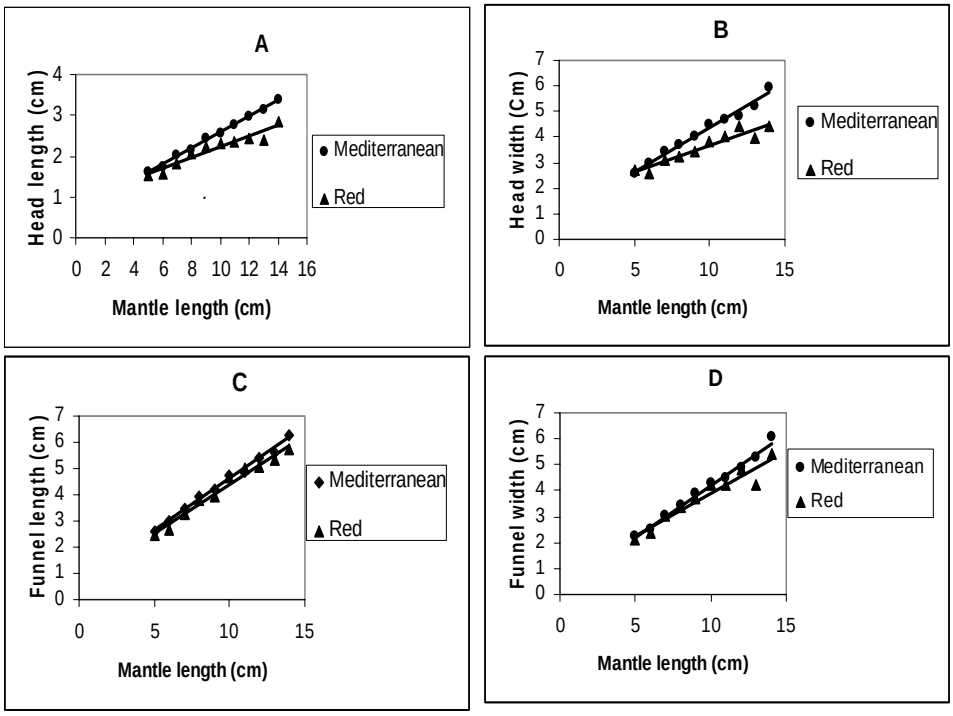

Fig. (1): Comparison of two regression lines of mantle length vs. head length (A), head width (B), funnel length (C) and funnel width for Egyptian Mediterranean and Red Sea populations of the common *Octopus vulgaris*.

Table (2): Constants of the relationship between mantle length (ML) and body weight (BW) from previous studies and the present work.

Sex	a	b	n	r	Area	Size range (cm)	Source
M	0.350	2.988	584	0.979		-	
F	0.542	2.804	434	0.969	Catalonia (Western Mediterranean)	-	Guerra and Manriquez, 1980
M+F	0.420	2.917	1018	0.969		3-22	
M	0.757	2.740	37	0.950		4.9-21.5	
F	0.587	2.830	55	0.970	South Africa (Atlantic Ocean)	4.6-21.5	Smale and Buchan, 1981
M+F	0.718	2.80	92	0.970		4.6-21.5	
M	3.306	2.323	155	0.900		8-22	
F	1.654	2.576	165	0.920	Valencia (Western Mediterranean)	9-26	Sanchez and Obarti, 1993
M+F						-	
M	0.442	2.882	168	0.950		5-16	
F	0.413	2.916	175	0.940	Mallorca (Western Mediterranean)	5-16	Quetglas, *et al.*, 1998
M+F	0.437	2.889	343	0.940		5-16	
M	0.621	2.811	60	0.973		5-13.4	**Present work**
F	0.544	2.864	88	0.972	Alexandria (South-eastern Mediterranean)	4.6-13.9	
M+F	0.571	2.845	148	0.973		4.6-13.9	
M	0.968	2.715	27	0.961		4.5-13.5	
F	1.446	2.460	44	0.910	Suez (Red Sea)	4.7-13.6	
M+F	1.038	2.648	71	0.939		4.5-13.6	

Table (3): Empirical and calculated weights of *Octopus vulgaris* captured from the Egyptian Mediterranean and Red Sea.

Mantle length (cm)	Mediterranean Sea				Red Sea			
	Gutted weight (g)				Gutted weight (g)			
	Empirical		Calculated		Empirical		Calculated	
	Male	Female	Male	Female	Male	Female	male	Female
4.5		34.50		40.43	83.00	56.65	57.42	58.54
5.5	73.08	79.16	74.81	71.83	70.00	95.88	99.00	95.91
6.5	112.17	108.47	119.64	115.91	170.19	144.85	155.80	144.67
7.5	164.87	180.24	178.88	174.62	213.12	223.25	229.76	205.73
8.5	281.53	224.84	254.30	249.90	373.16	271.91	322.72	279.92
9.5	375.92	340.65	347.62	343.65	343.70	369.68	436.47	368.03
10.5	433.45	428.68	460.55	457.73	625.29	474.50	572.72	470.79
11.5	578.75	589.75	594.74	593.96	498.20	-	733.14	588.88
12.5	785.89	756.09	751.81	754.17	959.22	-	919.35	722.98
13.5	701.57	1048.46	933.36	940.14	1165.82	756.00	1132.95	873.70

Table (4): Condition factors (k) of *Octopus vulgaris* captured from the Egyptian Mediterranean and Red Sea.

Mantle length (cm)	Mediterranean Sea		Red Sea	
	Condition factor (K)		Condition factor (K)	
	Male	Female	Male	Female
4.5	-	31.941	91.084	54.564
5.5	44.181	49.044	47.727	55.265
6.5	41.535	40.015	55.268	56.219
7.5	39.971	43.875	50.987	54.996
8.5	45.779	38.809	60.063	48.564
9.5	44.855	41.194	44.138	45.673
10.5	38.359	37.673	53.592	40.748
11.5	38.797	39.115	35.612	-
12.5	40.936	38.580	50.854	-
13.5	30.162	42.799	47.384	30.919
Mean ± S.d	41.623 ± 7.613	41.503 ± 8.750	53.506 ± 12.879	50.723 ± 13.961

4. DISCUSSION

The importance of determining populations identity is essential in fishery investigations. Various authors have shown that biometric characters of the early developmental stages of fishes are influenced by different environmental factors such as temperature and salinity (Lindsey & Amason, 1981, and Blouw & Hagen, 1987).Comparison of morphometric regressions in the present study showed significant differences in four of seven morphometric measurements. This degree of biometric differences is sufficient to recognize the Mediterranean *O. vulgaris* as a distinct group from that of the Red Sea. The Mediterranean octopus has comparatively higher morphometric dimensions in head length, head width, funnel length and funnel width. Such morphometric differences between the two populations may be attributed to the high range of temperature degrees in the Red Sea compared with that of the Mediterranean, which may have caused a decrease in morphometric measurements of Red Sea population. This is in good accordance with Caveriviere *et al*. (1999) findings who reported that embryonic development times in *O. vulgaris* are in inverse relationship with temperature; this relationship is known for all cephalopod species.

The results of the relationship between dorsal mantle length and total body weight revealed that the growth in weight shows negative allometrically for males, females and for both sexes combined from the two habitats. The negative allometry found in the length-weight relationship agrees with the results obtained by Guerra and Manriquez, (1980), Sanchez and Obarti (1993) and Quetglas, *et al*. (1998) for the same species in Western Mediterranean and Smale and Buchan (1981) in Atlantic Ocean. The results of length-weight relationship & condition factor indicate that representatives of the common octopus from the Red Sea are heavier than those captured from the Mediterranean. The variations in length-weight and condition factor of species from the Mediterranean and Red Sea agrees with the findings of Shenouda (1976) and Bakhoum (2000). It may be attributed to variations in temperature between the two habitats, which is one of the main factors regulating cephalopod growth (Forsythe and van Heukelem 1987 and Forsythe 1993).

The natural mortality coefficient of Mediterranean fish was comparatively higher than that the of Red Sea octopus. From all aspects, it is clear that the environmental conditions in the Red Sea are more suitable

and favourable for *O. vulgaris* than that of Mediterranean Sea.

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