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Allometry of the Gastropod *Melanopsis praemorsa* (Thiaridae: Prosobranchia) From Azraq Oasis, Jordan

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Abstract: A total of 300 specimens of the freshwater gastropod *Melanopsis praemorsa* (Thiaridae: Prosobranchia) from Azraq Oasis, Jordan, were studied for age, growth and shell morphometrics. Nonlinear and linear allometric analysis, Von Bertalanfi's and Richard's growth models were used to analyze the results. The results show the life span to be five years and the mean observed lengths of the five age cohorts range from 9.6 to 20.6 mm. The theoretical maximum length of this snail may reach 25.7 and 21.4 mm, respectively while the shell and dry body weights averaged 380.8 and 239.8 mg, respectively. The relationships of the shell length to shell and dry body weights are curvilinear and the relationships of the shell length to shell width, aperture length and aperture width are linear. These results are mainly in agreement with the results reported for other snails with similar relationships between the measured snail parameters.

Key words: *Melanopsis*, allometry, growth model, population structure, shell morphometrics, gastropod

INTRODUCTION

Melanopsis is a genus common in Europe, North Africa and the Near East. The shells are medium in size (up to about 30 mm in length), elongate, rather thick and solid and may be smooth or heavily sculptured. Also distinctive is the very narrowly constricted posterior aperture of the shell (Schütt, 1983). *Melanopsis praemorsa* (Linnaeus, 1758) occurs throughout much of the Mediterranean area. *M. praemorsa* is a variable species. Two forms are found in Jordan, the smooth *M. praemorsa buccinoidea*, which is common in Azraq Oasis and other springs and the ribbed *M. praemorsa costata*, which is common in streams and rivers. Several species of larval trematodes have been reported from this snail from several freshwater localities throughout Jordan (Ismail and Abdel-Hafez, 1983, 1984, 1987a; Ismail and Badair, 1987, 1989).

A number of studies have used allometry and growth models to study the population structure, growth modeling and shell morphometrics of a number of snails. Ismail and Elkarmi (2006) reported on the age, growth and shell morphometrics of *Monodonta dama* from the Gulf of Aqaba, Elkarmi and Ismail (2006) studied the population structure and shell morphometrics of *Theodoxus macri* from Jordan, Grossowicz *et al.* (2003) examined the distribution of *Melanopsis* snail and Heller *et al.* (2002) reported on the systematics of *Melanopsis* from the coastal plain of Israel. Moreover, Ismail and Abdel Hafez (1987b) reported on the population dynamics of this snail from Yarmouk River. The present research was carried out to better understand the population structure and shell morphometrics of this snail from Azraq Oasis.

MATERIALS AND METHODS

Study area: Azraq Oasis is a semi-desert area in the East Jordanian Desert 85 km east of Amman, the capital of Jordan. It is the only permanent water in this region. Its water is supplied by two springs, one in North Azraq and the other is in South Azraq. Azraq pools are infested with several snail species. Most predominant are *M. praemorsa, Melanoides tuberculata* and *Theodoxus macri*.

Sampling and analysis: A total of 300 *M. praemorsa* (Thiaridae: Prosobranchia) snails were collected by hand picking from Azraq Oasis pools. In the laboratory, shell length, shell width, aperture length and aperture width were measured using vernier calipers, to the nearest 0.1 mm. The shells of snails were separated from soft tissues and dried to constant weights at 100°C. The dry weights of both the shell and soft body were weighed using an electrical digital balance accurate to 1 mg. Measured snails were divided into size groups of length intervals which were estimated using histogram plots that

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show normal distribution of length. Normality was tested at 95% confidence level. These histograms used to estimate the possible life span of *M. praemorsa* snails.

The growth in length of M. praemorsa was theoretically calculated using the Von Bertalanffy's Growth Formula (VBGF) (Lt = L∞] 1-e-k (t-t0[( ) and the Richard's Growth Formula (RGF) (Lt = L∞] 1-A*e-kt[ ). Lt is the length at age t, A = 1-(minimum length/maximum length), k is the growth coefficient and t_0 is the length at which the age is theoretically nil. The constants L∞, k and t_0 were calculated using the Quasi-Newton method (Ostle and Mensing, 1975) to the age-length data. For comparison with VBGF and RGF, the observed age length data were fitted to a linear regression equation. The relationships of the shell length to dry body weight and shell weight were described using a power regression equation (Ott, 1984). The relative coefficient of condition (Kn), which measures the degree of fitness and suitability of the environment with regard to feeding condition, was also estimated (Le Cren, 1951). Kn was calculated as: Kn = X/aLn where X represents the dry body weight, L is the shell length, a and n are the coefficients of the power regressing equation.

The relationships of the shell length to shell width, aperture length, aperture width, shell weight, dry body weight, ratio of aperture width to shell width, ratio of aperture length to shell length and ratio of shell width to shell length were studied using regression analysis.

RESULTS

Age and growth: The frequency distribution of shell length of the collected snails, which fits normal distribution, indicates the presence of five age cohorts for *M. praemorsa* (Fig. 1). The mean observed length at each of these age cohorts was 9.6, 12.3, 15.3, 18.0 and 20.6 mm, respectively (Table 1). Calculated shell lengths using VBGF and the linear method were highly correlated with the observed values (adjusted R^2 >0.98) (Table 1). Lower correlation was found when using RGF (adjusted

Table 1: Observed and calculated shell lengths (mm) of various age groups of *Melanopsis praemorsa* from Azraq Oasis using Von Bertalanffy's Growth Formula (VBGF) and the Richard's Growth Formula (RGF) and Linear regression equation

Age (years)	Mean observed length	VBGF	RGF	Linear model
1	9.6	9.0	11.9	9.7
2	12.3	12.9	14.1	12.4
3	15.3	15.9	15.8	15.2
4	18.0	18.2	17.1	17.9
5	20.6	19.9	18.1	20.7
Adjusted R^2 or variance explained (%)		98.01	79.65	0.99

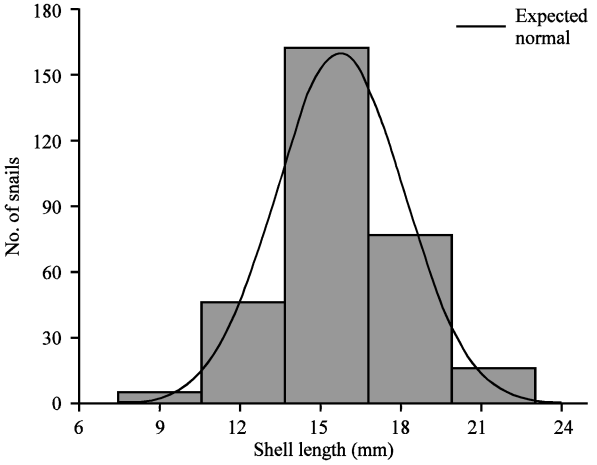

Fig. 1: Frequency distribution of estimated age groups of *Melanopsis praemorsa* from Azraq Oasis showing expected normal distribution (N = 300)

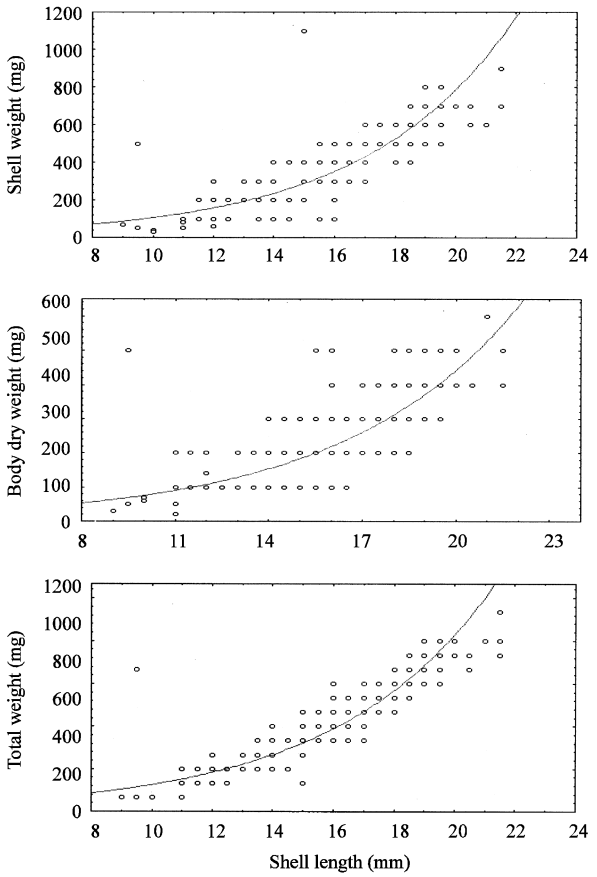

Fig. 2: The curvilinear relationships of the shell length to dry body weight, shell weight and total weight of *Melanopsis praemorsa* from Azraq Oasis

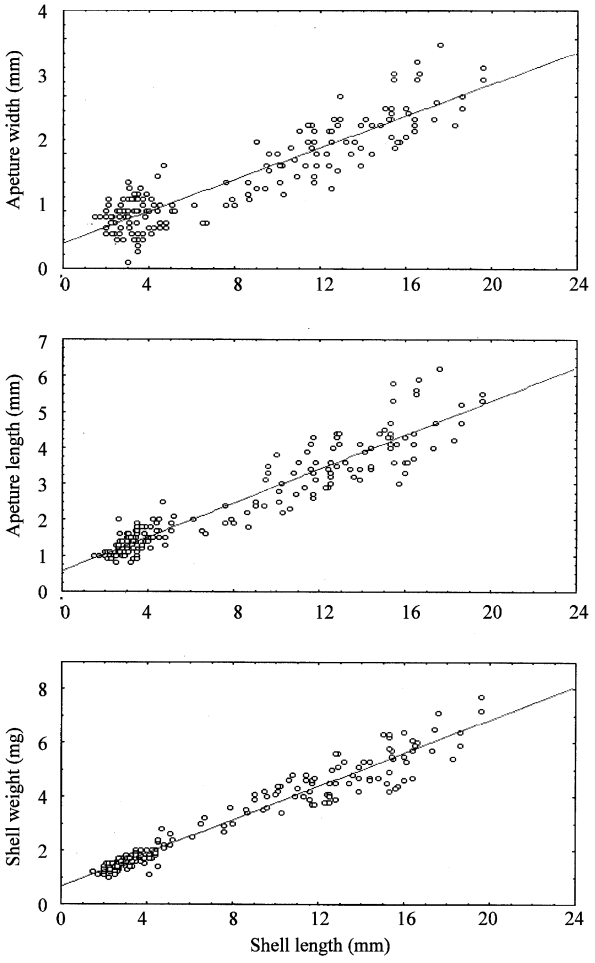

Fig. 3: The relationships of the shell length to shell width, aperture length and aperture width of *Melanopsis praemorsa* from Azraq Oasis

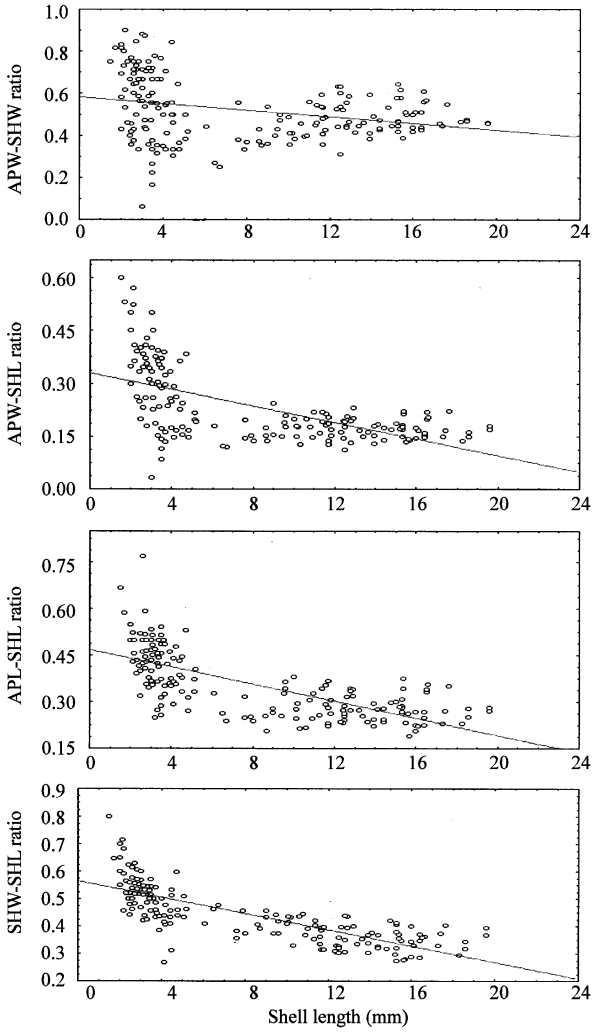

Fig. 4: The relationships of the shell length (SHL) to shell width (SHW)/SHL, aperture length (APL)/SHL, aperture width (APW)/SHL and APW/SHW ratios of *Melanopsis praemorsa* from Azraq Oasis

R^2 = 79.65%). Thus, it is expected that this snail may survive up to five years. The annual observed increase in length ranges from 2.0 to 2.7 mm. Theoretically, the increase ranges from 1.7 to 3.9 mm using the VBGF and from 1.0 to 2.2 mm using RGF. The theoretical growth parameters of *M. praemorsa* were different using VBGF and RGF (Table 2). The theoretical maximum growth was 25.70 and 21.43 mm and the growth coefficients (K) were 0.443 and 0.265, respectively. The length at t_0 was calculated to be 0.625.

Allometric analysis: Collected *M. praemorsa* snails range in length from 9.0 to 21.50 mm, with a mean value of 15.8 mm. Their shell and dry body weights range from 30 to 900 mg with an average of 380.8 mg and from 20 to 600 mg with an average of 239.8 mg, respectively. The increase in shell and body weights was slower in young snails than older ones. This produced curvilinear relationships of the shell length to total weight, shell weight and dry body weight (Fig. 2). The power regression equations for these relationships are:

$$X = 0.459\ (L)^{2.598}$$
$$X1 = 0.326\ (L)^{2.574}$$
$$X2 = 12.936\ (L)^{0.177}$$

Where X, X1 and X2 represent the total, shell and dry body weights, respectively and L represents the shell length. The relationship of the shell width, aperture length and aperture width to shell length was linear (Fig. 3).

Table 2: Growth parameters of *Melanopsis praemorsa* from Azraq Oasis using Von Bertalanffy's Growth Formula (VBGF) and the Richard's Growth Formula (RGF)

Parameter	VBGF	RGF
L8	25.697	21.426
K	0.443	0.265
t_0	-0.625	

Table 3: Measurements (means in mm±SD) of shell length (SHL), shell width (SHW) aperture length (APL) and aperture width (APW) of various age groups of *Melanopsis praemorsa* from Azraq Oasis.

Age (years)	SHL	SHW	APL	APW
1	9.6±0.42	4.8±0.45	4.4±0.55	2.7±0.45
2	12.3±0.85	5.9±0.56	5.7±0.55	3.7±0.80
3	15.3±0.81	7.1±0.56	7.0±0.59	4.0±0.52
4	18.0±0.83	8.2±0.62	7.8±0.64	4.7±0.65
5	20.6±0.64	9.1±0.33	8.4±0.48	5.2±0.80

The relative coefficient of condition (Kn), which measures the progression of body weight and length, was measured for young and old snails (age groups 1 to 3 and 4 to 5, respectively). It was 1.000 and 1.041 for both groups, respectively.

The mean shell length of age groups 1 to 5 of M. praemorsa ranges from 9.6 mm to 20.6 mm. The shell width ranges from 4.8 to 9.1 mm, aperture length from 4.4 to 8.4 mm and aperture width from 2.7 to 5.2 mm (Table 3). The regression equations for the relationship shown in Fig. 3 are:

$$W = 1.036+0.397\ L$$
$$AL = 1.649+0.342\ L$$
$$AW = 0.394+0.236\ L$$

The ratios of the shell width/shell length, aperture length/shell length, aperture width/shell length and aperture width/shell width with shell length decrease with age (Fig. 4). This may indicate that this snail become more elongate with age

DISCUSSION

The frequency distribution of the shell length of collected *Melanopsis praemorsa* snails indicated the presence of five age cohorts and thus this snail may survive to five years. Similar results were observed for the annual increase in length for *Monodonta dama* (Ismail and Elkarmi, 2006). However, more evident difference in annual increase in length was reported for other snails. Ismail *et al.* (2000) reported higher rates of increase in length of *Drupella cornus* from the Gulf of Aqaba. Similarly, the annual observed increment of the limpet *Cellana radiata* from the Gulf of Aqaba was also higher than the present study (Ismail and Elkarmi, 1999).

The increase in shell and body weights was slower in young snails than older ones of *M. praemorsa* in the present study. This produced curvilinear relationships of the shell length to both shell and dry body weights. This was also true for *D. cornus* (Ismail *et al.*, 2000) and *C. radiata* (Ismail and Elkarmi, 1999). However, power regression equations for these relationships for different snails were different. Moreover, the relationship of the dry body weight to shell weight was linear for both *M. praemorsa* in the present study and *D. cornus* from the Gulf of Aqaba. The relationships of the shell length to shell width, aperture length and aperture width were linear for both *M. praemorsa* from Azraq and *D. cornus* (Ismail *et al.*, 2000). However, linear regression equations were different for both snails. Similarly, the shell length to shell width relationship of *C. radiata* was also linear (Ismail and Elkarmi, 1999).

REFERENCES

Elkarmi, A. and N. Ismail, 2006. Population structure and shell morphometrics of the gastropod *Theodoxus macri* (Neritidae: Prosobranchia) from Azraq Oasis, Jordan. Pak. J. Biol. Sci., 9: 549-552.

Grossowicz, N., N. Sivan and J. Heller, 2003. *Melanopsis* from the Pleistocene of the Hula Valley (Gastropoda: Cerithiodea). Israel J. Earth Sci., 52: 221-234.

Heller, J., N. Sivan and F. Bea-Ami, 2002. Systematics of *Melanopsis* from the coastal plains of Israel (Gastropoda: Cerithiodea). J. Conchol., 37: 589-606.

Ismail, N.S. and S.K. Abel-Hafez, 1983. Larval stages of digenetic trematodes of *Melanopsis praemorsa* (L. 1785) (Thiaridae) snails from Yarmouk river, Jordan. Z. Parasitenkd., 69: 613-626.

Ismail, N.S. and S.K. Abel-Hafez, 1984. Two new cercariae from *Melanopsis praemorsa* (L. 1785) (Thiaridae) snails in Azraq Oasis, Jordan. Jpn. J. Parasitol., 33: 353-359.

Ismail, N.S. and S.K. Abel-Hafez, 1987a. Seasonal variation in infection rates of *Melanopsis praemorsa* (L. 1785) (Thiaridae) snails with larval trematodes in Azraq Oasis, Jordan. Jpn. J. Parasitol., 36: 13-16.

Ismail, N.S. and S.K. Abel-Hafez, 1987b. Population dynamics of *Melanopsis praemorsa* (L. 1785) (Thiaridae) snails in Yarmouk river, Jordan and its seasonal infection with larval trematodes. Arab Gulf J. Sci. Res., B5 20: 287-299.

Ismail, N.S. and S.M. Bdair, 1987. Four new Xiphidiocercariae from *Melanopsis praemorsa* (L. 1785) (Thiaridae) snails in Jordan. Jpn. J. Parasitol., 36: 135-141.

Ismail, N.S. and S.M. Bdair, 1989. Two new furcocercariae from *Melanopsis praemorsa* (L. 1785) (Thiaridae) snails in Jordan. Helminth., 26: 15-20.

Ismail, N.S. and A.Z. Elkarmi, 1999. Age, growth and shell morphometrics of the limpet *Cellana radiata* (Born, 1778) form the Gulf of Aqaba, Red Sea. Venus, 58: 61-69.

Ismail, N.S., A.Z. Elkarmi and S.M. Al-Moghrabi, 2000. Population structure and shell morphometrics of the corallivorous gastropod *Drupella cornus* (Gastropoda: Prosobranchia) in the Gulf of Aqaba, Red Sea. Indian J. Mar. Sci., 29: 165-170.

Ismail, N.S. and A.Z. Elkarmi, 2006. Age, growth and shell morphometrics of the gastropod monodonta dama (Neritidae: Prosobranchia) from the Gulf of Aqaba, Red Sea. Pak. J. Biol. Sci., 9: 843-847.

Le Cren, E.D., 1951. The length-weight relationship and seasonal cycle in perch (*Perca fluviatilis*). J. Anim. Ecol., 20: 201-210.

Ostle, B. and R.W. Mensing, 1975. Statistics in Research. Iowa State University Press, Iowa, USA., pp: 206.

Ott, L., 1984. An Introduction to Statistical Methods and Data Analysis Duxbury Press, Boston, pp: 482.

Schütt, H., 1983. The Aquatic and terrestrial mollusks of Jordan known until now according to the collection of Dr. Bandel 1978 (in German). Nature und Mensch, pp: 49-64.