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Biometrics of *Nassarius mutabilis* (l.) (Gastropoda, Nassaridae) in the Central Adriatic Sea

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KEY WORDS: Neogastropoda, commercial species, Nassaridae, *Nassarius mutabilis*, Adriatic Sea.

ABSTRACT Shell height, shell diameter, total weight and fresh meat weight were measured on specimens of *Nassarius mutabilis* (L.) collected with a dredge at two different depths in the central Adriatic sea. The results obtained separately for the two sexes showed that females generally have a higher shell height and that, starting from a certain size, they tend to become more globular and heavier than males.

RIASSUNTO Sono stati analizzati altezza e diametro della conchiglia, peso totale e peso fresco della carne su esemplari di *Nassarius mutabilis* (L.) catturati tramite campionamenti con draga effettuati a due diverse profondità nel medio Adriatico. I risultati relativi ai due sessi evidenziano che le femmine mostrano una taglia maggiore e che, a partire da una certa dimensione, tendono anche ad assumere una conformazione più globosa e un peso, sia totale che della carne, superiore rispetto ai maschi.

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INTRODUCTION

Nassarius mutabilis (L.) inhabits fine sands and fine muddy sands at depths between 2 and 15 m along Mediterranean coasts (FISCHER *et al.*, 1987). It is a gonochoristic species which reproduces from the end of winter to the beginning of spring. Fertilization is internal and eggs are layed between march and may in conical, transparent egg capsules, which attach to hard substrates (FABI & GIANNINI, 1983). Indirect development results in the production of a veliger (RIEDL, 1991). *N. mutabilis*, as all other members of the family, is a carnivore which feeds on dead organisms, although it may predate live animals, suffocating them by means of its foot (TORELLI, 1982). It spends most of the day buried in the substrate with its proboscis protruding from it and emerges during the night when it wonders around in search of food, like his congeneric species (BEDULLI, 1976; CRISP, 1978).

N. mutabilis is especially abundant in the central Adriatic sea, where it represents an important resource for small-scale fisheries (PICCINETTI & PICCINETTI-MANFRIN, 1998). Fishing for this species takes place between the beginning of autumn and the end of spring, by use of a special baskets, like traps, baited with dead fish.

Unlike other members of the same genus (e.g., *Nassarius reticulatus* L.), knowledge on the biology of *N. mutabilis* is poor, despite its commercial importance. This study is, therefore, aimed at expanding the knowledge on the biology and biometry of this gastropod.

MATERIALS AND METHODS

Seasonal sampling (one for each season) was carried out off Senigallia, along the Italian coasts of the central Adriatic sea between October 1988 (autumn) and June 1989 (summer), at two different depths (6 and 13 m) by use of a modified dredge containing a 6 mm mesh bag. All specimens of *N. mutabilis* were preserved in alcohol (90°). The height (H) of each individual was measured and its sex determined by visual analysis of external reproductive organs. The few suspect imposex individuals were discarded. Size-frequency distributions for the two sexes were obtained from these data. One-way analysis of variance (ANOVA; LINDMAN, 1992) was used to compare mean size of males and females at different depths and seasons. Height data were log-transformed ($\log x$) in order to satisfy normality and homoscedasticity requirements. Normality was tested using a Chi-square goodness-of-fit test and homoscedasticity by use of Bartlett's test. Both tests resulted positive in all cases with the exception of data from 13 m depth, which resulted heteroscedastic and unsuitable for the application of ANOVA.

Maximum diameter of the shell (D), total fresh weight (Wt) and fresh weight of the meat (Wm) were measured for a subsample of individuals from each season. Regression equations for H/D, H/Wt, and H/Wm were calculated separately for males and females. Outliers were identified using Cook's test and eliminated. The regression coefficients obtained were compared between sexes using a t-test.

RESULTS

The size-frequency distributions show that, at all depths and in all seasons, females had a greater size than males. Such difference resulted significant ($p<0.01$) in all cases with the sole exception of the 6 m depth ($p=0.895$), which was the only case where both sexes were prevalently represented by small individuals (males: mean H=13.9±3.0 mm; females: mean H=14.1±3.9 mm). A great discrepancy was found in the abundance of *N. mutabilis* at 6 m and 13 m in spring, the latter being approximately four times the former (fig. 1; Tab. I).

Table II summarises the regression equations obtained for H/D, H/Wt and H/Wm for each sex (258 females and 205 males). In all cases a significant difference was scored in the

regression coefficients of males and females.

Males of the smaller size classes had slightly greater diameter, total weight and meat weight than females with equal lengths. With increasing size this difference decreased and, eventually, reversed. In fact, from 11.5 mm and 14.5 mm in height, Wt and Wm respectively, were greater in females than in males. This trend became increasingly obvious as animals got larger. For example: at H = 5 mm, Wt and Wm were 0.45 g and 0.012, respectively in males and 0.42 g and 0.009 g, respectively in females. On the contrary, at H = 25 mm, Wt and Wm were 3.04 g and 1.19 g, respectively in males and 3.23 g and 1.33 g, respectively in females.

CONCLUSIONS

The size-distributions obtained for *N. mutabilis* show that, in agreement with data reported for other Neogastropods (FRETTER, 1984), males generally have a smaller mean size than females. Furthermore, height/diameter and height/meat weight ratios show that, starting from 14.5 mm, corresponding to approximately one year of age (CESPUGLIO *et al.*, 1999), the shells of females gain a more globose shape compared to males. This is associated to a greater increase in meat weight in females. Total weight, too, shows an increase in females with respect to males, starting from 11.5 mm. Such differences become increasingly evident as size increases, as already observed in other prosobranchs (FRETTER, 1984). Nevertheless, the differences between male and female *N. mutabilis* are not marked enough to allow inference of true systematic sexual dimorphism.

Discrepancies in the mean size of individuals found at 6 m and 13 m, lead to the conclusion that there may be a difference in spatial distribution according to size, smaller individuals being more frequent in shallow waters and larger ones, at greater depths.

Finally, the difference in abundance between the two depths in spring, where significantly lower numbers of individuals were recorded at 6 m, may be correlated with the fact that *N. mutabilis* reproduces in this period (FABI & GIANNINI, 1983; CESPUGLIO *et al.*, 1999). Mass migrations are, in fact, quite common in the Nassaridae during this phase of their biological cycle (TALLMARK, 1980; LAMBECK, 1984).

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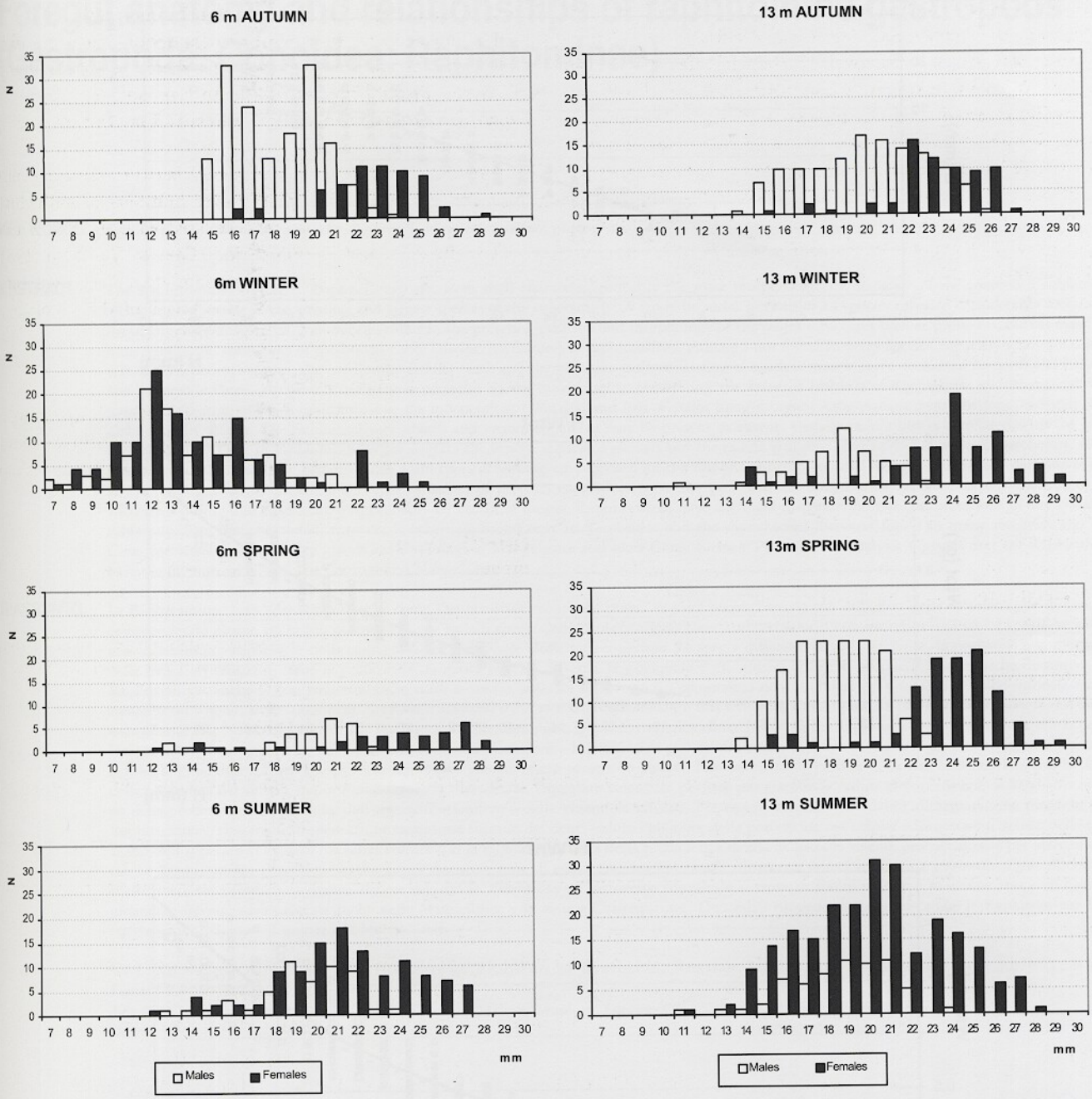
Table I. Medium sizes (Hm) ± standard deviation and total number of specimens (Ntot) obtained for males and females of *N. mutabilis* at the two dephts examinated (6 and 13 m) in all seasons.

Season:	6 m		13 m	
	males	females	males	females
Autumn	Ntot = 160 Hm = 18.3±2.2 mm	Ntot = 61 Hm = 22.5±2.4 mm	Ntot = 137 Hm = 20.3±2.8 mm	Ntot = 66 Hm = 23.2±2.3 mm
Winter	Ntot = 98 Hm = 13.9±3.0 mm	Ntot = 129 Hm = 14.1±3.9 mm	Ntot = 49 Hm = 18.6±2.3 mm	Ntot = 79 Hm = 23.2±3.6 mm
Spring	Ntot = 28 Hm = 19.6±2.8 mm	Ntot = 34 Hm = 22.9±4.4 mm	Ntot = 151 Hm = 18.5±2.1 mm	Ntot = 103 Hm = 23.5±2.7 mm
Summer	Ntot = 51 Hm = 19.6±2.3 mm	Ntot = 109 Hm = 21.0±3.1 mm	Ntot = 64 Hm = 18.7±2.4 mm	Ntot = 237 Hm = 19.9±3.6 mm

Table II. Regression equations obtained for H/D, H/Wt and H/Wm for 205 males and 258 females of *N. mutabilis*.

Relation	Sex	N	Equation	R^2	p
H/Wt	Males	205	$Wt = 0.0007 * H^{2.6134}$	0.970	<0,01
	Females	258	$Wt = 0.0006 * H^{2.6888}$	0.970	
H/Wm	Males	205	$Wm = 0.0001 * H^{2.8829}$	0.892	<0,01
	Females	258	$Wm = 0.0001 * H^{3.0676}$	0.896	
H/D	Males	205	$D = 0.723 * H$	0.823	<0,01
	Females	258	$D = - 0.751 + 0.776 * H$	0.897	



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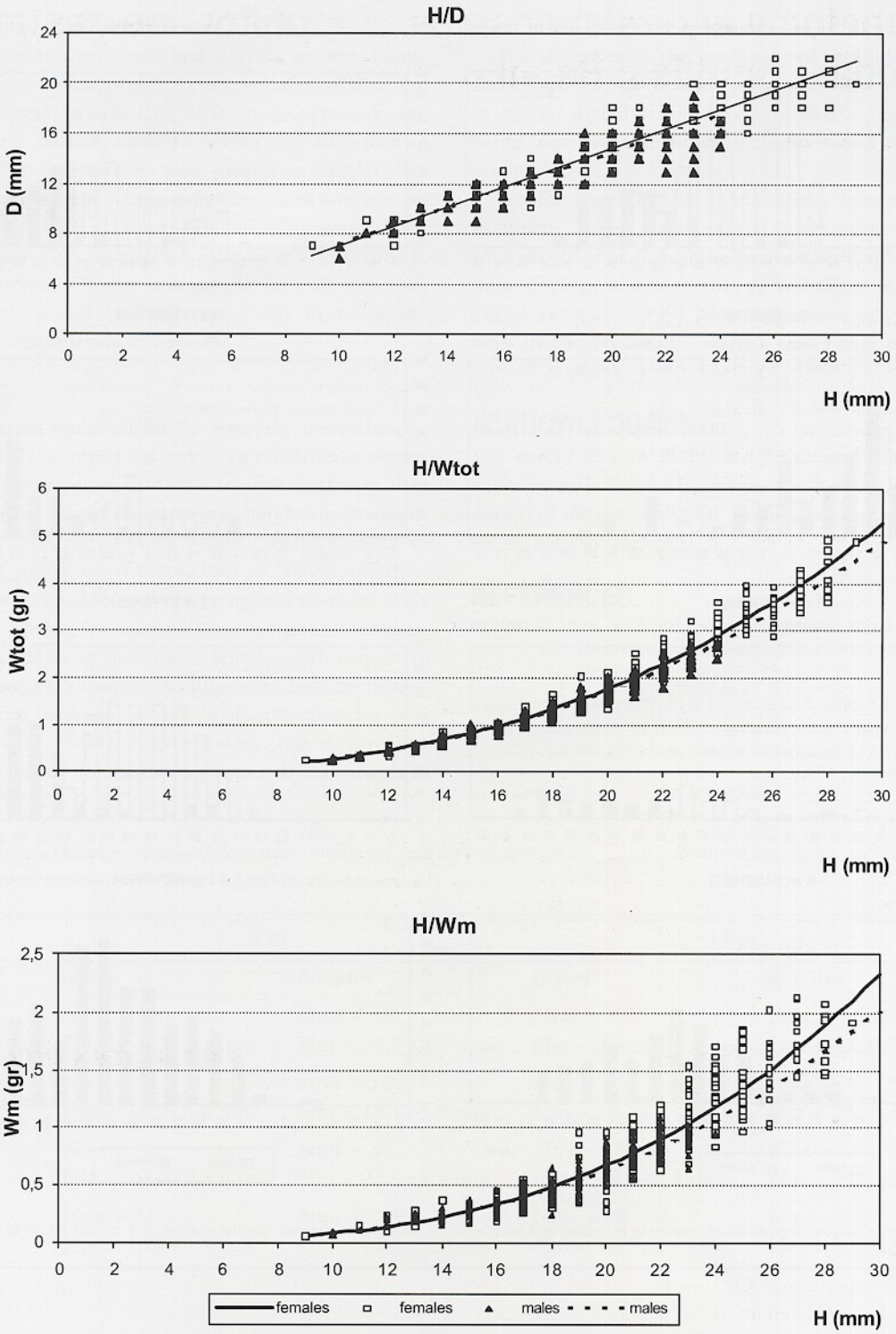

Figure 2. Regression relations obtained for H/D, H/Wt and H/Wm for 205 males and 258 females of *N. mutabilis*.

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