Predictive use of length-weight regression in Eledone cirrhosa

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ABSTRACT : Statistical error both in weight and length measurement of octopods, normally distributed data frequency and low correlation coefficients suggest the use of predictive (ordinary or inverted) regression to be often preferable to the functional one.

Body length measurements have been a classical problem in many species of octopods. Because of the physical mouldy structure, dorsal mantle length recordings still cause various and dissimilar results, especially with respect to estimation of length-weight correlations.

Pereiro & Bravo de Laguna (1980) report good examples of such a problem by analysing different length-weight relationships described in literature. Correlation coefficients are usually lower than in most vertebrate species: this is mainly due to high variability, both in weight estimate and in length measurements (Caddy, 1983). The present paper deals with estimation and use of length-weight functions for the species Eledone cirrhosa.

A three years trawl survey (5 campaigns) has been carried out in northern Tyrrhenian Sea by means of 148 tows. Global catches of E. cirrhosa (1500 individuals) have been subsampled , frozen at -20 °C and weeks later used for morphometric analyses. Dorsal mantle length and total body weight measurements were collected upon 823 specimens (340 males and 483 females) and log-transformed with the common technique (Ricker 1975).

Three kinds of L-W regression have been considered:
- The ordinary predictive regression. - The inverse predictive regression. - The functional regression.

		MALES		FEMALES	
		r	n	r	n
April	1985	0.87	66	0.93	128
August	1985	0.95	55	0.95	81
May	1986	0.98	59	0.97	86
September	1986	0.95	46	0.95	42
April	1987	0.96	114	0.91	146
grouped springs		0.94	239	0.94	360
grouped summers		0.95	101	0.96	123
all grouped		0.94	340	0.97	483

Tab. 1 Correlation coefficient (r) and specimen number (n) of the 16 sets data of E. cirrhosa.

The correlation coefficients have been computed for each survey and sex separately (see table 1). Grouping together these sets of data gives no advantage resulting in similar r values. The regression results of the 16 groups of data have been compared and analysed. Main common features can be summarized into four points.

1) The result precision (i.e. correlation coefficient) is quite unlinked to the number of specimens used, but it is likely determined by the sex and the gonadic development stage.
2) The correlation coefficient is almost never close to 1, then the application of the GM regression for predictive use is not correct (Jensen, 1986). This can be done only if the basic assumptions of the parametric regression, such as random sampling and variance homoscedasticity, are not met (Ricker 1973).
3) The lower r , the higher results the difference between the ordinary and the inverse predictive regression lines (e.g. fig.1). In our samples, the weight estimated from a length datum with the two ways gives up to 10-20 % differences in the extreme sizes (see tab.2).

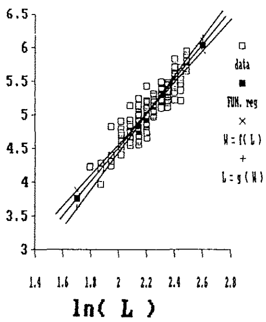

Fig.1 Predictive and functional regressions: sample of 146 females (April 87).

4) E. cirrhosa is a short-lived species (about 18 months), and by means of fishing sampling, it normally shows a single age class. Consequently all our frequency distributions satisfy the Normal distribution at 99% level if tested with the Kolmogorov-Smirnov procedure.

In E. cirrhosa, and likely in other octopods, variability is due to both length and weight measurement, and regression assumptions are usually met.

So, r being never close to 1 and regression lines different, any predictive use, namely to estimate weight from length or length from weight, must be done with the respective minimization.

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Length-weight relationship in males and females of Sepia orbignyana and Sepia elegans (Cephalopoda : Sepiidae)

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Cephalopods are dioecious and, except a few species, the two sexes do not show marked differences. Sexual dimorphism is mostly limited to hectocotylization in males and to different body proportions, which can be displayed as different length-weight relationships.

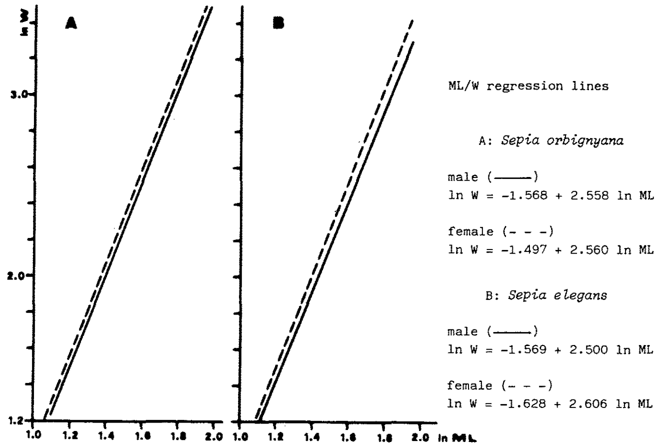
The genus *Sepia* is characterized by the presence of the rigid cuttlebone which allows precise measurement of mantle length. The genus is represented by three species in the Mediterranean: *Sepia officinalis* L., 1758, *Sepia orbignyana* Férussac, 1826, and *Sepia elegans* Blainville, 1827, all of which exhibit some degree of sexual dimorphism, mostly evident in the posterior part of the cuttlebone, which is broader in females to hold the large egg mass. Sexual dimorphism is less distinct in the latter two species (NAEF, 1923), in both of which females attain a larger size than males (MANGOLD-WIRZ, 1963). According to ADAM (1952) as well, in both *S. orbignyana* and *S. elegans* females are slightly larger than males, also the cuttlebone is larger; males have longer arms than females. ADAM & REES (1966), who quote the data of ADAM (*op. cit.*), state that in *S. elegans* "there is no noteworthy difference in the relative measurements of the two sexes".

To detect possible sexual differences in body proportions in *S. orbignyana* and *S. elegans*, the mantle length-weight relationships of the two sexes of each species were compared.

Specimens of the two species were collected in the South Adriatic Sea by a trawler from Mola di Bari (Italy) at a depth of 130 m, in May 1986. Mantle length (ML) was measured to the nearest 0.1 cm, and weight (W) to the nearest 0.1 gr. The parameters of the ML/W regression curves of each sex for the two species were calculated using the power curve equation: $W = a\,ML^{b}$. For statistical analysis these curves were then transformed into straight line equations using natural logarithms: $\ln W = \ln a + b \ln ML$. The pairs of straight lines of each species were compared by the Student's *t*-test, with the method of the "*axe majeur réduit*" (MAYRAT, 1959), being ln ML the independent variable (table 1).

	sex	*n*	Range of ML (cm)	*a*	*b*	*r*	*P*(%)	*df*	slope *t*	slope *cl* (%)	position *t*	position *cl*(%)
S. orbignyana	♂	38	3.6-7.1	0.208	2.558	0.982	<0.1	85	0.266	20.4	4.453	>99.9
	♀	51	2.3-9.0	0.224	2.560	0.992	<0.1					
S. elegans	♂	51	3.2-6.3	0.208	2.500	0.956	<0.1	99	0.317	24.8	5.358	>99.9
	♀	52	3.2-6.2	0.196	2.606	0.980	<0.1					

n = number of specimens; *a*, *b* = parameters of power curve ($W = a\,ML^{b}$); *r* = correlation coefficient; *P* = significance level of *r*; *df* = degree of freedom; *t* = Student's *t*; *cl* = confidence level of difference.



In both species the differences between the male and the female ML/W regression curves are very highly significant ($cl > 99.9\%$), limited to their position; on the contrary, as regards their slope, the pairs of curves do not differ significantly ($cl < 90\%$)(table 1). Therefore it can be assumed that in both sexes the individual growth in weight basically follows the same physiological rules; whereas the significant differences in position show that females of both species are statistically heavier than males. Bearing in mind that males have longer arms than females (ADAM, 1952), and that there is no noticeable difference in mantle thickness, it follows that the body is proportionally broader in females than in males. The comparatively small size of the samples should not affect negatively the present test. Actually an increase in size of samples should increase the *t* value and, thus, further increase the level of confidence (MAYRAT, 1959).

Finally all four regression curves have the value of the exponent *b* less than 3, which shows that in both sexes of both species growth in weight is negatively allometric, i.e. cuttlefishes become more slender as size increases, as already pointed out by NAEF (1923) and, limited to *S. elegans*, by ADAM (1952).

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