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DETERMINATION OF INDIVIDUAL MEIOFAUNA DRY WEIGHT VALUES IN RELATION TO DEFINITE SIZE CLASSES

by

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Résumé

Détermination des poids secs des organismes de la méiofaune, à partir des classes de longueur.

Les poids secs des espèces méiobenthiques les plus fréquentes sont déterminés dans des groupes différents. Pour rendre valable la comparaison, l'auteur reprend toutes les déterminations de poids secs et de poids frais, disponibles dans la littérature. Les chiffres sont résumés dans un tableau.

Introduction

The object of this paper is to consider the knowledge available on biomass data of meiobenthos taxa and to present a list of biomass dry weight values with respect to definite size classes, on the basis of which it is more possible to calculate meiobenthic dry mass data.

Since Mare (1942), investigations on the ecology of meiofauna have been essentially descriptive but subsequently in the late 60's and early 70's there was a surge of interest in studying functional interrelationships as well as in calculating the energetic role of meiobenthic individuals in the marine system (see Coull and Bell, 1979). The meiofauna is suggested as being an important link in the productivity cycle of benthic ecosystems (Ankar and Elmgren, 1976; Gerlach, 1978) and, therefore, the evaluation of energetic terms on the basis of unit dry weights is essential for an ecological comparison with micro- and macrofauna (McLachlan, 1977; McIntyre, 1978).

Already early in the 40's and 50's calculations and estimations were made on meiobenthic wet weight values (Mare, 1942; Bougis, 1946; 1951; Nielsen, 1951; Smidt, 1951), but first Wieser (1960) presented results on both wet and dry weight restricted to Nematoda, which are useful for comparable biomass evaluation in other areas of investigation. In the following years, in addition, a lot of papers have been presented dealing with the estimation of meiobenthic biomass, but on the meiobenthic species level measurements of biomass weights have been performed only by Wieser (1960), Juario (1975) (Nematoda), and Beschnidt and Noack (1976) (Oligochaeta, Ostracoda).

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Material and methods

The organisms used in these studies were collected from tidal beaches of Sylt (North Sea), from the sandy beach near Falkenstein in the brackish water Kiel Fjord, from a 10m station of the investigation area called "Hausgarten" in the brackish water Kiel Bight (Baltic Sea), from the subtidal investigation area of the Fladenground (North Sea), and from a tidal flat of tropical waters (Cebu, Philippines).

The sampling for meiofauna was performed by pushing a short (0—15cm) plexiglass core liner (4.9cm inner diameter) into the sediment. In the laboratory the samples were sorted within a day, while the animals remained alive. Separating the fauna from the sediment was carried out by the shaking supernatant technique of Wieser (1960). Weighing for biomass calculations were performed with a Mettler microbalance (range 10^{-3} to 10^{-7}g). The organisms were sorted according to different size classes which can be seen in Table 1. For the estimation of the individual weights it is of eminent importance to get individuals free of any inorganic or organic matter. Therefore, the individuals were pipetted repeatedly from dish to dish until there was no soiling detectable. These washing procedures were carried out with 0.2µm filtered seawater. After that, a counted number of individuals of each size class was pipetted onto a prepared GF/C Whatman filter and rinsed with distilled water removing excess salt. The filter was then over dried at 60°C for 24 hours and placed in a desiccator for cooling. For each dry weight estimation at least 15 control values were determined, both according to the different taxa and size classes.

Results and discussion

A summary of the biomass figures of the most abundant meiofauna groups reported in this paper is given in Table 1. The average values were related to individual dry weights. For comparison, as far as possible, all data on meiobenthic taxa reported elsewhere were collected and summarized in Table 2. It can be seen that the most measurements are made on nematodes and, with regard to dry weight determinations, the average values compare favourably with the data reported in size class 0.5—1.0mm but, in other taxa, the values are generally somewhat higher. However, it is undeserving to discuss and compare the values presented with those from literature because there is no exact statement in relation to body size.

The determination of dry weight biomass has been intended to provide standard values with a fairly high reliability for different size categories related to body length, so that one can also compare data from one geographic area with that from another. The average dry weights of each category, for example, attained on nematodes living in sediments of the North Sea area of Sylt agree exactly with those obtained from the Baltic or tropical waters and vice versa. The establishment of the respective size classes resulted from numerous assessments in relation to body length and weight. Hence, the averaged individual weights reported are representative of a crowded number ranked according to each size category.

Average dry weights on nematodes with remarks on body length reported by Guille and Soyer (1968), seem to me to be too low. These values presented are calculated by using the formula given by Andrassy (1956) and converted into dry weight according to Wieser (1960). The values reported from Ostracoda and Copepoda, however, are obviously too high. It can be seen that the data determined by McLachlan (1977) are in good agreement with those presented in this study.

TABLE 1

Average dry mass weights (μg/ind.) of meiobenthic taxa according to definite size classes.

taxa	size classes 0.5—1.0mm (μg)	1.5—2.5mm (μg)	3.0—4.0mm (μg)
Turbellaria	0.63±0.24	1.73±0.22	8.81±1.67
Nematoda	0.17±0.08	1.12±0.12	6.27±0.59
Oligochaeta	5.52±0.85	13.61±1.04	28.59±1.25
Nemertini		8.74±0.73	19.4 ±0.95
Harpacticoida	0.6—0.9mm 0.56±0.13	1.0—1.2mm 1.63±0.16	
Ostracoda	0.6—1.0mm 7.83±0.78		
Halacarida	0.8—1.0mm 7.64±0.59		

The determination and evaluation of biomass weight for meio- and microfaunal taxa are very laborious and, consequently, different procedures have been developed. For determination of average wet weights, the methods most employed are either the evaluation according to the formula presented by Andrassy (1956), a most accurate method but only practicable for cylindrical and smooth individuals, or weighing filter dried batches of animals with a microbalance. In return, the determination of dry weight is more uniform and reproducible and considered to be of fairly high reliability, but often different temperatures have been used for drying the animals. In addition, calculations of dry mass weights are sometimes carried out determining the individual ash-free dry biomass (Dye and Furstenberg, 1977; McLachlan, 1977) to distinguish between organic and inorganic (e.g. shells of mollusks, ostracods, and foraminifers) dry weight. This may be essential, however, for a meaningful comparison with macrofauna and therefore data expressed as ash-free dry weights are recommended as very suitable ones to compare biomass densities, but the evaluation of production rates is only to understand on the basis of the total individual weight. With regard to wet weight determination Wieser (1960) already stated that no meaning can be attached to wet weight of small animals determined by direct weighing

TABLE 2

Summary of wet and dry mass weight determinations (μg/ind.) from the literature.

taxa	wet weight determinations		dry weight determinations	
	μg/ind.	author	μg/ind.	author
Nematoda	0.31	Ankar and Elmgren, 1976	0.07	Ankar and Elmgren, 1976
	0.51	Rachor, 1975	0.13—0.19	Juario, 1975
	0.85	Vivier, 1978	0.2—1.4	McLachlan, 1977
	1.2—4.1	Wieser, 1960	$\bar{x}$: 0.5	
	1.7, 3.0	Mare, 1942	0.1—0.5	
	2.0	Beschnidt and Noack, 1976	$\bar{x}$: 0.3	
	2.1	Kölmel, 1977	0.25—0.37	Scheibel, 1976
	5.8—6.0	Kisseleva and Slavina, 1973	0.3	McIntyre, 1978
	5.2—10.3	Tietjen, 1969	0.42±0.05	Dye and Furstenberg, 1978
	$\bar{x}$: 6.8±1.6		0.48	Wieser, 1960
	6.8—33.2		2.12	Coull, 1970
	$\bar{x}$: 14.1±9.0		0.09 (1mm, length)	Guille et Soyer, 1968
	0.3 (small ind.)	Stripp, 1969	0.27 (1-2mm, length)	
	1.2 (medium ind.)		0.48 (2mm, length)	
	4.2 (large ind.)			
	0.6 (small ind.)	Smidt, 1951		
	7.8 (bigger ind.)			
	sieve classes (μm) :	Thiel, 1972		
	1.1±0.05 (42—100)			
	3.6±0.6 (100—150)			
	7.6±1.9 (>150)			
Copepoda	0.29—7.6	Dinet, 1980	0.3—0.5 $\bar{x}$: 0.4	McLachlan, 1977
	1.03	Rachor, 1975	0.71—2.14	Scheibel, 1976
	2.0	Thiel, 1972	1.23	Coull, 1970
	2.4, 5.0	Mare, 1942	1.3	Ankar and Elmgren, 1976
	6.5	Ankar and Elmgren, 1976	1.7	Wieser, 1960
	7.1—7.6	Tietjen, 1969	1.9	McIntyre, 1978
	$\bar{x}$: 7.4±0.16		1.7—1.8 (small)	Guille et Soyer, 1968
	8.0	Stripp, 1969	3.5—3.8 (large)	
	8.7—10.3	Kisseleva and Slavina, 1973	0.47±0.05 (interstitial)	Dye and Furstenberg, 1978
	9.9	Smidt, 1951	1.65±0.35 (burrowing)	
	20.0	Beschnidt and Noack, 1976		
Ostracoda	10.0	Stripp, 1969	0.5	McLachlan, 1977

	12.0	Smidt, 1951	11.0	Coull, 1970
	37.8	Kisseleva and Slavina, 1973	18.0	Wieser, 1960
	41.0	Ankar and Elmgren, 1976	18.0	McIntyre, 1978
	50.0	Beschnidt and Noack, 1976	25.0	Ankar and Elmgren, 1976
	123.4—126.2 x̄: 124.7±0.91	Tietjen, 1969	40.0—59.0	Guille et Soyer, 1968
Halacarida	3.0	Ankar and Elmgren, 1976	0.6	Ankar and Elmgren, 1976
	6.0	Stripp, 1969	1.4	Coull, 1970
	6.56—1.03	Dinet, 1980	3.0—4.0	Guille et Soyer, 1968
	50.0	Beschnidt and Noack, 1976		
Polychaeta	5.0	Stripp, 1969	0.5	McLachlan, 1977
	30.0—34.5 x̄: 32.5±0.91	Tietjen, 1969	6.2	Coull, 1970
			7.0	McIntyre, 1978
			2.0—4.0 (larvae) 50.0—100.0 (1mm, length)	Guille et Soyer, 1968
Kinorhyncha	2.2	Ankar and Elmgren, 1976	0.4	Ankar and Elmgren, 1976
	13.0—14.4	Kisseleva and Slavina, 1973	2.2	McIntyre, 1978
			2.7	Coull, 1970
			3.0	Wieser, 1960
Amphipoda	16.6—30.0 x̄: 26.7±5.6 20.0—40.0 x̄: 26.2±5.4	Tietjen, 1969	6.2	Coull, 1970
			10.38±4.0	Dye and Furstenberg, 1978
			30.0 (juvenils) 450.0 (small)	Guille et Soyer, 1968
Bivalvia (larvae)	9.0	Stripp, 1969	5.0	McIntyre, 1978
	15.0—30.0 x̄: 21.3±4.0	Tietjen, 1969	5.76	Coull, 1970
Turbellaria	9.0	Ankar and Elmgren, 1976	1.4	Ankar and Elmgren, 1976
			2.0	Coull, 1970
Oligochaeta	100.0	Ankar and Elmgren, 1976	1.1—2.0 x̄: 1.6	McLachlan, 1977
			18.0	Ankar and Elmgren, 1976
Gastrotricha			0.7	Hummon, 1976
Tardigrada			0.5	McLachlan, 1977
Nauplii	0.28	Rachor, 1975	0.9	McIntyre, 1978

since evaporation through the body wall takes place too rapidly to allow definition of stable state. The common practice of rolling individuals on filter paper or a cloth is difficult to standardize and can be a source of serious error. In addition, most of the data reported up tc now are based on meiofauna individuals without any statement about their size, thus it is often impossible to use such values from the literature for further investigations. Only Guille and Soyer (1968), Smidt (1951), Strip (1969), Scheibel (1976), and Thiel (1972) have tried to give a more detailed information on the stature of single specimens. On the species level, the only data have been reported by Wieser (1960), Juario (1975), and Beschnidt and Noack (1976).

For this reason, the aim of this paper is to determine dry mass weight factors in relation to body size of the most abundant meiofauna taxa for calculating benthic biomass data with more accurate reliability.

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Summary

Biomass dry weight values of the most abundant meiobenthic taxa were determined. The values are related to definite size classes. For comparison, as far as possible all date of wet and dry weight determinations of individual meiofauna groups reported in the literature were collected and summarized.

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