STATOLITH DIAMETER AS AN ALTERNATIVE MEASURE OF SIZE IN THE MYSID, *NEOMYSIS NIGRA* NAKAZAWA, 1910 (MYSIDA)

BY

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ABSTRACT

Total length, and the length of carapace and telson, are generally used to measure the size of mysid crustaceans. However, this method may not be as accurate for measuring these animals, since mysids commonly bend their abdomen when they are collected and preserved. Besides, the fragile carapace of mysids may result in less accurate outputs in such size measurements. The aim of this study was to determine the relationship between carapace length and statolith diameter in Mysida. The carapace length and statolith diameter were measured in 1199 individuals of *Neomysis nigra* Nakazawa, 1910. The statolith diameter was significantly correlated with carapace length. It is suggested that the statolith diameter of mysids could be used as an alternative measurement for characterizing body size in these crustaceans.

RÉSUMÉ

La longueur totale, et la longueur de la carapace et du telson, sont généralement utilisées pour mesurer la taille des crustacés mysidacés. Cependant, cette méthode peut ne pas être aussi exacte pour mesurer ces animaux, car les mysidacés plient fréquemment leur abdomen quand ils sont ramassés et conservés. De plus, la fragile carapace des mysidacés peut entraîner des résultats moins précis dans de telles mesures. Le but de cette étude a été de déterminer la relation entre la longueur de la carapace et le diamètre du statolithe chez les mysidacés. La longueur de la carapace et le diamètre du statolithe ont été mesurés chez 1199 individus de *Neomysis nigra* Nakazawa, 1910. Le diamètre du statolithe a été significativement corrélé avec la longueur de la carapace. Il est suggéré que le diamètre du statolithe des mysidacés pourrait être utilisé comme une mesure alternative pour caractériser la taille du corps chez ces crustacés.

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INTRODUCTION

Mysids commonly bend their abdomens when they are collected from the fields, making accurate total length measurements difficult. In addition, total length may be changed by the rigor mortis after preservation in formalin or ethanol (Amaratunga & Corey, 1975; Delgado et al., 2013). Therefore, carapace length is usually used as a body length in mysid crustaceans, because it is considered to be more accurate than total length. However, the carapace of mysids is attached at the front of the thorax part and may be lifted free along most of its length (Peterson & Gosner, 1999), and the soft carapace of mysids may be damaged by freezing for isotope analysis (Fanelli et al., 2009). Consequently, alternative methods to measure the size of mysids need to be developed.

The statocysts, which are located in the endopods of the uropods, are a pair of sense organs in most mysid crustaceans, except members belonging to the family Petalophthalmidae (Mauchline, 1980). A statocyst comprises a vesicle, a statolith and sensory hairs. The external part of the statolith can have a spherical, hemispherical or discoidal shape. Statoliths consist of fluorite and calcareous or organic materials (Wittmann et al., 1993). Most statoliths are composed of fluorite (CaF_2), others are mineralized with vaterite (CaCO_3), or are not mineralized at all (Ariani et al., 1993). The size of statoliths have been used to analyse the occurrence of larvae within a population of *Mysis relicta* Lovén, 1862 (cf. Morgan & Beeton, 1978).

The objective of the present study is to investigate the relationship between carapace length and statolith diameter in mysids, and to know whether statoliths can be an alternative indicator of mysid size measurement.

MATERIAL AND METHODS

Neomysis nigra was collected from an embayment at Ojo-ri, located at 33°27'N 126°54'E, on the eastern coast of Jeju Island, South Korea, using a hand net (mesh size: 500 μm). Specimens were immediately preserved in 70% ethanol after sampling.

Carapace length (CL) and statolith diameter (SD) were measured of 1199 randomly selected specimens. Measurements were performed under a stereomicroscope equipped with an image analysing system (Olympus SXZ10, Active Measure, Japan). The statoliths of specimens were removed from the endopods of uropods, and washed in distilled water. Carapace length was measured from the posterior margin of the eye socket to the mid-point of the posterior margin of the carapace (Cole & Mistakidis, 1953) (fig. 1A). Statolith diameter was

Fig. 1. The measurement of body size of *Neomysis nigra* Nakazawa, 1910. A, Carapace length; B, statolith diameter. This figure is published in colour in the online edition of this journal, which can be accessed via <http://booksandjournals.brillonline.com/content/journals/15685403>.

measured along the long and short axes, which were averaged out (fig. 1B). The relationship between carapace length and statolith diameter was examined by regression analysis using the following the allometric equation:

$$CL = a + bSD.$$

Fig. 2. The relationship between carapace length (CL) and statolith diameter (SD) of *Neomysis nigra* Nakazawa, 1910.

RESULTS

The carapace length ranged from 0.42 to 2.84 mm. The statolith diameter ranged from 30.7 to 183 μm . Statolith diameter increased with increasing carapace length. An allometric relationship between carapace length and statolith diameter was established from individual measurements: $\text{CL} = 0.072 + 0.014\text{SD}$. Carapace length was significantly correlated with statolith diameter ($n = 1199$, $r^2 = 0.826$, $p < 0.001$) (fig. 2).

DISCUSSION

Most mysids have two statoliths which function as special sense organs in the endopods of the uropods (Mauchline, 1980). Although the formation of statoliths at the base of the inner uropods is completed within 3 h after ecdysis (Gorokhova, 2002), the statolith diameter increases with body size during ontogenetic development (Schlachter et al., 1992). Because most statoliths are made of fluorite (CaF_2), which is a mineral form of calcium fluoride (Ariani et al., 1993), statoliths are relatively harder than the carapace. Hence, statoliths might be easier to handle, and less prone to breaking during sampling and preservation than the carapace. In addition, measurement errors could be reduced due to the simple and hard structure of statoliths. The results showed a significant correlation between carapace

length and statolith diameter. Therefore, we suggest that the statolith diameter of mysids could be an alternative measurement of body length in mysid crustaceans.

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