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# The use of the ecdysed carapace for measurements of the growth of prawns

by

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## INTRODUCTION

The term ecdysed carapace is used to distinguish that part of the exoskeleton, corresponding to the carapace, which is shed, each time ecdysis (or moulting) occurs, from the actual carapace which is an integral part of living or, in preserved specimens, intact prawns.

Estimates of size increase in prawns are usually calculated from measurements of (a) total length from the tip of the rostrum to the base of the spines on the telson (Forster 1951, Reeve 1969), or (b) carapace length measured from the post-orbital margin to the mid-dorsal posterior margin of the carapace (Cole 1958, Farfante 1969), or (c) live weight as described by Forster (1970).

Each of these methods involves the capture and manipulation of the prawns to be measured and this can cause considerable stress, particularly to newly moulted individuals. In addition, since it is frequently desirable to observe the pattern of growth (Kurata 1962), measurements must be made during each inter-moult period. In young prawns this means disturbance as often as every three days. When prawns are held in individual containers, for example in nutrition experiments (Forster and Beard 1973) and pollution studies (Wilson and Connor 1971), where it is important that the incidence of cannibalism and shock is minimized, the ecdysed carapace may be removed from the container and measured with very little disturbance to the prawn. In this way the frequency of moulting is recorded and the increase in carapace length at each moult is measured directly. This

report describes some of the factors that can influence the accuracy of measurements of the ecdysed carapace.

METHODS

Measurements of ecdysed carapaces were made with a binocular microscope fitted with a 20 mm graduated eyepiece and a vernier micrometer fitted with pointed jaws (Cole and Mistakidis 1953). The latter was modified by the addition of a short spring between the clamping collar and the movable jaw (see Figure 1, Cole and Mistakidis 1953). This reduced oscillations of the movable jaw parallel to the axis of the micrometer spindle: otherwise these developed when the spindle was rotated.

Carapaces of prawns in the size range studied were not particularly strong and were liable to distort unless supported while being measured. Microscopic measurements were made with the carapace supported by water or preservative in a watch glass. The micrometer, which had the great advantage of being very rapid in operation, was more likely to compress unsupported carapaces, particularly those below 10 mm in size. It was found by my colleague, Mr Edge, that more consistent measurements were made when carapaces were placed on a tapered glass tube at a point where the diameter of the tube was slightly less than the external width of the carapace. Live prawns were measured with the micrometer.

Penaeus occidentalis and Macrobrachium rosenbergii were used in this study, since specimens were readily available in the laboratory. They ranged in size from 8.8-18.7 mm carapace length.

The prawns were kept separately in plastic containers for 16-20 days in a flow of either full salinity water or brackish water at 28 degrees C. Each morning the containers were inspected and any ecdysed carapaces found were removed with a large bore pipette and measured. Prawns that had not moulted were also measured. The carapaces were then preserved in either 4% formol saline or 70% ethyl alcohol. They were subsequently measured at 3- or 4-day intervals for 6 weeks, to determine

any variation in length during preservation. In addition 14 newly ecdysed carapaces (9-16 mm length) were held in warm sea water for 24 hours before measurement so that the extent of deterioration could be observed.

RESULTS

Repeated measurements of machined metal blocks showed that over the range 6-15 mm accuracy was similar with both micrometer and microscope. In each set of measurements the standard error, expressed as a percentage of the mean, was less than 0.2%.

Carapaces over 15mm in length were difficult to measure with the microscope, since they occupied the extreme edges of the field of vision. Ecdysed carapaces less than 10 mm in length were best measured with the microscope, since at this stage they were easily distorted by the jaws of the micrometer. Over 10 mm in size the errors of measuring ecdysed carapaces with the micrometer were no greater than when the more robust live prawns were measured.

Repeated micrometer measurements of 16 live P. occidentalis and 16 M. rosenbergii were made over periods of 20 and 16 days respectively. In addition 10 repeated measurements were made on 13 ecdysed carapaces. The mean percentage standard errors of these measurements and the 95% confidence intervals of the mean were:

| | Live prawns | | Ecdysed carapace | |
|---|---|---|---|---|
| | Mean % SE ± 95% confidence interval | No. of measurements | Mean % SE ± 95% confidence interval | No. of measurements |
| P. occidentalis | 0.25 ± 0.06 | 237 | 0.19 ± 0.06 | 130 |
| Range | (0.04-0.98) | | (0.10-0.48) | |
| M. rosenbergii | 0.18 ± 0.04 | 213 | - | |
| Range | (0.05-0.33) | | | |

Repeated measurements of the 13 ecdysed carapaces (mean 12.37 mm, range 10.37-15.49 mm) gave the standard deviation of the means from each carapace to be 0.073 or 0.59% of the mean (12.37 mm). Thus 95% of the mean lengths obtained in this way were within 1.18% (2 x 0.59) of the actual length; for example, a carapace of 12.00 mm might be expected to vary by 0.28 mm (11.86-12.14 mm).

Eighty-two ecdysed carapaces were collected and preserved for six weeks in either 4% formol saline or 70% ethyl alcohol. Those that had been placed in alcohol appeared to be firmer and more resistant to distortion by the jaws of the micrometer even after three days' preservation. The standard error was again determined as a percentage of the mean for each series of individual carapace measurements, and the mean and 95% confidence intervals of these were:

| Preservative | Mean % SE ± 95% confidence interval | No. of measurements |
|---|---|---|
| 4% formol saline | 0.20 ± 0.08 | 262 |
| range | (0.03-1.39) | |
| 70% ethyl alcohol | 0.14 ± 0.03 | 276 |
| range | (0.05-0.64) | |

This showed that neither preservative caused a significant increase in variation in the measurements. The differences between initial (before preservation) and final carapace lengths were compared with zero by means of "students" t test for each preservative separately. The results were:

| Preservative | Mean difference in mm | 95% confidence limits |
|---|---|---|
| 4% formol saline | - 0.01 | - 0.06 to + 0.04 |
| range | (- 0.31 to + 0.77) | |
| 70% ethyl alcohol | - 0.02 | - 0.04 to + 0.01 |
| range | (- 0.14 to + 0.15) | |

There was no significant increase or decrease in carapace length after six weeks' preservation in either preservative at the 95% level.

Carapaces that were not preserved but left in warm sea water for 24 hours became too fragile to be accurately measured.

## RECOMMENDATIONS

On the basis of these observations experiments using individually held prawns at Conwy are routinely inspected as early as possible each morning. Ecdysed carapaces are removed with the least possible disturbance to the prawn and measured under the binocular microscope, unless they exceed 10 mm length in which case a micrometer is used. When it is necessary to delay measurement the carapaces may be preserved in 70% ethyl alcohol which is more pleasant to use than 4% formol saline.

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