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PRELIMINARY NOTE ON VARIATION OF PROTOCONCHAE OF *CLIO PYRAMIDATA* (LINNAEUS, 1767) (MOLLUSCA, PTEROPODA)

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ABSTRACT

A new method for the use of infraspecific variation in the characterization of watermasses in the past is indicated. The various formae of the thecosomatous pteropod *Clio pyramidata* can be distinguished by the size of their protoconch. Since in marine sediments these protoconchae are usually the most intact part of the pteropod shells, they can be used to trace the distribution of the formae in the past, and thus of the watermasses of which these are characteristic.

INTRODUCTION

Clio pyramidata (Linnaeus, 1767) shows distinct latitudinal variation of a clinal type (Van der Spoel, 1967). The adult shell shows clear differences in populations of different watermasses, while intermediates are found in transitional areas between the major watermasses. Palaeontological studies based on these infraspecific variations may contribute to the knowledge of hydrographical situations in the past. In sediment samples adult shells are, however, too frequently fragmented to make identification of the different forms of *Clio pyramidata* possible. Protoconchae on the contrary are usually intact in the sediment. To demonstrate the value of the protoconcha a preliminary study is made on the variation using protoconch length and width.

Table I

Locality	Station		Position		Data	Specimens
1	Cirrus	several :	59°00'N	19°00'W	several, 1965	30
2	Dana Exped.	4205^{III} :	51°48'N	30°30'W	1-VII-1931	103
3	Dana Exped.	1386^{V} :	45°15'N	08°43'W	24- VI-1922	104
4	Dana Exped.	4019^{X} :	35°08'N	10°22'W	30-III-1930	50
5	Dana Exped.	4017^{IX} :	29°13'N	14°12'W	27-III-1930	73
6	Dana Exped.	4009^{V} :	24°36'N	17°27'W	18-III-1930	58
7	Dana Exped.	1178^{III} :	10°24'N	54°38'W	19- XI-1921	50
8	Dana Exped.	4003^{X} :	08°26'N	15°11'W	9-III-1930	52
9	Dana Exped.	4000^{V} :	00°31'S	11°02'W	4-III-1930	16

MATERIAL

From nine localities shown in figure 1 material is studied. Data on these localities are enumerated in table I.

The protoconchae are measured as indicated in figure 2, measurements were accurate to 0.005 mm.

RESULTS

In the North Atlantic Ocean *Clio pyramidata* is represented by the tropical forma *lanceolata* (Lesueur, 1813) and the coldwater forma *pyramidata* (Linnaeus, 1767). The two formae show an intergradation zone between 40°N and 50°N. The protoconchae of these two forms distinctly differ, but the group of intermediates, the transitional form, is also recognizable as a separate group. The differences are given in table II.

As the embryonic shell does not increase in size during growth of the specimens, seasonal influences on size can not be expected. Vertical migration of the populations causes regular vertical dispersal of the formae, so depth of sampling will not influence the results presented here. Fossil records of protoconchae will therefore also be useful to trace hydrographical conditions in the past.

Comparison of recent plankton samples from the

Table II

	Number of specimens	Length		Width	
		Mean	Standard deviation	Mean	Standard deviation
Tropical form	50	0.332 mm	0.015	0.187 mm	0.005
Transitional form	72	0.408 mm	0.016	0.203 mm	0.012
Coldwater form	31	0.355 mm	0.014	0.213 mm	0.011

North Atlantic Ocean provided the results given in figure 1. Samples of the Bay of Biscay (3) show a dominance of the transitional water form and a minor percentage of the coldwater form. In the open ocean at about 50°N (2) the influence of the Gulf Stream is greater so that at this locality an equal mixture of coldwater, transitional water and tropical populations is found. Vertical lines in figure 1 connect the tops in the curves representing the different forms.

The coldwater top coincides with a top in the curve of the tropical form at the most southern station (9). The mean width of the protoconch of this tropical form is however 0.195 mm, while the mean width is normally 0.187 mm for the tropical and 0.213 mm for the coldwater form. When populations are compared the width should be studied in addition to the length of the protoconch.

Close to 60°N (1) the populations are composed entirely by the coldwater form. The southernmost samples studied (7, 8, 9) are composed of tropical specimens. North of 20°N the coldwater influence becomes evident in the populations in which also transitional forms are present.

The station under full influence of the West African upwelling waters (6) shows a significant absence of tropical specimens. This is also shown by the protoconch mean length of 0.365 mm and mean width of 0.207 mm, values indicating the presence of cold water. Up to the Strait of Gibraltar a distinctly separate top for the tropical form is found in the curves (5, 4) so that the absence at latitudes north of 20°N is not a normal one but an incidental absence due to upwelling cold water which causes the suppression of the tropical forma at 24°36'N 17°27'W (6). The top near 0.35 mm in sample 6 can be due to presence of tropical as well as of coldwater specimens. Comparing the width as well as the length of the protoconchae composing this top, with the values for the three forms, it becomes clear that about 10% of the specimens had the tropical type of protoconch and 90% the coldwater type of protoconch.

This preliminary study proves that protoconchae in plankton and in sediment samples can provide information concerning hydrographical conditions by their variation in size. It is logical that species composition of protoconchae in the sediment gives another possibility to trace ecological conditions in the past.

REFERENCES

SPOEL, S. VAN DER, 1967. Euthecosomata, a group with remarkable developmental stages: 1-375, figs. 1-361. (Noorduyn & Zn., Gorinchem).

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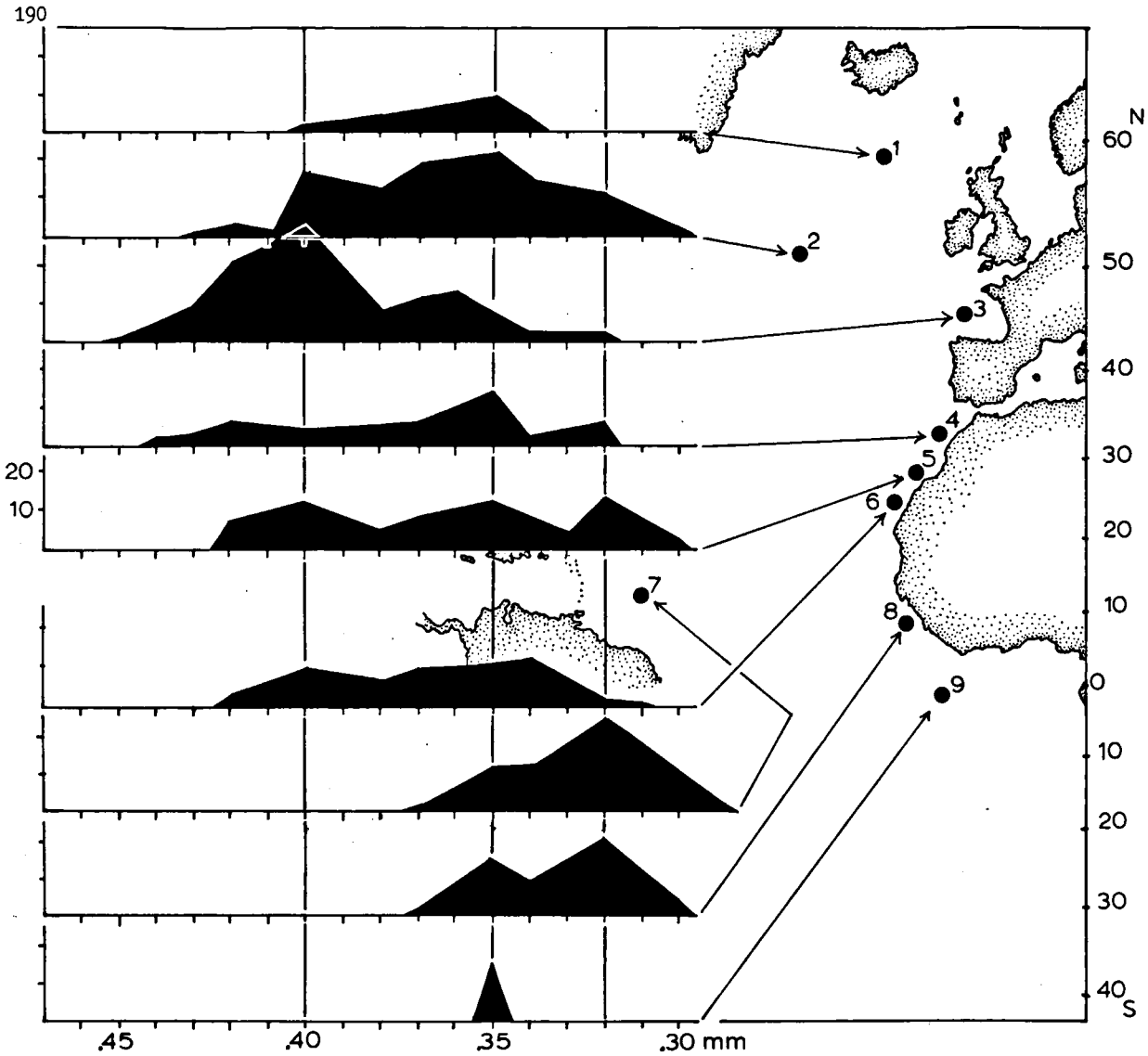

Fig. 1. Map of the localities studied (1-9) and the length of the protoconchae in the various samples (horizontal axis) and the number of specimens (vertical axis).

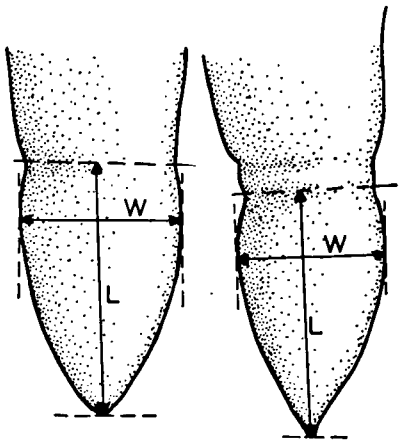

Fig. 2. Two protoconchae of different type of *Clio pyramidata* showing how the measurements for the length (L) and the width (W) were taken.