n Analysis of the Variation in Form of the Dog-Whelk nder Different Ecological Conditions

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SULTS OBTAINED BY I. C. McManus, S. Richards and J. J. Ryder of S 6 Sc. while on a field course at the onard Wills Field Centre, Taunton, Somerset in October 1968.

THE DOG-WHELK, Nucella lapillus, is a marine gastropod with a whitish-coloured, spirally coiled ll. An ear-shaped operculum covers the aperture ough which the foot projects. This is used to attach animal to the rock (See Fig. 1.)

purpose of this project was to see whether the e and proportions of dog-whelks in a particular ulation varied with the degree of exposure to wave on. The force on any surface, such as that produced wave action, is proportional to the area of the surface. vever the force holding the aminal to the rock is portional to the size of the muscle and it is likely this will increase with length. Since the degree of iation with length of both factors is unknown, then of three situations could arise:-

(a) The force exerted by the wave action could increase more with increase in length than does the muscular force. This would result in smaller dog-whelks in areas of greater wave action.

(b) The two forces could increase equally with increase in length and thus dog-whelks of all sizes could be found in all conditions.

(c) The force due to the muscle could increase more with increase in length than does the force due to wave action. This would result in large dog-whelks in rougher seas.

Thus, purely from theoretical considerations, this situation has been divided into three possibilities, one of which is true. Which one this is can be determined by experimental techniques. The technique used in this case, was to analyse the structure of different dog-whelk colonies at different sites.

sites were chosen on the North Somerset coast:

1) Watchet. This consisted of a very sheltered cove, indicated by the great expanses of sea-weed, particularly Fucus vesiculosus and Fucus serratus.

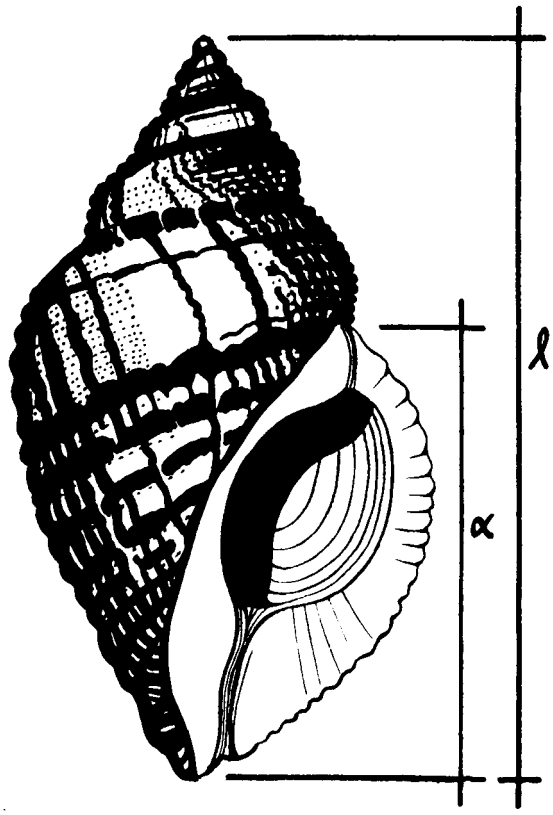

Fig 1. Common Dog-Whelk. *(Nucella lapillus)*

(2) Hurtstone Point. This is a very exposed shore indicated by the sparseness of the sea-weeds. This point was divided into 3 areas all of varying exposures. Both of these sites are less than 10 miles apart and both are facing onto the Bristol Channel, and thus variations due to salinity, mean water temperature, heights of tides, etc., were considered to be negligible. The exposures quoted are only relative to one another.

The method of collecting was to find a large boulder or rock face and systematically to remove every dog-whelk from its surface.

This removes any human error due to removing only the most obvious dog-whelks i.e. the largest ones. The lengths of both the aperture (α) and the whole animal (l) were measured and these results were tabulated with the value of α/l calculated as a percentage This value of α/l gives an indication of the proportions of the animal, and thus the relative size of the muscle of the foot.

These results were then analysed by two methods:-

(1) By means of a Scatter Diagram. (Figs. 2, 3, 4. 5.) The x-axis shows the values of l and the y-axis the values of α. Thus for each dog-whelk there is one position on the graph. This method has the advantage of being able to place both variables on the same graph and thus enables one to see the distribution more fully, but it has the disadvantage in that the relative numbers of each size cannot be shown except by rather more complex methods.

(2) By means of a Histogram. (Figs. 6-13) In the histograms of length, the length is plotted along the x-axis and the frequency i.e. the number of times each length occurs, is plotted on the y-axis. A block is then drawn above each size.

CONCLUSIONS

From these results it can be seen that in fact case (a) is correct and the force due to the wave action is greater than the muscular action as the length increases However another interesting fact which can be obtained from these graphs is that as the animal gets smaller the aperture tends to occupy more of the total length. In one case the aperture under very exposed conditions was 90% of the total length and under sheltered conditions in the animal the ratio was 29%. Therefore, not only does the dog-whelk tend to become smaller as the degree of exposure increases, but the muscular foot becomes larger relative to the total length. Both these factors together enable the animal to adapt itself to its environment.

ACKNOWLEDGMENTS

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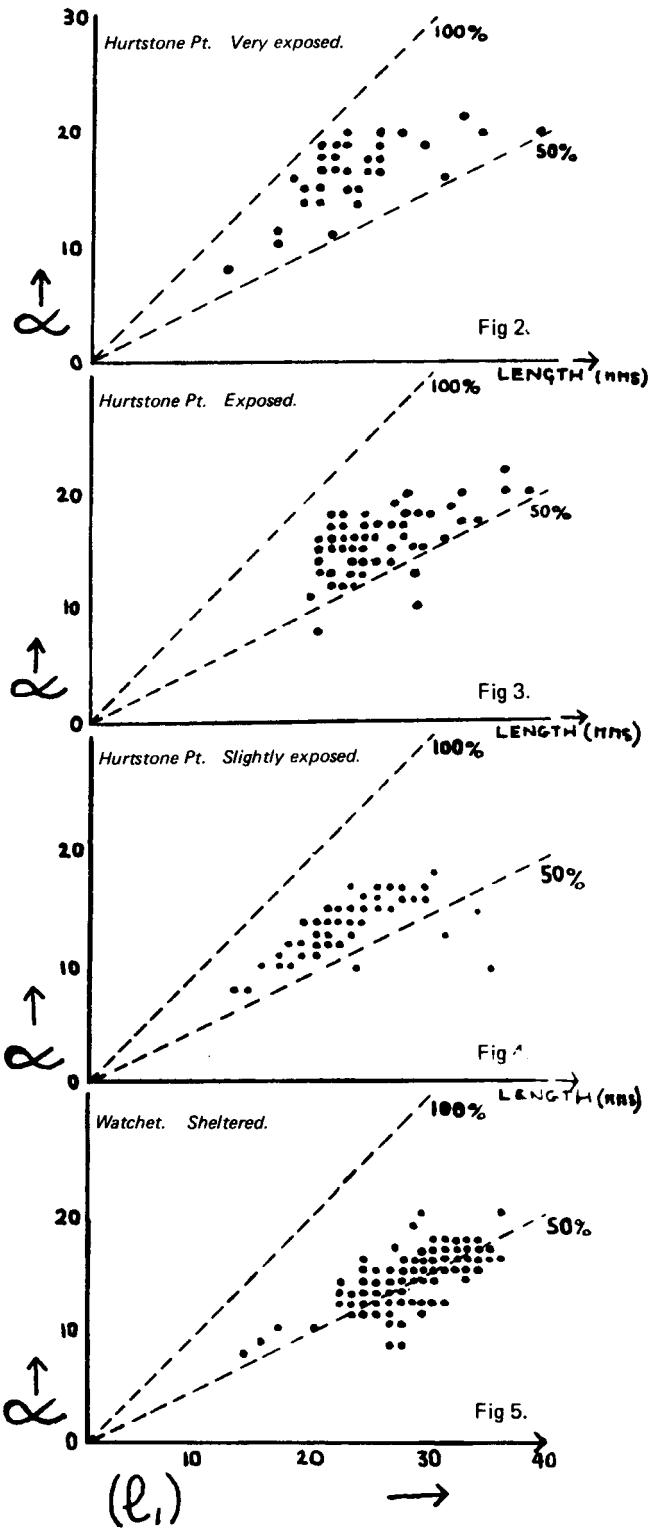
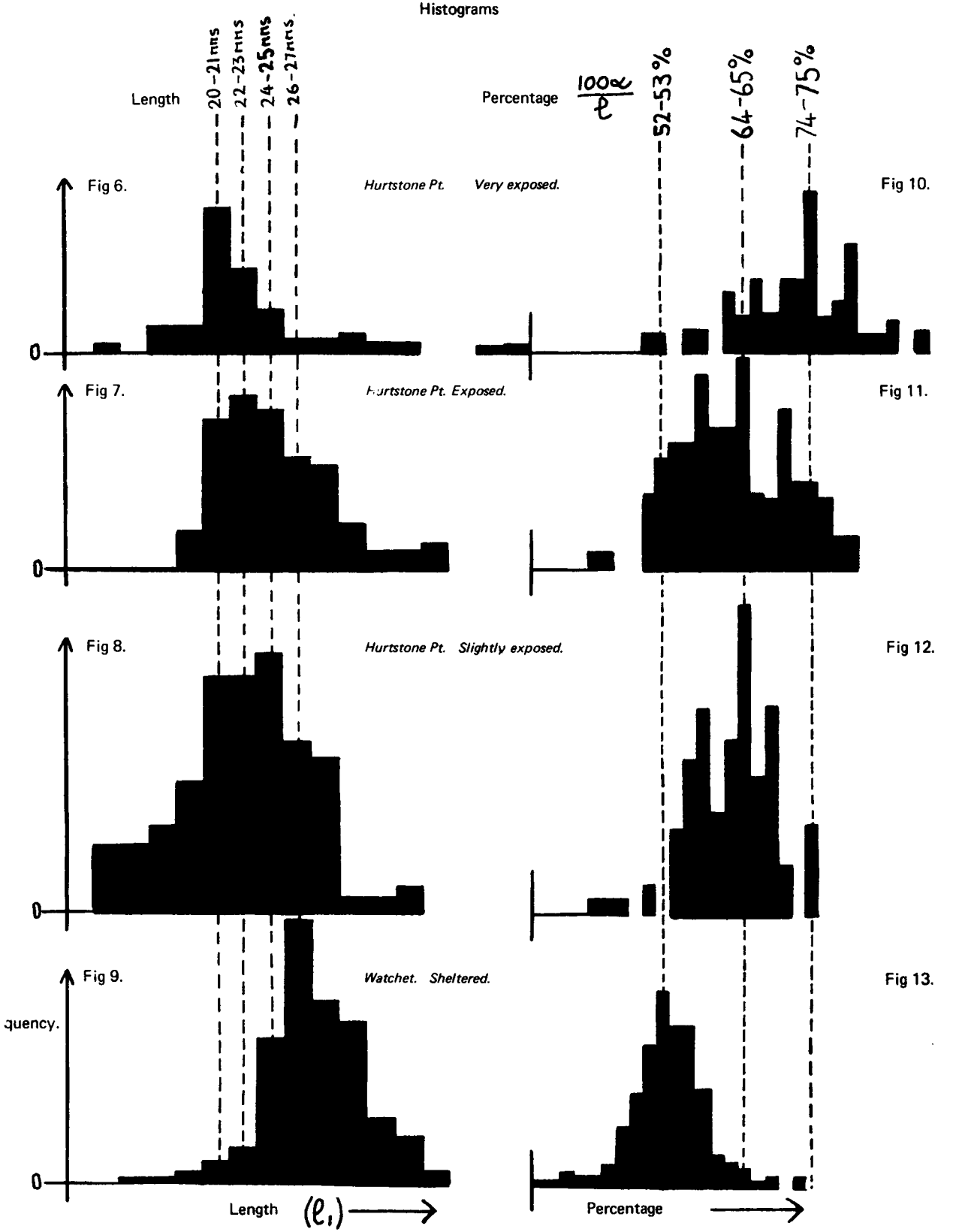
Scatter Diagrams. Length – Aperture.




Length
20-21mms
22-23mms
24-25mms
26-27mms
Percentage
100a/l
52-53%
64-65%
74-75%
Fig 6.
Hurtstone Pt.
Very exposed.
Fig 10.
0
Fig 7.
Hurtstone Pt. Exposed.
Fig 11.
0
Fig 8.
Hurtstone Pt. Slightly exposed.
Fig 12.
0
Fig 9.
Watchet. Sheltered.
Fig 13.
quency.
0
Length (l1)
Percentage