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THE INFLUENCE OF TOPOGRAPHY AND CURRENT ON SIZE COMPOSITION OF LOBSTER POPULATIONS

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INTRODUCTION

Observations on the size composition of the landed catch of the lobster Homarus gammarus in England and Wales have been collected for several years. These records show marked variations in the relative proportions of various size groups between one area and another. The fishery is at present managed by a single control - a minimum size limit of 80 mm carapace length (CL) measured from the eye socket parallel to the mid-line. The regional variations in size composition have implications with respect to proposals to increase the total yield by increasing this minimum size on a national basis. This paper reports on studies of the causes of those variations.

THE SELECTIVE INFLUENCE ON LOBSTER SURVIVAL IN AN AREA OF (a) CREVICE AVAILABILITY (b) VOLUME OF LEE FROM WATER CURRENTS

(a) Cobb (1970) and Dybern (1973) have shown for H. americanus and H. gammarus respectively that a lobster occupies a hole proportional to its size. It can be readily appreciated that in a given area of sea-bed many small rocks will offer more small crevices suitable for small lobsters than few large rocks. Conversely, few large rocks will offer more large crevices suitable for large lobsters than many small rocks. Thus the relative availability of shelters could be an important control on the numbers of lobsters of any size group that could survive in the area.

(b) Observations in a flume (Howard and Nunny, in preparation) have demonstrated that the locomotory activity of lobsters is limited to currents of less than 25 cm sec^{-1}. Lobsters occur commonly in areas experiencing surface tidal flows of 125 cm sec^{-1}, which implies a current of some 50 cm sec^{-1} at 5 cm above the bottom. It appears likely therefore that lobsters need to exploit the areas of lee created by outcrops on the sea-bed. As the volume of lee produced by an outcrop is proportional to the cross-sectional area it presents to the current, it seems likely that the size of lobster able to shelter in the lee will also be proportional to the size of the outcrop. Flume experiments (Howard and Nunny, in preparation) suggest that this is so. For example, juvenile lobsters (12-25 mm CL) were able to shelter behind a block 22 x 21 x 13 cm, in a current of 55 cm sec^{-1}, whereas 'adults' (70-90 mm CL) would not.

It would seem reasonable to suppose that as an individual lobster grows and becomes dissatisfied with its niche that it moves during slack water to a more suitable site. The size distribution of outcrops (and hence niches) on the sea-bed has a pattern created by transport, erosion, etc. Therefore, when the whole population is making this niche selection, one would expect that the lobster size distribution should reflect, to some extent, the sea-bed topography.

SUPPORTING EVIDENCE

The proportions of the various size groups in pot-caught samples from lobster fisheries tend to vary more from area to area, and less from year to year, than would be expected if fishing effort and recruitment levels were the only controls operating. Good examples of the extremes are provided by Bridlington and Norfolk grounds. The modal carapace length measurement of 254 lobsters sampled at Bridlington in 1972-74 was 88 mm, whereas that of 303 lobsters sampled in Norfolk was 62 mm. This distribution is much the same as in Buckland's records of 1875 and 1877, a century ago. What evidence we have of the intervening time is that the size distributions have been remarkably constant, leading Graham (1949) to investigate the possibility that the lobsters of Norfolk were of a genetically-isolated dwarf race. He concluded, however, that they were not, but that the absence of large lobsters was 'in some way natural and not due to fishing'.

This spatial variation combined with temporal constancy of lobster size distributions suggests that the control is exerted by the habitat, and the hypothesis presented here could be the natural control to which Graham referred. Diving observations have shown the sea-bed off Norfolk to consist primarily of small flints and low chalk outcrops with few features more than 30 cm high and across. This is what would be predicted from a study of the littoral zone at low water, Admiralty charts, and echo sounder traces of the area. In contrast, Bridlington lobster grounds appear from the same types of evidence to have large rock or clay features over a metre high, and several metres across, although this has not yet been confirmed by diving. However, the indications are that the size distribution of lobsters matches the size distribution of the sea-bed outcrops and hence the niche availability. Diving studies by Scarratt (1968) and Cobb (1970) on *H. americanus* have also led both those authors to observe independently that there appears to be a relationship between lobster size and rock size.

DISCUSSION

The constancy of the size composition over a period of years of the lobster populations in the two areas, together with the differences observed between the areas, suggests that these distributions are not controlled solely by the recruitment/fishing intensity relationship. Two postulated mechanisms by which the topography of the area and current flow rate influence the numbers of lobsters of different sizes living there fit the available evidence. The hypothesis predicts that survival of post-larval lobsters will be greatest on grounds not able to support many adults because of the differences in niche size required. As areas of the sea-bed protected from dumping and dredging operations have to date been restricted to those supporting a commercial population, it is possible that unprotected 'nursery areas' exist. Similarly, hatchery-reared juveniles would probably survive better if released at slack water into an area with many small crevices, rather than on to a commercial lobster ground.

SUMMARY

The effects of crevice availability and protection from water currents on lobster survival are considered. Evidence is presented that these two factors affect selectively the survival of different size groups in a given area. Thus the habitat could affect the size composition of a lobster population in an area, and so must be considered in the management of lobster fisheries.

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