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A comparison of seasonal growth of five species of bivalves in the Menai Straits

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ABSTRACT

The growth of the meat and shell of five species of bivalves during 1967 and 1970 is described. The method used demonstrated the relatively fast rate of growth of the meat early in the year, leading to a high meat:shell ratio by mid-summer. The relatively higher growth rate of the shell in the late summer led to a decline in this ratio in the late summer to reach its former value by the early winter.

It is suggested that the growth of meat early in the year is particularly controlled by the food supply. The extent of this increase may have an important influence on the total annual growth of the whole animal.

I INTRODUCTION

There is a considerable volume of literature on condition in bivalves; that relating to oysters has recently been reviewed (Walne 1970). Although a number of papers give information on seasonal variation in condition, it is very rarely linked to growth and therefore the changes recorded are the result of changes in relative growth of shell and meat.

An adequate measurement of growth in bivalves requires that samples are sacrificed at intervals in order to separate the growth of meat and shell. If a wild population of a species which does not carry annual rings, and which contains a number of year groups, is studied, it is difficult to measure growth rate. The method described in the paper overcomes these difficulties by setting out selected samples before the growing season starts and sacrificing the samples at intervals, on the assumption that they are still representative of the whole population.

II METHODS

This study measured the growth of meat and shell by sampling at approximately monthly intervals populations in which the range of sizes had been restricted. In all cases, with the exception of *Mytilus*, hatchery-reared stocks of known age were used. Individuals were then selected in such a manner that their live weight did not vary by more than ± 1 g from a standard. To simplify the work this was usually close to the mode for the population. The selected individuals were then split up at random into groups of 50-55 and each group was placed in an individual compartment of a tray standing at the low water of spring tides at our oyster ground in the Menai Straits, Anglesey. The trays were made of wood frames 11 cm deep and were divided into nine compartments each measuring 30 x 50 cm. A wire mesh closed the top and bottom of the trays.

Each compartment can be considered as a sub-sample of the original selected population. At about monthly intervals all the surviving bivalves in one compartment, selected at random, were brought back to the laboratory where the mean dry weight of the meat and shell was measured.

The following four species were studied in 1967 and 1970: *Ostrea edulis*, *Crassostrea gigas*, *Mercenaria mercenaria* and *Mytilus edulis*; *Venerupis decussata* was also examined in 1970. The method employed for the two burrowing species (*Mercenaria* and *Venerupis*) was changed in 1970. The populations were selected in the same manner and then each was allowed to bury in individual frames sunk in the mud. The tops of the frames were closed with a mesh to prevent the loss of animals and access by predators.

III RESULTS

In this paper only increase in meat and shell weight is considered. Typical results, illustrated in Figure 1, show that growth is reasonably regular and it is therefore possible to work from smoothed curves. The results discussed in this paper are based on successive 30-day periods from 1 January; these correspond closely to the months of the year. Appropriate values have been read from smoothed curves of the type shown in Figure 1.

A check on the accuracy of the estimates of growth obtained from single samples of 50 drawn from the population is given from occasions when more than one sample was examined at the same time. Table 1 shows four sets of data obtained in 1970. Generally the agreement was good, and the effect of the occasional aberrant sample is minimized by working from smoothed curves rather than the raw data.

Table 1 The mean dry meat and shell weight of replicate samples of 50 animals after various periods of growth

Species	Days growth	Dry meat (mg)		Dry shell (g)	
		Initial	Final	Initial	Final
Ostrea	273	14	209 191	0.52	7.98 7.89
Mercenaria	231	18	87 99	0.59	3.17 3.44
Venerupis	231	41	347 362 403	0.32	2.41 2.87 2.85
Mytilus	211	242	509 611 504 424	1.34	5.03 5.68 5.68 5.17

Table 2 shows the size of the animals at the beginning of the first standard 30-day period studied and at the end of the last 30-day period.

Table 2 Initial and final sizes of animals used

Species	Days	Dry weight (mg)			
		Meat		Shell	
		Initial	Final	Initial	Final
1967					
Ostrea	30-360	6.4	179	260	6 800
Crassostrea	30-330	13.0	600	440	1 990
Mercenaria	30-240	38.1	140	1 300	3 180
Mytilus	30-240	28.3	470	251	2 060
1970					
Ostrea	90-330	13.9	200	520	7 650
Crassostrea	60-330	550	3 810	16 000	62 600
Mercenaria	120-270	19.8	100	600	3 020
Venerupis	120-330	42.2	395	338	3 950
Mytilus	150-270	277	802	1 630	4 580

The percentage increase in meat and shell weight in each 30-day period is shown in Figures 3 and 4.

Growth of meat

In 1967 the first marked increase in meat occurred in period 3 (March) in Crassostrea and Mytilus and not until one month later with the other two species. Although observations did not start until later in the year in 1970 it appears from the shape of the curves that growth was about one month later. This may be a reflection of the fact that water temperatures were 1 to 2°C lower in periods 3 and 4 in 1970 compared with 1967; hours of sunshine were also lower. With all species and in both years the maximum percentage increase occurred in periods 4, 5 and 6. After period 6 there was a considerable fall in the rate of growth. Part of this fall is explained by the fact that as the year progresses the animals become larger and therefore the percentage increase in size can be expected to fall, but a comparison of the results from 1967 and 1970 suggests that this is only a small part of the reason. In 1970 the sizes of the Crassostrea and Mytilus used were nearly as large at the beginning of the year as those used in 1967 were at the end of the year. In 1970 these two species showed increases of 50 per cent or more in a 30-day period, which is considerably greater than the increases obtained after period 6 in 1967. From this it follows that the reduced percentage increase obtained after period 6 in 1967 was due not to the size of the animal but to other factors. It is thought that the decreased rate of growth was caused by an inadequate population of phytoplankton in the sea water. Some decrease could be caused by spawning but this is unlikely to have been a major factor, since it is improbable that either Crassostrea or Mercenaria spawn at the rather low water temperatures occurring in the Menai Straits, yet their pattern of growth was the same as the other species.

Figure 2 shows for the two species of oysters the proportion of the total increment for the year which was achieved by the end of each successive month. There was a close similarity between the two years but the two species showed a clear difference, with Crassostrea completing a larger proportion of its growth earlier in the year compared with Ostrea.

Shell growth and condition

The period of the maximum rate of shell growth was generally a little later in the year than meat growth, and the decline after period 6 was less steep. Since the weight of shell can either increase or stay the same between successive samples (losses due to abrasion are thought to be very small during the summer), consideration of the condition ratio

$$\frac{\text{dry meat weight}}{\text{dry shell weight}} \times 100$$

provides information on the relative growth of the two components. This ratio, calculated for the end of each 30-day period, is plotted on Figures 3 and 4. The picture presented is very similar for all species and for both years. The value of the ratio increased in the spring, reached a peak in period 5 or 6 and then declined until, by period 11-12, it reached a value close to that of the previous spring.

This seasonal pattern was caused by an imbalance in the rate of growth of meat and shell. In the spring the meat grew more rapidly than the shell, causing an increase in the value in the ratio. As the summer progressed, the shell grew at a relatively faster rate until the ratio was restored to the value characteristic of the species.

IV DISCUSSION

The technique described for measuring the growth rate can estimate the changes in meat and shell weight over a short period of time. The results obtained have demonstrated the high growth rate obtained in meat weight early in the year when the water temperature was 8-9°C. For *Ostrea edulis* this is earlier in the year and at a lower temperature than estimates based on shell length and total weight measurements (Walne 1958). The discrepancy is explained by shell growth commencing later, and proceeding initially at a slower rate, than the meat growth.

It is probable that the early growth of meat has an important influence on the year's growth of the whole animal and on its spawning potential. Since it proceeds at a relatively low temperature it is likely that the quantity and quality of the food supply exerts a dominating influence.

V REFERENCES

WALNE, P. R., 1958. Growth of oysters (*Ostrea edulis* L.). J. mar. biol. Ass. U.K., 37, 591-602.

WALNE, P. R., 1970. The seasonal variation of meat and glycogen content of seven populations of oysters *Ostrea edulis* L. and a review of the literature. Fishery Invest., Lond., Ser. 2, 26 (3).

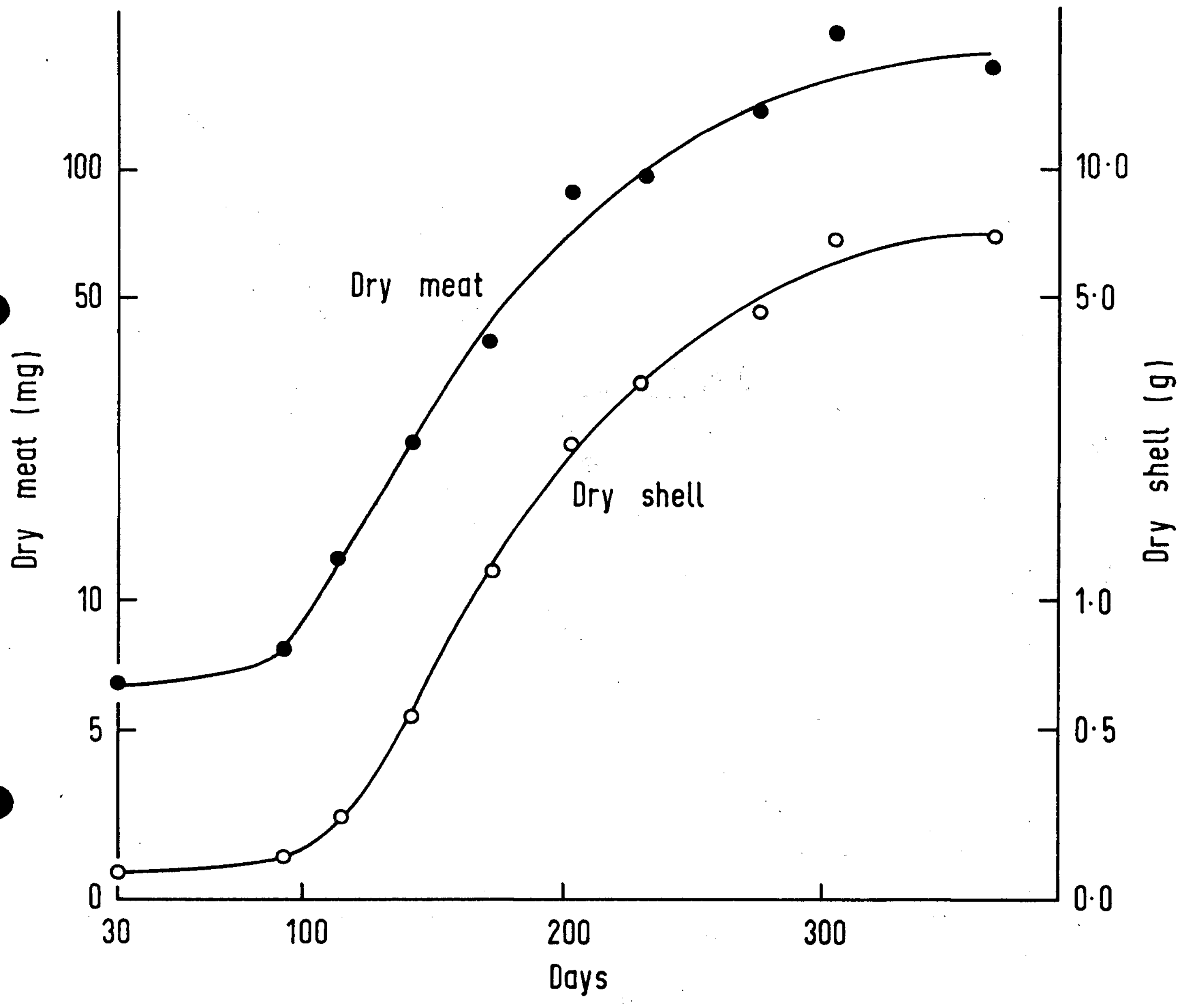


Figure 1 The growth of dry meat weight and dry shell weight of Ostrea edulis for 1967.

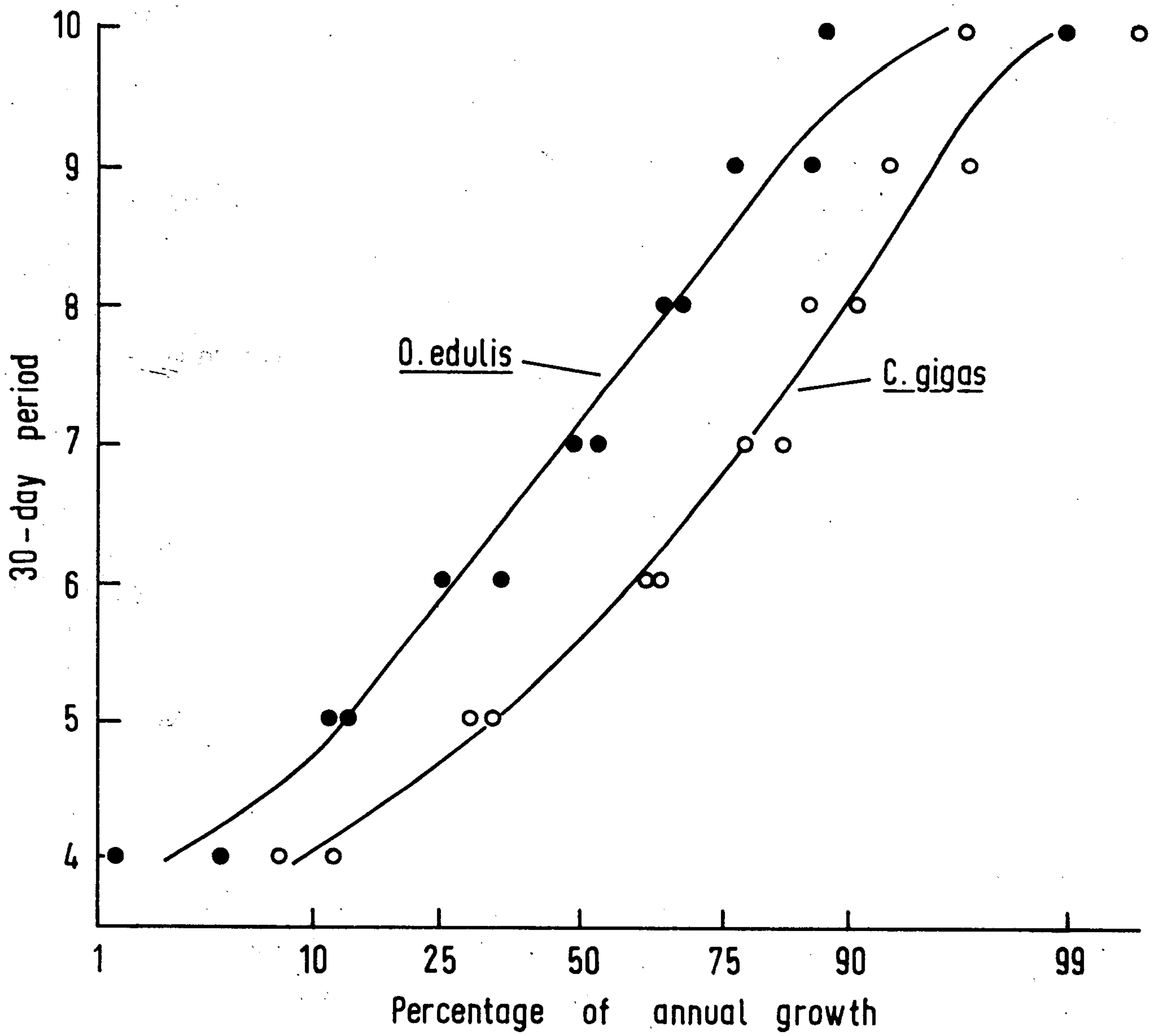
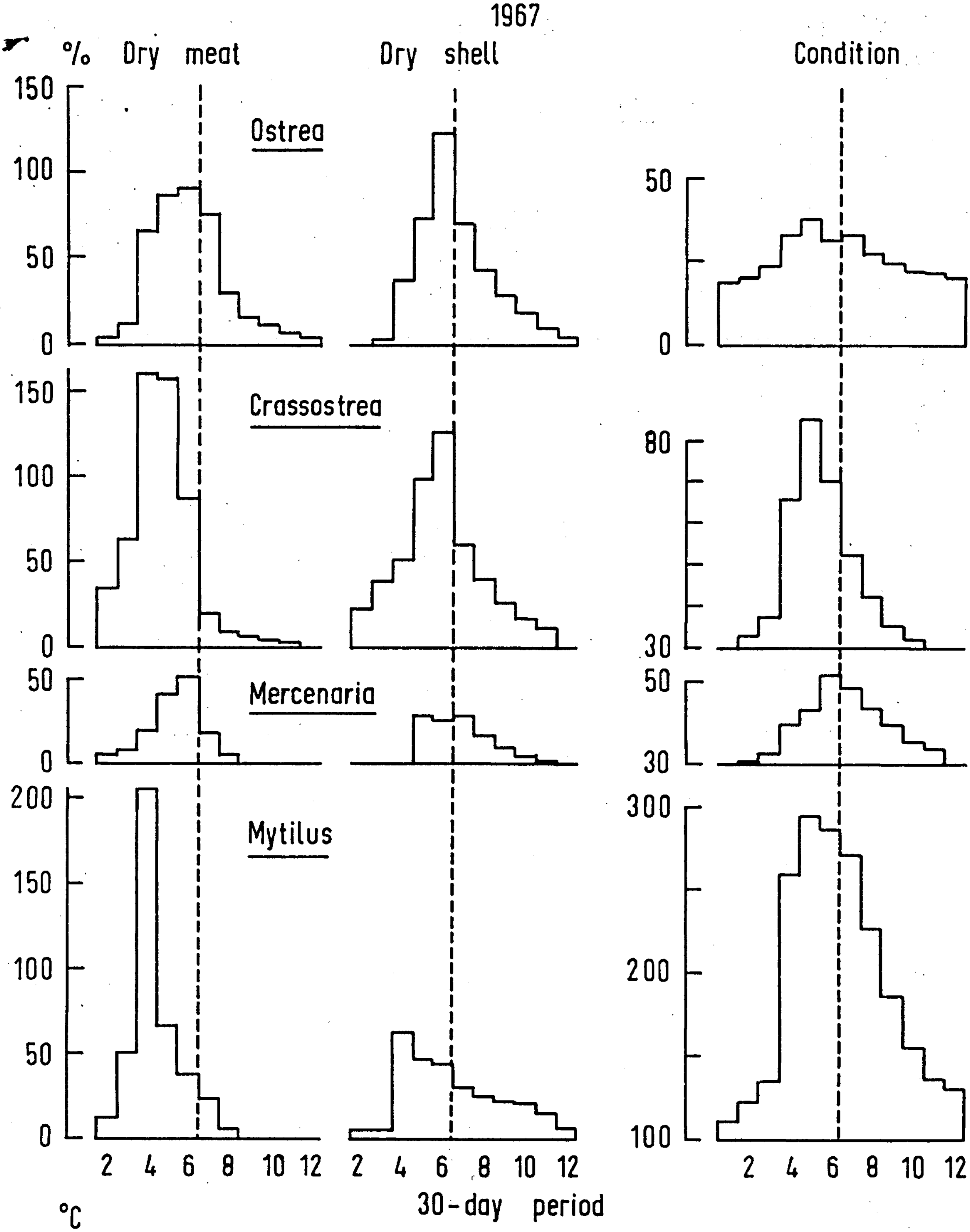


Figure 2 The percentage of the total dry meat weight increment in successive periods of the year for 1967 and 1970.



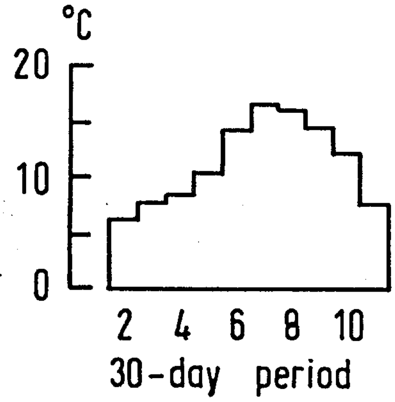


Figure 3 The percentage increment in dry meat and shell in successive 30-day periods in 1967, and the condition ratio at the end of each period.

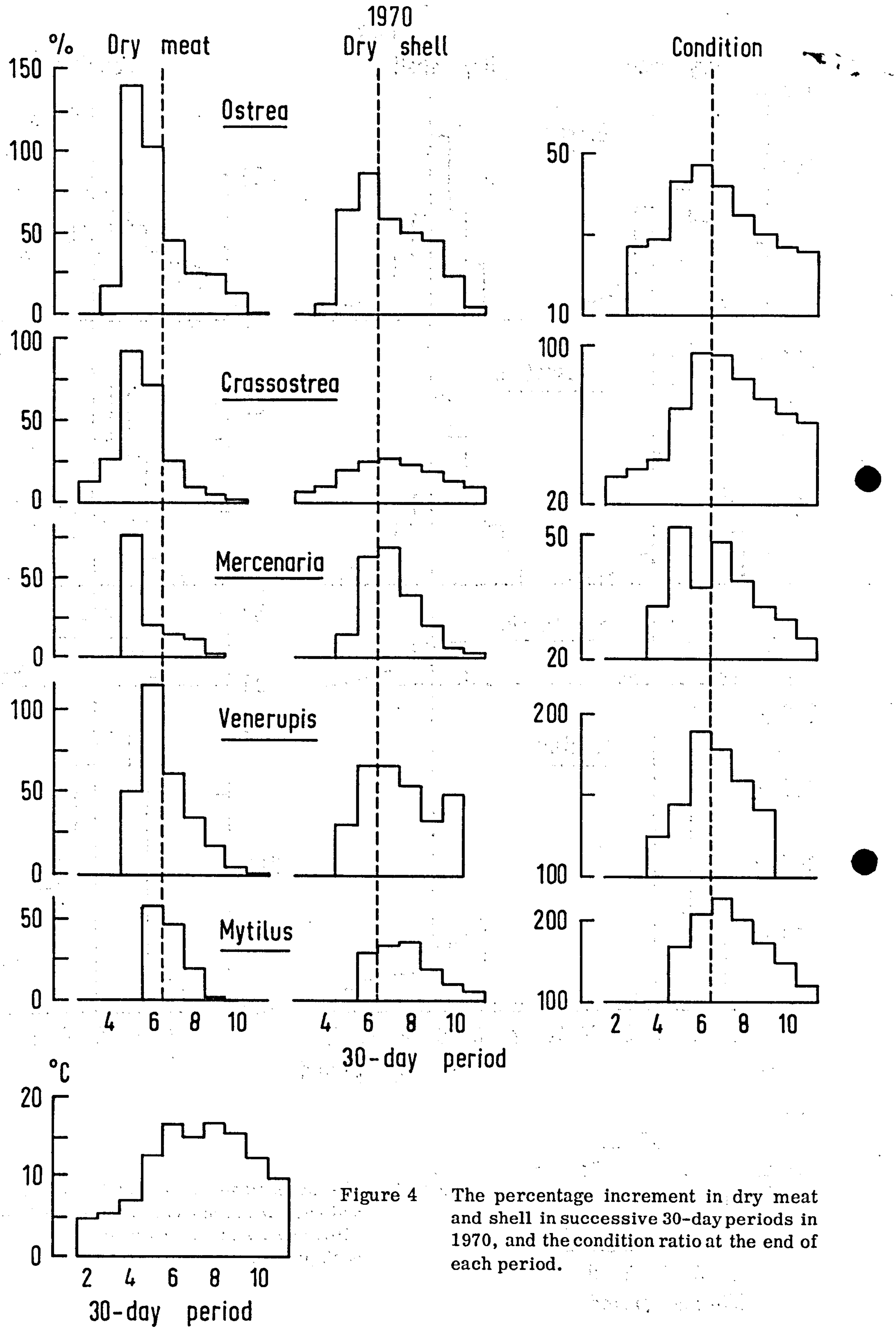


Figure 4 The percentage increment in dry meat and shell in successive 30-day periods in 1970, and the condition ratio at the end of each period.