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Sex Reversal in Ostrea virginica

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During the summer of 1932 the work on sex reversal in Ostrea virginica was continued. It was especially designed to show that oysters may change sex in either direction and to determine whether this change may be affected by the proximity of oysters of the opposite sex.

Sex ratios in oysters of known age.

Samples of oysters from the Totten bed, which was planted with spat in 1929, have been examined each year. In 1930 most of these oysters did not contain ripe sexual products but out of 167 oysters examined about 17% were male and 2% were female. In 1931 practically all were found to be mature although about 12% of the 500 oysters examined were not in such a condition that the sex could be determined. Still, of these 500 oysters, about 62% were male, 25% were female and 1% hermaphrodite. Now, in 1932 a sample of 157 oysters of this year-group were examined. Of these 68 (about 43%) were male and 84 (about 54%) were female. The sex could not be determined in 4% and one was a hermaphrodite. It is thus plainly shown that in these oysters of known age the sex ratio has been changing and the proportion of females to males has been increasing.

In 1930 a number of spat settled on the shells of these 1929 oysters. In 1932 a sample of 63 of these oysters was examined, and it was found that 54 (about 86%) were male, 3 (about 5%) were female, 1 was hermaphrodite and 5 were not determinable. This extraordinarily small proportion of females seems to suggest that the close proximity of the older females had prevented that swing in the

sex ratio which was taking place in the 1929 spat. But it was thought possible that the change might have been retarded by poor conditions due to growing in clusters. Accordingly oysters were taken from two other beds planted with spat in 1930. One of these beds, Cooper bed, is near the mouth of Bideford river where the water is colder and salter than it is near the station. Here, out of 87 oysters, 66 (about 76%) were male, 14 (about 16%) were female, 3 were hermaphrodite and 4 were indeterminable. The other bed, England's bed, is opposite the Biological station, where the water is slightly warmer than it is at Totten bed. Out of 100 oysters, 69 were male, 27 were female and 4 were indeterminable. Now, on these last two beds there were no older oysters and it can be seen that the proportion of males to females on England's bed is very similar to that found on Totten bed in 1931 and that it is somewhat higher on the Cooper bed. This is in accord with the general tendency for the swing from male to female to take place less rapidly in colder water. To check the effect of crowding the above oysters were all measured and compared with Totten bed oysters of the 1929 year-group gathered during the spawning season in 1931. The results are summarized in the following table.

	Totten bed.		England's bed.	Cooper bed.
	1929 spat in 1931.	1930 spat in 1932.	1930 spat in 1932	1930 spat in 1932.
Average length.	5.9 cm.	6.3 cm.	6.65 cm.	5.4 cm.
Growth in current yr.	0.9 cm.	0.62 cm.	1.2 cm.	0.47 cm.
Average width.	3.8 cm.	3.9 cm.	3.73 cm.	3.9 cm.
Average "area"	23.6	22.2	25.0	21.3

From this table it can be clearly seen that the 1930 spat are doing as well on the Totten bed in 1932 as is to be expected considering the temperature of the water - i.e. the rate of growth is between

those found on the Cooper bed and England's bed and not far behind that made by the 1929 spat on Totten bed in 1931. Since the rate of growth may be accepted as a good indication of the well-being of the oysters it may fairly be assumed that the 1930 spat on Totten bed are not living under very poor conditions in 1932, so that this cannot be accepted as an explanation of the high proportion of males to females. It becomes all the more probable that the close proximity of older females is the correct explanation.

Changes in oysters of known sex.

During the breeding season of 1931 the sex was determined in 260 oysters by boring a small hole in the shell of each and extracting a little of the contents of the gonad with a pipette. These operations did not, apparently, hurt the oysters which usually soon closed up the holes again. But there was no good place to put the wire baskets containing the oysters and the mortality was very heavy. In 1932 it was found that 202 of the bored oysters had died and 26 were not producing mature sexual products at the time of examination; of the remainder 21 were male in 1931 and 4 of these had become female in 1932, while 11 were female in 1931 and 5 had become male in 1932. It is noticeable that more oysters changed sex in the female to male direction which certainly does not seem to be the usual case in nature but it is suggested that the poor environment (as shown by a heavy mortality) is responsible for this state of affairs.

Lastly the sex was determined in about 250 oysters in the manner described above in 1932. Some of these were embedded in cement blocks in such a way that the valves could open and shut but the relative positions of the oysters were fixed. Others were placed in wire baskets with the sexes separated. In this way it is hoped to obtain experimental evidence on the influence of one sex on the other.

The baskets containing the oysters were kept suspended from the wharf during the summer and the mortality was very light so that it is hoped that some interesting results will be obtained when the oysters are examined in 1933.

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