PHYSIOLOGICAL CONSIDERATION CONCERNED WITH THE DISTRIBUTION PATTERNS OF OYSTER

BULLETIN OF THE MARINE BIOLOGICAL STATION OF ASAMUSHI,
VOL. IX, NO. 4. 1959

PHYSIOLOGICAL CONSIDERATION CONCERNED WITH THE DISTRIBUTION PATTERNS OF OYSTER

By

HIDEAKI SHINKAWA
新　川　英　明
Hiroshima Women's College, Hiroshima, Japan

(With 4 figures)

As was shown in the writer's previous report (Shinkawa, 1959), the vertical distribution of oysters is characteristic to each species, namely the distributing zone becomes low in the following order; that is *Crassostrea gigas*, *C. echinata*, *Ostrea circumpicta* and *O. denselamellosa*. It was also noted that in the intertidal zone the distributing zone of oysters (*C. gigas* and *C. echinata*) is lower in the estuary than that in the open sea. Fig. 1 shows the distribution patterns of oysters in Hiroshima Bay, which is general in Southern Japan.

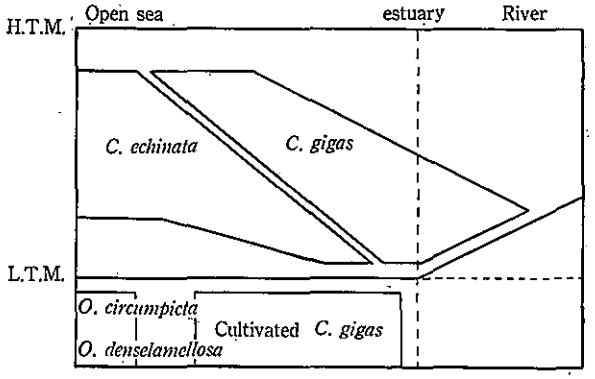

Fig. 1. The vertical distribution pattern of oysters in Hiroshima Bay.

Moreover, the distribution of oysters in a sunny place is different from that in a shady place. Namely though the lower limit of the distributing zone in a shady place is the same as that in a sunny place, the upper limit in the former is higher than that in the latter (Fig. 2).

As for the oysters in the sunny place, the mortality is higher in individuals which live in the high level of the distributing zone. These phenomena are more conspicuous in oysters living in the estuary than in the open sea.

Fig. 2. The difference of the distribution of oysters between the sunny and shady places.

From these observations, it may be suggested that two environmental factors, the concentration of sea water and the high temperature condition during the exposure to the air, are related to the oyster distribution.

In general it seems that the change in the distributing level from the open sea to the estuary is related to the concentration of sea water, and that the change in the vertical distribution in the same place is related to the temperature condition during the exposure to the air.

It is clear from the field observations that the concentration of sea water contained in the mantle cavity is higher in the oysters living in the open sea than in the estuary, and the temperature of the sea water in the mantle cavity is higher in the oysters occupying the high level than in those of the low level, and also that the exposure duration to high temperature is longer in oysters in the high level than in the low level.

Accordingly it seems that the specific character of tolerance of the oysters for the said two factors is one of the limiting factors which control the oyster distribution. Thus, at first, it is necessary that the tolerance for these factors is clarified from the physiological viewpoint.

The methods and results of the experiment with regard to the above mentioned are as follows. Six species of oysters were used for this experiment, and the tolerance of both heart and gill cilia with regard to the above two factors was measured by the following methods.

The relative value of the ciliary activity could be estimated by the writer's "fatty particle method" (Shinkawa, 1959). If a few drops of milk is dropped into the sea water containing a folded gill piece, many fatty particles become suspended to move on the surface of the gill piece by ciliary movement. Therefore the ciliary activity may be represented by the velocity of the said fatty particles. Here it is convenient to measure the said velocity by the fatty particles running along the filament which is at the fold of the gill piece. In the present study the velocity was represented by the moving time required for a distance of 1.35 mm of gill filament.

The relative tolerance of gill cilia for high temperature can be estimated by the following method. A thermo-regulated aquarium was used into which were put

small glass tubes including sea water of various concentrations. Some pieces of the oyster gills prepared for this experiment were put into each tube and at favourable times some of the pieces were taken out and the activity of the gill cilia was microscopically observed.

The activity of the oyster heart was investigated using sea water of various concentrations and under different temperature conditions, and the number of heart beats was observed through the openning made in the left valve.

1) The activity of the gill cilia of the oysters was examined in various concentrations of sea water under the same temperature condition. The activity decreases in diluted sea water and the concentration range showing the normal activity is characteristic to each species, as shown in Fig. 3.

As is shown in Fig. 3, the activity of the gill cilia in diluted sea water of the examined oyster species decreases in the following order; *Crassostrea rivularis*, *C. gigas*, *C. nippona*, *C. echinata*, *Ostrea circumpicta* and *O. denselamellosa*. This is parallel with their horizontal distribution from the estuary to the open sea.

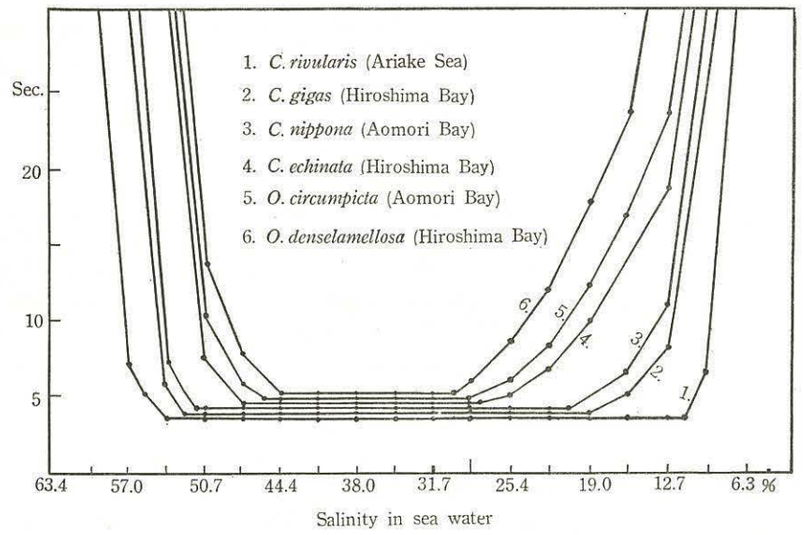

Fig. 3. The relation between the ciliary activity and the concentration of sea water using the oyster in the normal sea water. The time (sec.) shows the velocity of fatty particles running along the gill filament.

2) The tolerance of gill cilia for high temperature is higher in normal (32‰) and concentrated (35–51‰) sea water than in diluted sea water (28–3‰). This tolerance is also characteristic to each species, namely that of the species living at the low level (*O. circumpicta* and *O. denselamellosa*) is lower than the species at the high level (*C. echinata* and *C. gigas*).

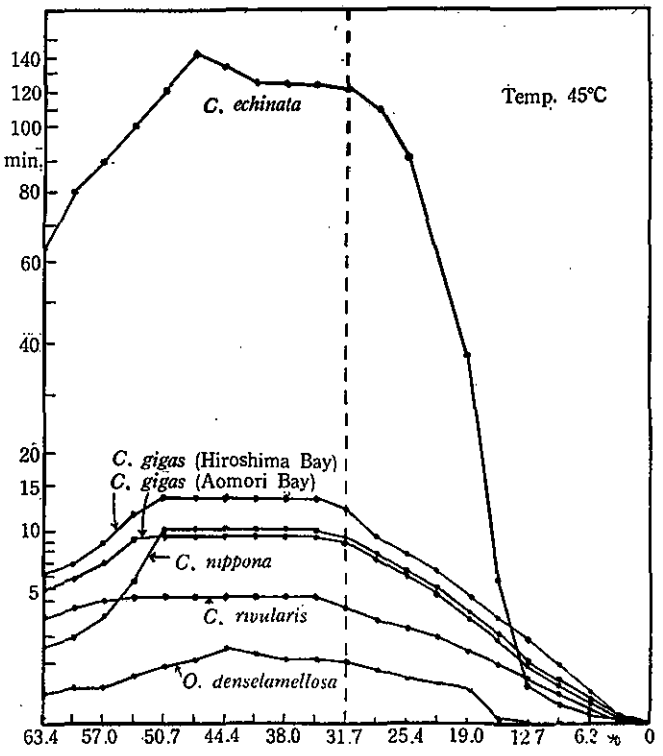

Fig. 4. The tolerance of gill cilia for high temperature in various concentrations of sea water. The lapse of time (min.) from the beginning of the experiment to the stopping of ciliary activity is given on the ordinate.

3) The above phenomenon (2) is also found in the experiment on the activity of the heart of the oyster, namely at high temperature condition, the activity of the heart stops earlier in diluted sea water than that in concentrated sea water, and the number of heart beats is more irregular in diluted sea water than in concentrated sea water.