RHYTHMS, FEEDING AND RESPIRATION OF THE OYSTER *CRASSOSTREA GIGAS*

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ABSTRACT

Endogeneity of valve movement rhythms was demonstrated for the Pacific oyster *Crassostrea gigas* under constant conditions of temperature, light, salinity, water level and food availability. Rhythms continued for up to 6 weeks until the experiments were terminated. The rhythms showed a high degree of temperature compensation between 13 - 24^{O}C, but at 4^{O}C the free-running period was abnormally long. The length of the "open", or active phase decreased with temperature. Oysters collected from subtidal sites, as opposed to intertidal sites, also exhibited endogenous rhythms when held under constant condition. Oysters that received no food during a starvation trial were also rhythmic.

Oysters subjected to artificial tidal cycles (HL 6:6h), show very precise synchronization of valve opening and closing to the cycles. Oysters were also be entrained to water disturbance cycles (6:6h) and light cycles (LD 12:12h), but the synchronization was not as precise.

Rhythms were characterized by (1) split rhythms (2) spontaneous changes in the free-running period (3) spontaneous changes in rhythm clarity (4) spontaneous phase changes (5) and a lot of "noise". These characteristics suggest that the underlying pacemaker controlling the rhythm may consist of more than one oscillator or more than one group of oscillators. No conclusive evidence could be found for semilunar or lunar rhythmicity.

Cycles in the rate of algal cell clearance over a 24h period were shown by individual oysters. As a consequence of the variability between individuals combining the data tended to hide the existence of the rhythms. No evidence for rhythms in assimilation efficiency was found. Cell clearance rates were also affected by rising temperature over the range 4 - 25^{o}C, reaching a peak value at 17^{o}C. The rate of cell clearance fell sharply after 60 - 90min of feeding in a closed system, indicating that the rate was significantly affected by the decline in food availability. The time taken to open the valves and to start faeces production fell with increasing temperature. The amount of faeces production followed a similar trend. Assimilation efficiency fell with increasing temperature and many negative values were evident, suggesting contamination. However the total weight of faeces produced was less than that of food available implying that the oysters were assimilating inorganic material. The time taken to open the valves and the % oysters that opened their valves was adversely affected by declining salinity over the range 8.5 - 34$^{o}/_{oo}$. The time taken to start faeces production and the % of oysters that produced faeces followed a similar trend. Assimilation efficiency was not significantly different at 25.5 and 34$^{o}/_{oo}$. AE% could not be measured at 8.5 and 17$^{o}/_{oo}$ due to a lack of normal faeces.

Individual oysters showed cycles in the rate of oxygen uptake, but these were not synchronized to the tides or to each other. Pooling the data to calculate means cancelled out the individual rhythmicities. The presence or absence of food did not affect the expression of the cycle. The rate of oxygen uptake was positively correlated to oyster dry weight, temperature and salinity. Though for salinity the rate of oxygen uptake fell sharply below a critical salinity occurring between 10 - $13^{o}/_{oo}$.

Oysters held in sealed respirometers maintained a constant rate of oxygen uptake until a critical level of oxygen availability was reached, the rate of oxygen uptake dropped significantly below this level. The slope of the regression lines ('b'), prior to reaching the critical oxygen level, increased with temperature, salinity and food concentration. But the time taken to reach the critical oxygen level, and the level of oxygen availability at which this occurred, was not significantly correlated with temperature, salinity or food concentration. The pattern of valve movement corresponded to the level of oxygen available. Valve movements became very frequent as the critical oxygen level was approached. Activity was reduced to occasional periods of valve movement after it was reached. The level of activity was adversely affected by declining salinity, but was not affected by the level of food availability.

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