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Hypoxic life of intertidal acorn barnacles

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Abstract:

Oxygen levels were monitored within the mantle cavities of three barnacle species (*Chthamalus stellatus*, *Semibalanus balanoides*, *Elminius modestus*), using optode microsensors. Conditions were always hypoxic, even when barnacles were actively using the prosoma and cirri to pump aerated seawater into the mantle cavity. Mantle fluid oxygen concentrations were extremely variable; behaviour and oxygen concentrations were not closely coupled. Ventilation of the mantle cavity depended partially on external water flow, with higher and more stable mantle fluid oxygen concentrations being sustained when the water around barnacles was agitated. During emersion, barnacles initially pumped seawater between the mantle cavity and the cone above the opercular plates to achieve ventilation. As water was lost it was replaced by air bubbles, eventually resulting in an air-filled mantle cavity. In *S. balanoides* and *E. modestus*, once the mantle cavity was filled with air, the barnacle usually used up the oxygen within the bubble within 2–3 h and did not regain oxic conditions until the barnacle was reimmersed in seawater. In *C. stellatus*, the air bubble was repeatedly refreshed for many hours by pneumostome formation. In response to low environmental salinity, all three species closed the opercular plates firmly and rapidly used up oxygen within the mantle fluid.