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Intragel oxygen promotes hypoxia tolerance of scyphomedusae

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Abstract:

Populations of jellyfish are known to thrive in many low oxygen environments, however, the physiological mechanisms that permit these organisms to live in hypoxia remain unknown. The oxyregulatory abilities of four species of scyphomedusae were investigated, and it was found that *Aurelia labiata*, *Phacellophora camtschatica*, *Cyanea capillata* and *Chrysaora quinquecirrha* maintain steady oxygen consumption to below 20 hPa oxygen(<10% air saturation). Oxygen content of the mesoglea of *A. labiata* was measured using a fibre optic oxygen optode and oxygen profiles through the gel are characterised by a gradient that decreases from just below normoxia at the aboral subsurface to ~85% air saturation near the subumbrellar musculature. This gradient sustains oxyregulation by scyphomedusae, and it is demonstrated that *A. labiata* must be using intragel oxygen to meet its metabolic needs. Gel can also be used as an oxygen reservoir when *A. labiata* moves into hypoxia. Gel oxygen is depleted after about 2 h in anoxia and recovers to 70% of normal after 2.5h in normoxia. Behaviour experiments in the laboratory showed that Aurelia labiata behaves similarly in normoxia and hypoxia (30% and 18% air saturation). The acute threshold for provoking behavioural changes in *A. labiata* is somewhere near its critical partial pressure, and oxygen stratification stimulates swimming back and forth across the oxycline. Intragel oxygen dynamics are recognised as a fundamental component of medusan physiology.

Key-words: Critical partial pressure, gel, hypoxia, jellfish, metabolic rate, oxyregulation, scyphomedusae