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Metabolic performance and survival of medusae in estuarine hypoxia

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Abstract:

Increasing eutrophication and hypoxia in marine environments appear to differentially promote the survival of some medusae species and the disappearance of others. To understand the physiological basis for this phenomenon, respiration rates and critical oxygen tensions (Pc) were measured for 12 species of medusae from Puget Sound (Washington State, USA). Mean mass-specific respiration rates ranged between 0.064 µmol O_2 g^{-1} h^{-1} for Aequorea victoria to 0.78 µmol O_2 g^{-1} h^{-1} for Cyanea capillata. Six of 12 species studied were oxyregulators; including the scyphomedusae Aurelia labiata, C. capillata, and Phacellophora camtschatica and the hydromedusae A. victoria, Polyorchis penicillatus, and Proboscidactyla flavicirrata. Mean P_cs ranged from 5.5 hPa in Muggiaea atlantica to 39.5 hPa in Euphysa flammea. The relationship between mass-specific metabolic rate and Pc was significant for oxyregulators but not oxyconformers. An apparent metabolic depression occurred variably within all oxyregulating species and 2 oxyconforming species, Clytia gregaria and Sarsia sp., whereby sub-P_c oxygen uptake decreased by 77 to 99% relative to standard aerobic metabolic rate (SMR). Anoxia survival varied from less than 2 h for E. flammea and Eutonina indicans to more than 10 h for A. victoria. The poor low oxygen tolerance of several Puget Sound species in our study was consistent with the historical disappearance of related species in the Adriatic Sea following increased frequency of dysaerobic events. Interspecies variation in aerobic metabolic characteristics and hypoxia and anoxia tolerance may explain why some medusae thrive in low-oxygen conditions, while others disappear.

Key-words: Medusae, oxyregulation, hypoxia tolerance, critical PO_2, hydromedusae, scyphomedusae