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Physiological adaptations to high intertidal life involve improved water conservation abilities and metabolic rate depression in *Littorina saxatilis*

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Abstract:

Mortality, rates of water loss, aerobic and anaerobic metabolic rates and changes in the parameters of cellular energy status were monitored in the intertidal gastropod *Littorina saxatilis* from different latitudes and shore levels during prolonged air exposure at elevated temperatures (30°C). Prolonged air exposure, imitating environmental conditions during summer low tide at high-shore levels, resulted in the onset of anaerobic metabolism, as indicated by the significant accumulation of succinate and alanine and a considerable depletion of high-energy phosphates (ATP and phospho-L-arginine, PLA). However, anaerobic metabolism accounted for only 1 to 2% of total ATP turnover in all groups, the remainder being supplied by aerobic metabolism. Snails from the White Sea population, which were more resistant to prolonged air exposure at 30°C than North Sea specimens, demonstrated higher anaerobic capacity and a depression of overall metabolic rate by ca 20% in air, whereas the less-resistant North Sea animals displayed very low anaerobic metabolic rates and elevated aerial oxygen consumption rates (110 to 125% of the rate observed in water). Within the White Sea population, high-shore periwinkles demonstrated higher resistance to prolonged air exposure than low-shore specimens associated with lower evaporation water loss, reduced rates of anaerobic ATP turnover, higher stores of L-aspartate and lower defended values of ATP and PLA. In contrast, no differences were found between high- and low shore snails in the North Sea. This may reflect environmental conditions at the 2 study sites, with stronger contrasts between high- and low-shore habitats in the White Sea than in the North Sea. In general, our data show that adaptation to prolonged air exposure at elevated temperatures, which may occur at high-shore levels during summer low tide, does not necessarily involve increased anaerobic capacity in *L. saxatilis*. Instead, enhanced abilities for water conservation and metabolic rate depression combined with increased stores of fermentable substrate seem to be crucial for survival during prolonged periods of emersion.

Key-words: Intertidal, air exposure, anaerobiosis, respiration, water loss, metabolic rate; littorina saxatilis