

THE RESPIRATORY PHYSIOLOGY AND ENERGY METABOLISM OF
FRESHWATER MUSSELS AND THEIR RESPONSES TO LACK OF OXYGEN

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(ABSTRACT)

Understanding the respiratory physiology and energy metabolism is important for establishing the dissolved oxygen (DO) requirements of freshwater mussels, determining the metabolite(s) indicative of environmental stress, and interpreting environmental conditions based on physiological indicators of mussels. Three studies were undertaken to address these questions. The first study was conducted with seven mussel species collected from reservoir and riverine habitats. The two objectives were to determine the diurnal patterns of valve gaping of freshwater mussels from different habitats, and to monitor heart rate changes of a mussel species that exhibited the diurnal gaping. The results showed that night gaping is evident for the mussels collected from lentic areas, but not for those collected from lotic areas. The heart rate of *Pyganodon grandis* increased when they gaped. The second study was conducted with nine species of freshwater mussels from different habitats. The three objectives were to determine the patterns (i.e., regulator and conformer) of oxygen consumption (OC) rate under declining DO, evaluate the effects of temperature on ability to regulate OC under declining DO, and finally to use this

information to predict DO criteria for maintaining freshwater mussels in captivity. The results showed that mussels living in the habitats subjected to low DO have a better ability to regulate the OC and were more tolerant to hypoxia. The third study assessed three mussel species from different habitats with different abilities to regulate OC under low DO. The two objectives in this study were to identify the energetic metabolite changes under different DO levels and air exposure for the three species, and to determine the appropriate tissue(s) and metabolite(s) to use for estimating the stress in mussels. The results showed that different biochemical strategies were used by *Villosa iris*, *Elliptio complanata*, and *Pyganodon grandis*. *Villosa iris* had the lowest anaerobic capacity. *Elliptio complanata* had a more efficient anaerobic metabolism, and *P. grandis* reduced energy metabolism under low DO and air exposure. Posterior adductor muscle, gill and mantle were good tissues for evaluating hypoxic stress. The mantle tissue had the highest glycogen store and was the best tissue for non-lethal study of physiological condition.