THERMAL TOLERANCES OF FRESHWATER MUSSELS AND THEIR HOST FISHES: SPECIES INTERACTIONS IN A CHANGING CLIMATE

Tamara J. Pandolfo
North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, Campus Box 7617, North Carolina State University, Raleigh, NC 27695 U.S.A.
email: tjpandol@ncsu.edu
Thomas J. Kwak
U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, Campus Box 7617, North Carolina State University, Raleigh, NC 27695 U.S.A.
W. Gregory Cope
Department of Environmental and Molecular Toxicology, Campus Box 7633, North Carolina State University, Raleigh, NC 27695 U.S.A.

ABSTRACT
Rising environmental temperatures result from changes in land use and global climate and can cause significant shifts in the composition and distribution of species within communities. In freshwater systems, the larval life stage, glochidia, of Unionida mussels develops as an obligate parasite on host fish gills or fins before transforming into the juvenile stage and dropping to the sediment to complete the life cycle. Because of the relationship between freshwater mussels and their often specific host fish species, mussels are not only limited by their own variable thermal tolerances, but also by those of their host fish. Our intent was to compile data from available literature regarding thermal sensitivities of eight species of freshwater mussels and their host fishes, to determine if the community structure of these systems is at risk from rising environmental temperatures. Mussels were both more and less thermally sensitive than specific host fish species (2.9 ºC mean absolute difference between mussel and host; range = 0 – 6.8 ºC). In 62% of mussel-host fish comparisons, freshwater mussels were more thermally tolerant than their hosts (3.4 ºC mean difference; range = 0.2 – 6.8 ºC), suggesting that some mussels are effectively more stenothermic than tolerance criteria indicate, which may pose additional environmental risk. Further analysis revealed that variation in mussel thermal tolerance could not be attributed to mussel acclimation temperature, species, life stage, or mean host fish thermal tolerance, suggesting that mussel thermal tolerance is controlled by multiple interacting and complex factors. Our findings in this meta-analysis suggest that thermal effects of anthropogenic landscape alteration and climate change may be compounded for freshwater mussels via their obligate life cycle interaction with fish and highlight the importance of considering global change effects in a community context.

KEY WORDS Host fish, Stream community, Thermal tolerance, Unionidae