ABSTRACT

Author:	Mia Forgione
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Thesis Advisor:	Steven Brady
Department:	Department of Biology and Honors College
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As the network of roadways throughout the United States has grown, so too has the amount of salt used to de-ice this network in winter. The resulting accumulation of salt in road-adjacent environments has many consequences for amphibian populations that rely on aquatic roadside habitats. Critically, effects of salt exposure in amphibian embryos and larvae – such as reduced survival and slowed development – have the potential to induce contemporary evolutionary changes in road-adjacent populations. Previous studies have found contrasting evidence for local adaptation and local maladaptation to road-adjacency in populations of the wood frog (Rana sylvatica), a pool-breeding amphibian found throughout much of the United States, including areas where de-icing is common. Here, to advance a more complete understanding of local (mal)adaptation patterns in road-adjacent wood frog populations relative to populations from unpolluted ponds, we tracked individual-level survival and development of 818 wood frog embryos to metamorphosis in response to four concentrations of salt. Specifically, we compared the effect of salt exposure on overall survival to metamorphosis, developmental stage-specific mortality, and developmental rate between wood frog embryos from five roadside and six woodland populations. We found that salt decreased survival to metamorphosis for all populations, but survival was notably lower for individuals originating from roadside populations than woodland populations. We further found that sensitivity to salt varied between life history stages for roadside populations, with embryos being most sensitive. We also found that salt slowed developmental rate to metamorphosis for all populations, but that roadside individuals showed notably slower development than woodland individuals. These results show for first time that aquatic-stage wood frogs from roadside populations bear a survival and development disadvantage to salt compared to their woodland counterparts throughout the entirety of aquatic development. Critically, our results also reveal that life stages prior to hatching are responsible for this survival disadvantage.