Drivers of thermal regimes in Atlantic salmon (*Salmo salar*) watersheds

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Atlantic salmon (*Salmo salar*) populations continue to experience significant declines across the North Atlantic due to myriad factors including acidification, invasive species, and warming waters related to climate change. Temperature is a key habitat metric for salmonids but the underlying factors that drive riverine thermal regimes, and the fine-scale thermal suitability of ecologically significant salmon watersheds in the province of Nova Scotia, Canada, remain largely unknown. Here, we combined field data with a machine-learning approach to: (i) identify the main environmental factors driving riverine thermal variability in two large watersheds in the Nova Scotia Southern Uplands region; and (ii) examine thermal habitat suitability for Atlantic salmon in the ~2313 km of river networks that comprise the studied watersheds. We found that riparian forest cover, landscape forest cover, and elevation had a significant cooling influence on water temperature, whereas slope, wetlands, and developed areas had a warming effect. Our predictions and thermal suitability maps suggest that 55% (~666 km) of the LaHave River (1214 km) and 22% (~235 km) of the St. Mary's River (1072 km) are predicted to have stressful average temperatures for adults during summer. Daily maximum temperature exceeded 20°C for more than 40% of the study period in 89% (~ 1084 km) of LaHave River, and 84% (~903 km) of St. Mary's River. Daily maximum temperature exceeded 23°C over 40% of the study period in 26% (~318 km) of LaHave River, and 10% (~110 km) of St. Mary's River. Significant reaches of both river networks are approaching stressful conditions for adult Atlantic salmon in the warmer months, whereas thermal conditions are more tolerable for juveniles. Such scenarios underscore the importance of protecting high-quality habitats and thermal refugia, without which salmon populations in this region are unlikely to recover.

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