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Notice of University Oral Examination
Master of Science in Engineering

Characterizing Thermal Refugia for Brook Trout (Salvelinus fontinalis) and Atlantic Salmon (Salmo salar) in the Cains River, New Brunswick, Canada

Nathan Wilbur

DATE: **Tuesday, January 3, 2012**
TIME: **10:00 am**
LOCATION: **TME Room, H224**

A pdf of the thesis is available in the CE Office

Examining Committee

Chairperson:	Dr. Eric Hildebrand
Supervisor:	Dr. Kerry MacQuarrie
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ABSTRACT: Anthropogenic influences and climate change are warming rivers in New Brunswick and threatening the cold water habitats of native salmonids. When ambient river temperatures in summer exceed the tolerance level of Atlantic salmon and brook trout, thermoregulation forces fish to seek out and become restricted to cold water refugia. These critical thermal habitats are often created by tributaries and concentrated groundwater discharge. Thermal infrared imagery was used to map cold water anomalies along a 53 km reach of the Cains River on 23 July 2008. Although efficient and useful for mapping surface temperature of a continuous stream reach, the fish did not use all identified thermal anomalies as refugia. Overall, 100 % of observed large brook trout >35 cm in length were found in 30 % of the TIR-mapped cold water anomalies. Ninety eight percent of observed small brook trout 8 – 30 cm in length were found in 80 % of the mapped cold water anomalies and their densities within anomalies were significantly higher than densities not in anomalies. Fifty nine percent of observed salmon parr were found in 65 % of the mapped anomalies; however, they were dispersed within study sites and their densities were not significantly different within anomalies compared to outside of the anomalies. No brook trout were observed at the seven non-cold water study sites that were investigated. Preference curves for habitat variables velocity, temperature, depth, substrate, and deep water availability near cold water anomalies were developed based on field investigations during high temperature events (ambient river temperature >21 ^{o}C). Small brook trout preferred water velocities in the range of 0.1 – 0.2 m/s, local water temperatures of 14 – 17 ^{o}C, water depths of 65 – 85 cm and 25 – 45 cm, and had highest preferences for silt and boulder sized substrate. Large brook trout preferred velocities of 0.1 – 0.2 m/s, local water temperatures of 14 – 17 ^{o}C, water depths of 45 – 65 cm, and had highest preferences for gravel, cobble, and boulder substrate. Atlantic salmon parr >8 cm in length preferred velocities of 0.8 – 0.9 m/s, local water temperatures of 20 – 23 ^{o}C, water depths of 25 – 45 cm, and highest substrate preferences for sand and boulder. Salmon parr and small brook trout had no particular preference for deep water near cold water anomalies; however, large brook trout were not found unless water at least 60 – 70 cm in depth, and optimally 70 – 90 cm deep was available within or adjacent to cold water anomalies. Both brook trout and juvenile salmon used a broad range of substrate, primarily ranging from sand to boulder size. Combined with thermal imagery, managers can use the preference curves developed here as a tool to help conserve and restore critical thermal refugia for Atlantic salmon and brook trout on the Cains River, and potentially similar river systems.