

Thermal profile of Margaree River in 2025

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Rationale

The aim of this report is to provide a thermal variability profile of the Margaree River to identify potential warm, stressful areas as well as cold-water areas that could serve as candidates for cold-water refugia at the watershed level.

Methodology

Between June and September 2025, the Margaree Salmon Association recorded water temperature at 31 sites across the watershed (Figure 1). At each site, the HOBO logger was deployed, and temperature was recorded every 15 minutes.

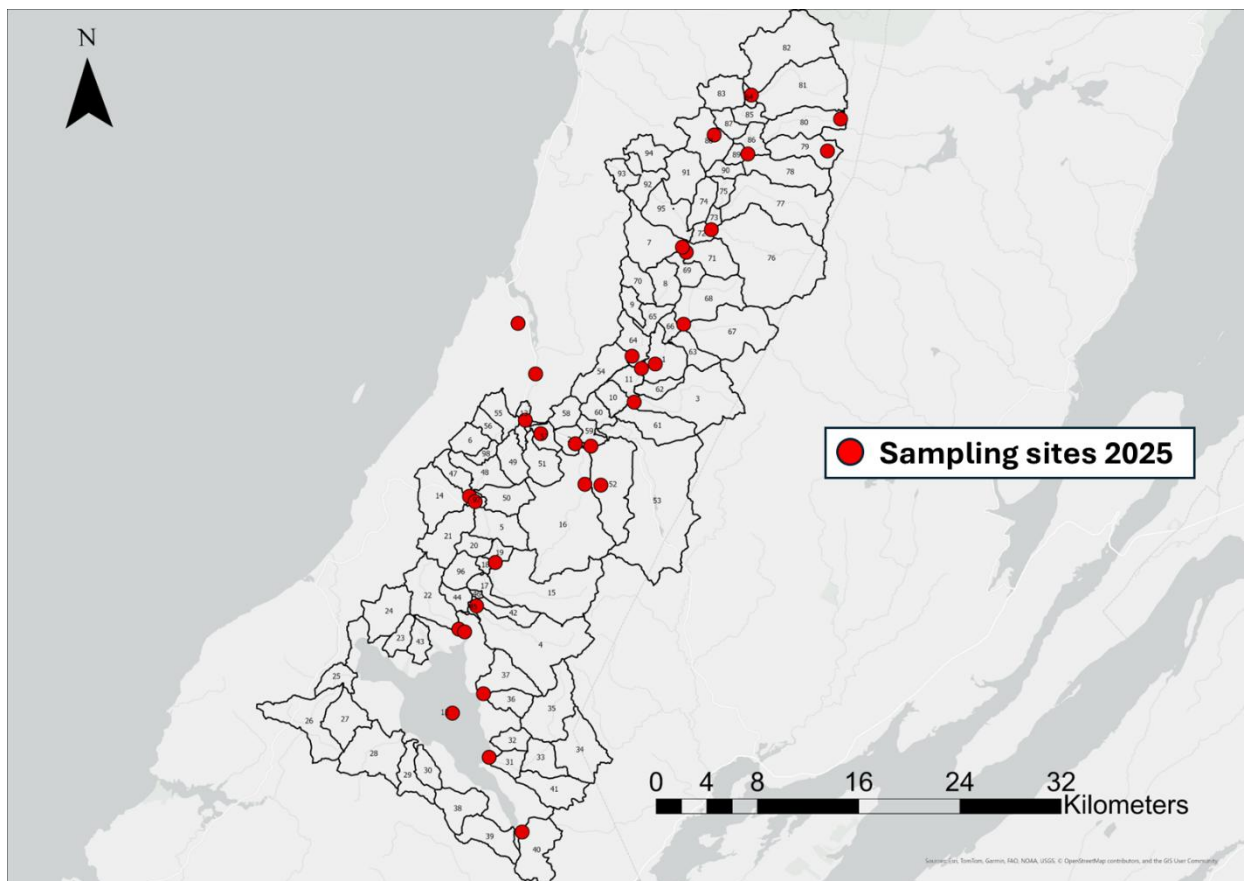


Figure 1. Red dots indicate the location of the sampling sites where temperature dataloggers were deployed across Margaree River watershed.

The temperature data were then used to predict thermal variability across the entire watershed using machine learning models. For this analysis, we calculated the average temperature between July 1 and August 31 to focus on the hottest period of the summer season. We also calculated the proportion of days when the maximum temperature exceeded 20 °C, which is considered stressful for adult Atlantic salmon.

Results

The machine learning models produced robust predictions, with small errors of 1 °C for average temperature and 0.14 days for the proportion of days with maximum temperature above 20 °C (Figure 2).

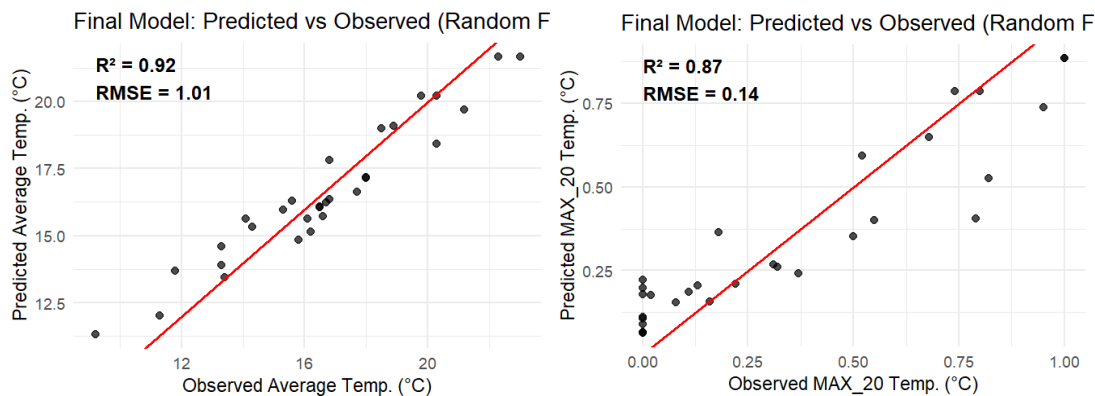


Figure 2: Observed versus predicted stream water temperature parameters from the final Random Forest model trained on all observed sites within Margaree River watershed. The red 1:1 line indicates perfect agreement, while the fitted points illustrate overall model accuracy.

Areas with high riparian forest cover, steep slopes, higher elevation, and greater wetland cover exhibited the coolest temperatures, whereas areas with extensive agricultural land and built-up areas showed a warming effect, with maximum temperatures exceeding 20 °C on more than 60% of the days between July 1 and August 31. A higher proportion of imperfectly drained soils also contributed to warmer water temperatures. Lake Ainslie exhibited the highest temperatures, with an average of 23 °C (Figures 3 and 4).

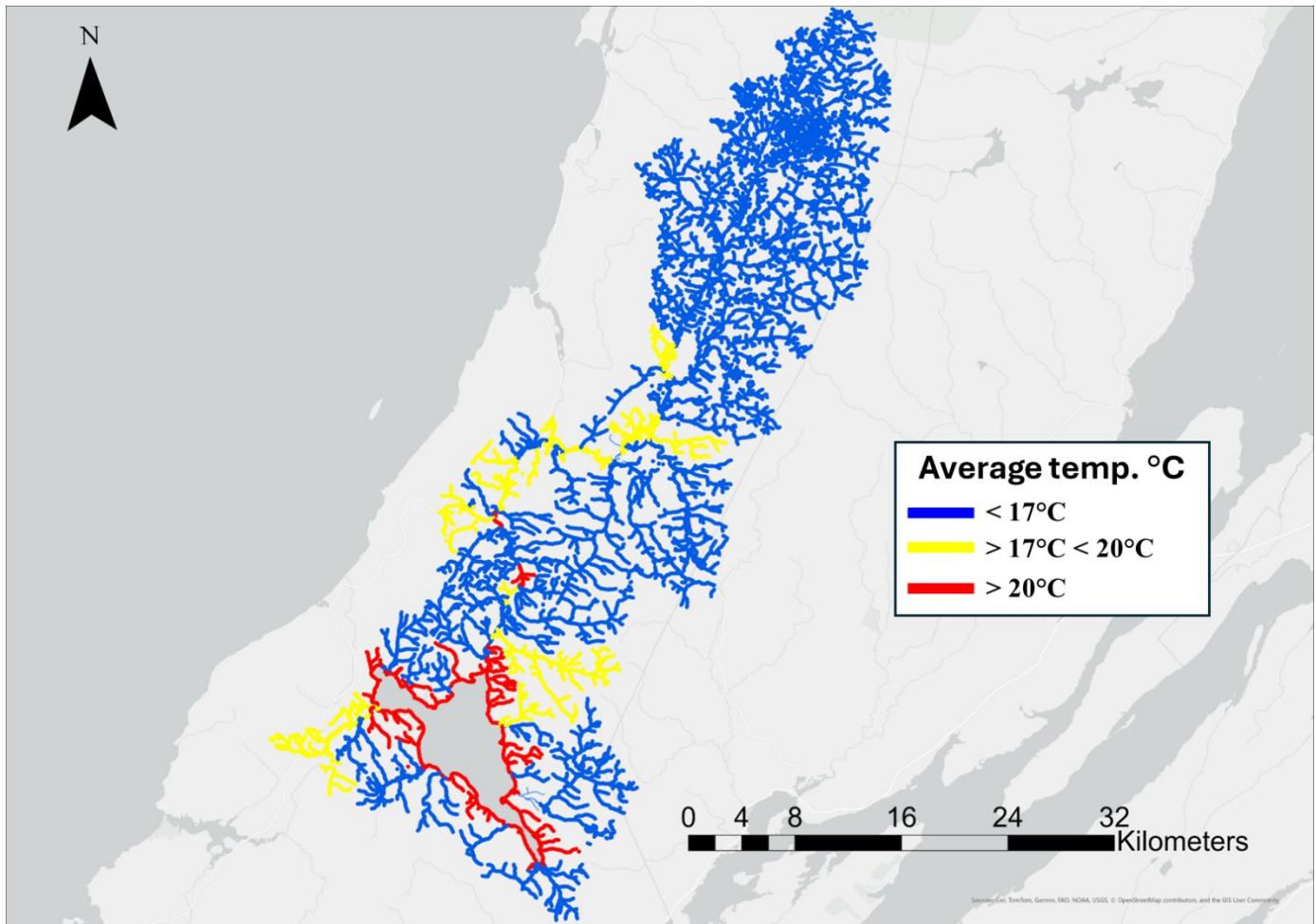


Figure 3. Thermal suitability map for adult Atlantic Salmon within Margaree River based on average temperature. River channels in blue excellent thermal conditions with average temperature below 17°C, channels in yellow indicate suitable waters but not ideal, and channels in red indicate stressful thermal conditions with average temperature above 20°C.

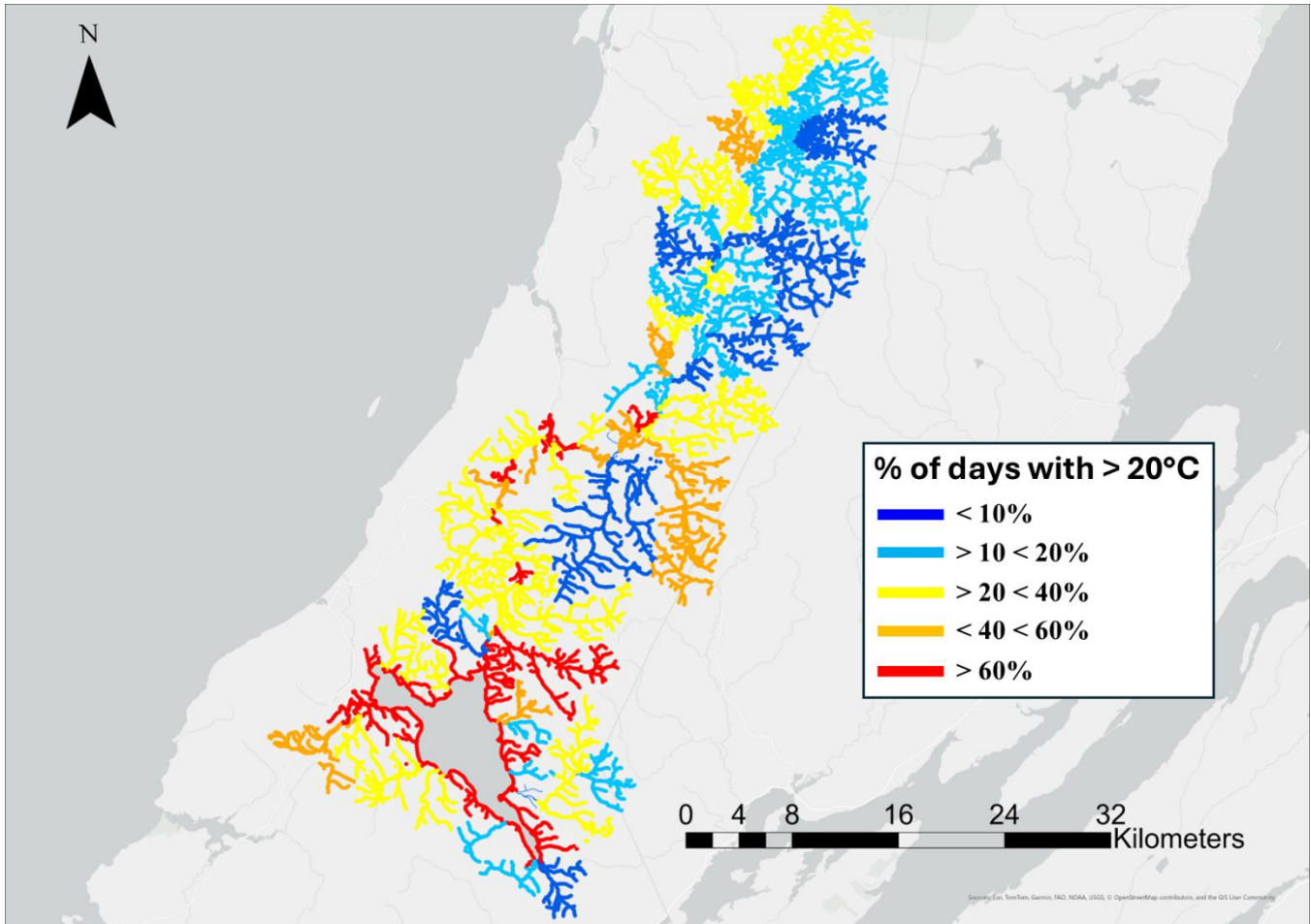


Figure 3. Thermal suitability map for adult Atlantic Salmon within the Margaree River based on the proportion of days when the maximum temperature exceeded 20 °C. River channels in dark blue represent excellent thermal conditions, with maximum temperatures exceeding 20 °C on less than 10% of the sampling period. Channels in light blue indicate good conditions, yellow represents suitable but suboptimal conditions, orange indicates stressful conditions, and red denotes unsuitable conditions, with maximum temperatures exceeding 20 °C on more than 60% of the sampling period.



Discussion and recommendations

These results indicate that tributaries with high riparian forest cover in high-elevation headwaters highlighted in blue are priority areas for protection, as they contribute significantly to maintaining cold-water inputs within the system. Tributaries highlighted in yellow should be prioritised for restoration actions. Among restoration actions we highlight the importance of tree planting in riparian zones, as this is the most effective strategy to build resilience against climate change and rising water temperatures. Tree planting in heavily agricultural areas is particularly beneficial—not only for shading the water, but also for reducing the runoff of agrochemicals, especially pesticides known for their toxicity to aquatic wildlife and their negative effects on water quality (Willis & McDowell, 1982; Brausch & Smith, 2015; Ahmed et al., 2022; Chen et al., 2023; Zhao et al., 2024). Riparian tree planting also stabilizes riverbanks and reduces erosion (Abernethy & Rutherford, 2000; Simon & Collison, 2002). Additional benefits include improved sediment filtration by root systems (Lowrance et al., 1984; Polyakov et al., 2005), enhanced habitat complexity through the input of large woody debris and organic matter (Gregory et al., 1991; Wohl et al., 2019), increased nutrient uptake that helps mitigate eutrophication (Mayer et al., 2007; Vidon et al., 2010), greater flood attenuation through slowed runoff and increased infiltration (Tabacchi et al., 2000; Dixon et al., 2016), and the creation of biodiverse habitat corridors that support both aquatic and terrestrial species (Naiman et al., 2005; Sweeney et al., 2004).

We recommend planting larger native trees, between 2–4 meters in height, combining fast-growing pioneers (e.g., Alder, Balsam Poplar, Red Maple, Trembling Aspen) with slow-growing, long-lived species (e.g., Eastern Hemlock, Yellow Birch, Sugar Maple). The fast-growing pioneers provide immediate shade and stabilize soils, while the long-lived species ensure long-term resilience and thermal regulation. Planting larger trees accelerates the regeneration process and increases survival rates in restoration projects. Considering the more frequent droughts associated with climate change, attention to site preparation will improve success rates. For example, some jurisdictions utilize superabsorbent hydrogel (SAH) to the soil that can substantially reduce tree mortality without the need for constant watering.

Protection and restoration of habitat conditions in cool water tributaries remains a priority to optimize ecosystem resilience, and salmon and trout rearing habitats.



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