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# Effects of forest harvesting on summer stream temperatures in New Brunswick, Canada: an inter-catchment, multiple-year comparison

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Abstract. This paper presents a pre- and post-harvest comparison of stream temperatures collected in five neighbouring streams (sub-catchments) over a period of five years (1994-1998). The aim of the study was to determine whether land cover changes from clear cutting in areas outside forest buffer zones (applied to streams >0.5 m wide) might contribute to an increase in summer mean stream temperatures in buffered streams downslope by infusion of warmed surface and sub-surface water into the streams. Specific relationships were observed in all five forest streams investigated. To assist in the analysis, several spatially-relevant variables, such as land cover change, mid-summer potential solar radiation, flow accumulation, stream location and slope of the land were determined, in part, from existing aerial photographs, GIS-archived forest inventory data and a digital terrain model of the study area. Spatial calculations of insolation levels for July 15$^{th}$ were used as an index of mid-summer solar heating across sub-catchments. Analysis indicated that prior to the 1995 harvest, differences in stream temperature could be attributed to *(i)* topographic position and catchment-to-sun orientation, *(ii)* the level of cutting that occurred in the upper catchment prior to the start of the study, and *(iii)* the average slope within harvested areas. Compared to the pre-harvest mean stream temperatures in 1994, mean temperatures in the three streams downslope from the 1995 harvest areas increased by 0.3 to 0.7°C (representing a 4-8% increase; p-value of normalised temperatures $<<0.05$). The greatest temperature change occurred in the stream that had the greatest proportion of its upper catchment harvested (16.8%), which also had the highest calculated potential solar loading ( ~2749 MJ per stream cell). From the analysis it was determined that the thinning applied to the forest buffer of that stream, with a basal area removal of ~28%, was insufficient to cause significant change in the observed stream temperature. Similar effects were observed following a second harvest in 1997. In general, increases in mean stream temperature coincided with forest harvesting activities outside forest buffers, where conditions promoting stream warming were greatest. In this study, no clear relationship existed between forest buffer strip width (ranging from 30-60 m) and the level of stream warming observed at the monitoring stations.

Keywords: terrain attributes, solar radiation, land cover, forest buffers,

New Brunswick regulations, spatial modelling, DEM, forest covertypes

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