Nutrient and organic carbon dynamics of a boreal hydroelectric reservoir complex over the initial years after flooding

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Reservoir construction can fundamentally alter the transport and export of nutrients and organic matter by rivers to coastal areas. Here we present a 9-year study of the La Romaine Hydroelectric Reservoir Complex, composed of four cascading reservoirs that were sequentially commissioned over 7 years, in Boreal Québec that flows into the St. Lawrence Estuary. We followed the longitudinal and temporal patterns in concentrations of total nitrogen (TN), total phosphorous (TP), dissolved organic carbon (DOC), and particulate organic matter (POM) as well as stoichiometric ratios (C:N, N:P, C:P) within the La Romaine River above, the four reservoirs, and downriver into the estuary. TN varied greatly within the reservoirs, suggesting active transformation and processing, and slightly increased from upriver to the bottom most reservoir but declined downriver. TP in contrast, consistently increased longitudinally suggesting that these young boreal reservoirs remobilise terrestrial P and are net exporters of P in the early stages of reservoir flooding. DOC was relatively constant between the river and the complex, suggesting no net change despite evidence of intense C processing within the reservoirs. POM declined through the complex suggesting that the cascading reservoirs act as POM traps up to the bottom most reservoir that was a new source of POM but did not export POM to the river. Stoichiometric ratios of N:P and C:P tended to decline from upriver through the reservoirs and downriver, as this are heavily influence by the longitudinal increases in TP while C:N ratios remained almost constant throughout the complex likely due to the little changes observed in DOC. Although the reservoirs were influenced by their upstream conditions, each had their own distinct nutrient and C dynamics, likely influenced by morphometry, residence time, and pre-flood landscape. Additionally, the bottom most reservoir plays an important role as the modulator in exports to the La Romaine River and St Lawrence estuary. The cumulative effect of the complex as a whole shifted in time, becoming less of a source of nutrients and POM relative to the pre-flood river as it ages.