



Forest clear-cut effects on greenhouse gas emissions from boreal inland waters – Insights from experiments and surveys

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Forest clear-cuts generally result in an increased export of carbon and nitrogen to downstream aquatic systems. These losses affect the greenhouse gas budget of managed forests. However, it is unknown if they modify greenhouse gas emissions of recipient aquatic systems. To address this question, we combined insights from whole-catchment experiments and lake surveys in boreal Sweden. Firstly, we assessed local-scale short-term effects using a four-year Before/After-Control/Impact-experiment in four headwater catchments. Here, we estimated air-water fluxes of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), combining concentration, ebullition and gas-transfer velocity measurements in hillslope groundwater, along stream transects and at multiple locations in lakes. Secondly, we assessed broad-scale steady state effects using Swedish national lake monitoring data from a wet and a dry year. Here, we related CO₂ concentrations in 439 forest lakes to the areal proportion of catchment forest clear-cuts. We found that aquatic greenhouse gas emissions did not respond to experimental forest clear-cuts. Importantly, riparian zones likely buffered clear-cut-induced increases in groundwater CO₂ and CH₄ concentrations. Experimental results were partly confirmed by monitoring data that showed no relationship between CO₂ patterns across lakes and clear-cut gradients in both wet and dry years. Conclusively, forest clear-cuts in the boreal zone are unlikely to have major direct effects on headwater greenhouse gas emissions over short time-frames. However, potential system- and scale specific or indirect long-term effects cannot be excluded.