



Effects of helicopter liming on stream water chemistry in an experimental catchment in Nova Scotia, Canada

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Terrestrial application of limestone via helicopter (helicopter liming) is a freshwater acidification mitigation technique which has been successfully used in European countries like Sweden and Norway to increase stream pH and decrease dissolved aluminum levels (Al) (Andersson, 1995; Fransman & Nihlgård, 1995), producing long term water quality improvements (Hindar et al., 2003; Traaen, et al., 1997). Despite the observed successes of helicopter liming in prior studies, very little liming research and efforts have been conducted in Canada, and specifically, Nova Scotia (Halfyard, 2003; Sterling et al., 2014). Therefore, freshwater response to terrestrial liming is poorly understood within the province and Canada (Dennis et al., 2012; Macleod, 2016; Sterling, et al., 2014). This research aimed to evaluate the effectiveness of helicopter liming, which is novel to Canada, at mitigating freshwater acidification in the chronically acidified Keef Brook catchment in Nova Scotia. This observational study documented and quantified the changes caused by helicopter liming conducted by the Nova Scotia Salmon Association, where dolomitic limestone (CaMgCO_3) was applied to the riparian zone of the Colwell Creek and MacGregor Brook subcatchments of the Keef Brook watershed. Lime was applied at a concentration of 10 t/ha on land, and at 2 t/ha on lakes and ponds. Preliminary statistical analysis in R statistical programme indicate that water quality was significantly improved post treatment in one treatment site (increased pH: $p = 0.024$, and decreased Al: $p = 0.002$), and improved without significance in the other (increased pH: $p = 0.483$, and decreased Al: $p = 0.145$), while water quality continued to worsen at both control sites (decreased pH: $p = 0.002$, increased Al: $p = 0.065$, and decreased pH: $p = 0.266$, increased Al: $p = 0.462$, respectively). The significant improvements of water chemistry following helicopter liming, especially considering the continued degrading of water quality at the control sites during the same time period, indicate that helicopter liming could be an effective method to mitigate chronic freshwater acidification, increase freshwater habitat productivity, and increase the chemical habitat suitability for the endangered Atlantic salmon subpopulations in Nova Scotia.