Natural Resources Canada | Ressources naturelles Canada

Bulletin 56

FRONTLINE EXPRESS

Canadian Forest Service – Great Lakes Forestry Centre

The effects of logging in riparian areas

INTRODUCTION

Riparian zones, the areas adjacent to water bodies, are treated with special consideration during forestry activities because of their important role in protecting aquatic ecosystems. The vegetation in these zones provides important wildlife habitat for both terrestrial and semi-aquatic organisms, helps regulate water flow and nutrient cycling, and protects water quality.

Figure 1. Aerial view of uncut riparian buffers

Until recently, most forest management prescriptions included a no-cut zone around water bodies (Figure 1) so that riparian areas could act as buffers during logging operations, preventing excessive biomass and sediment from reaching these sensitive areas. However, in many regions the landscape is now characterized by strips of uncut patches along streams and around lakes, creating unnatural patterns. Current management prescriptions seek to emulate natural disturbances across the landscape; these patches of older, uncut forest do not fit with this concept. Fire is the most common natural disturbance in the boreal forest and it does not leave riparian zones untouched, although fires tend to burn less intensely and more patchily in these areas, leaving some residual overstorey and gaps of various sizes.

For this reason, alternative riparian zone management options are being considered, including the possibility of partial harvesting. Studies are being conducted to examine the ecological effects and economic feasibility of partially logging riparian areas, with the goal of providing sound data on which to base policy decisions regarding this issue and to increase our understanding of both terrestrial and aquatic ecosystem response to disturbance.

GREAT LAKES FORESTRY CENTRE (GLFC) RESEARCH

While it is known that emulation of natural disturbances can lead to habitat complexity and long-term stability for the boreal forest, less is understood about the changes riparian areas and streams undergo as a result of these disturbances and whether these changes lead to long-term stability for aquatic ecosystems. Consequently, scientists with the Ecosystem Impact group at GLFC have been studying the effects of various forest management practices on aquatic ecosystems for a number of years. This work is currently focused on a large-scale study established in 2003 in the White River area. The White River Riparian Harvesting Impacts Project examines the environmental effects of partial harvesting in riparian zones in a boreal mixedwood forest. Since its establishment, scientists have been studying ecosystem impacts and have monitored species diversity and abundance to improve their understanding of the role of disturbances in regulating and sustaining aquatic ecosystems.

The study uses partial harvesting as a way to create gaps that are conducive to the growth of early-successional vegetation and thus emulate more closely patterns of natural disturbance across the landscape. The study area consists of six blocks, each on a separate watershed. Three of the sites were not logged and served as reference areas. The other three sites contained harvest blocks where the upland areas were clearcut and the riparian buffers were partially harvested. The logging prescription was to remove up to 50% of merchantable trees in accessible portions of the riparian buffers and resulted in 10%, 21% and 28% of the average basal area being removed. Logging took place in 2003 and 2004 during the winter months to minimize ground disturbance. Monitoring and data collection were carried out before and after logging. Studies have been examining the effects of partial logging on aquatic invertebrate populations, stream sedimentation and temperature responses, as well as the economic and operational feasibility of logging in riparian areas. The results to date from these studies are summarized here.

Effects on aquatic invertebrates

Leaf litter breakdown, an indicator of stream health, and associated aquatic invertebrates were measured in streams in the unlogged and partially logged riparian areas 2-3 years before and 3-4 years after logging. Results showed that while leaf litter breakdown rates varied from year to year, there was no difference in the rates between logged and unlogged areas. At the site with the lowest intensity of riparian logging, differences in the aquatic invertebrate community were noted, with some species increasing in number and others decreasing. These differences were attributable to the higher proportion of the watershed being clearcut, which in this study block was 85% of the upland watershed area harvested. The conclusion of this study was that partial harvesting of up to 50% removal in riparian areas is unlikely to harm leaf litter breakdown processes or have effects on aquatic invertebrate communities beyond those that would arise from upland logging disturbances.

Effects on stream sedimentation

Fine sediment deposition, which can have a negative impact on fish spawning beds and stream habitat quality, was measured at the sites for 2-3 years before and 3-4 years after logging. No significant differences were detected in sedimentation before logging or after upland clearcuts and partial logging in riparian buffers at two of the three areas. However, fine inorganic sediments were 3-5 times higher in the first year after logging at the site with the highest basal area removal in riparian buffers, although no significant change was detected in organic sediments, and the differences did not last beyond the first year. The results indicate that careful logging of riparian areas in winter can be conducted without posing significant long-term risk of increased sedimentation input to streams.

Stream temperature responses

High stream temperatures can be detrimental to certain aquatic organisms. Summer stream temperatures in three partially logged riparian and three reference areas were monitored two years before and after logging. There were no measurable differences in stream temperatures at two of the logged sites, while at the most intensively logged site (28% basal area removal in riparian buffers), daily maximum stream temperatures were nearly 4°C higher for about six weeks in the first summer after logging. These temperature increases were believed to be the result of disrupted cool water inputs following logging rather than a lack of shading to streams. Overall conclusions were that partial logging in riparian zones could sustain enough canopy cover to mitigate logging-induced water temperature increases.

Operational and economic feasibility of logging

Another study examined the operational and economic feasibility of partial harvesting in the riparian zones. Wood volume extracted and harvesting productivity were compared to those from the adjacent clearcut uplands. The logging operation used feller-bunchers and grapple skidders, with full-tree skidding and roadside delimbing. Operators were instructed to remove up to 50% of the merchantable trees in the accessible portions of the riparian zone and attempts were made to remove an approximately equal number of trees in each species and size class as were left on the site. Rather than marking trees, experienced machine operators used their own judgment, with the assistance of field staff on site. On average, 27-39% of the spruce/pine/fir basal area was removed.

The result was a patchy distribution of riparian forest with gaps of varying sizes, with most large gaps (> 100 m^2) resulting from skidder trails and access points that were up to 15 m wide. Results indicated that even though the effort required to harvest trees in riparian zones was greater, the volume of wood removed per unit effort was higher, due to the larger average size of the trees removed, which more than compensated for the effort.

CONCLUSIONS

In these studies, partial logging in riparian areas had minimal short-term impact on aquatic invertebrate populations, stream sedimentation and stream temperature when carried out during winter months. Carefully conducted logging that followed specific guidelines for tree removal required greater effort but was economically feasible due to the larger average size of trees harvested. Partial harvesting of riparian areas appears to be a reasonable approach to balancing the need for protecting these important areas and promoting ecosystem disturbance at a level that approaches that of natural disturbances.

Results from these studies will assist forest managers, regulators and policy-makers in their efforts to make sound decisions regarding the management of riparian areas.

PRINCIPAL COLLABORATORS

- Domtar Inc.
- Ontario Ministry of Natural Resources
- Living Legacy Trust
- Forestry Futures Trust
- Riparian Research and Management Network (Sustainable Forest Management Network)
- Laurentian University, University of Guelph, Lakehead University

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ISSN 1496-7847