Influence of Logging on Riparian Forest Understory in the Lower Spanish Forest of Central Ontario

Peter A. Quinby
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Introduction

Riparian zones have been well studied in western North American landscapes (e.g. Thomas et al. 1979) and in intensively managed landscapes - particularly agricultural areas (Lorance et al. 1984). Their existence in natural and semi-natural portions of North America's northern temperate forest, however, has not been well documented. In western forested landscapes riparian zones generally support greater plant and animal biomass compared to upland areas and they are a critical source of species diversity within the landscape. In intensively managed landscapes, riparian zones act as buffers and filters between both urban and agricultural activities and the most vital life-support resource - water.

Within the last 10 to 20 years, governments in Canada and the United States have developed guidelines for leaving buffer strips along streams in areas where logging is taking place. The primary reason for this is to protect those aquatic ecosystems that may potentially be affected by the logging activity. Little is known about the terrestrial component of riparian ecosystems particularly in northern temperate forests of eastern North America. Thus, the purpose of this study was (a) to determine if a unique riparian forest exists relative to adjacent upland areas and (b) to characterize the effect of clearcut logging (seven years prior to sampling) on the terrestrial portion of the riparian zone. Field work was carried out in the Lower Spanish Forest (LSF) area of central Ontario.

Methods

For this analysis, five questions were addressed as follows.

Question 1: Does a riparian zone exist in forested landscape of the LSF?

To address this question, the forest understory immediately adjacent to the stream (riparian zone) and vegetation on lower slopes at least 20 m from the stream (upland zone) was sampled. Forest understory vegetation included all vascular plants, mosses and liverworts as a group, and lichens as a group and was assessed for species and %cover (biomass index) in the layer 0 to .5 m high in 20, 1 x 1 m quadrats in each zone. The means for both species richness (no. spp./m^2) and biomass in

each zone were compared.

null hypotheses:

1. There is no difference in mean understory species richness for the riparian zone versus the lower slopes; this was tested with the rank sum test (Mann-Whitney).

2. There is no difference in mean biomass for the riparian zone versus the lower slopes; this was tested with the rank sum test (Mann-Whitney).

Question 2: Does logging significantly alter the species richness and biomass of understory vegetation in the riparian zone in the LSF landscape?

To address this question, the riparian forest understory vegetation in both ancient and logged areas was sampled. Forest understory vegetation included all vascular plants, mosses and liverworts as a group, and lichens as a group and were assessed for species and %cover (biomass index) for the layer 0 to .5 m high in 20, 1 x 1 m quadrats in each zone. Species richness was measured as number of species/m^2.

null hypotheses:

1. There is no difference in mean understory species richness for the ancient riparian zone versus the logged riparian zone; this was tested with the rank sum test (Mann-Whitney)

2. There is no difference in mean biomass for the ancient riparian zone versus the logged riparian zone; this was tested with the rank sum test (Mann-Whitney)

Question 3: Does logging significantly alter the species composition of understory vegetation growth forms in the riparian zones of the LSF landscape?

To address this question, the riparian forest understory vegetation in both ancient and logged areas was sampled. Forest understory vegetation included all vascular plants, mosses and liverworts as a group, and lichens as a group and were assessed for species and %cover (biomass index) for the layer 0 to .5 m high in 20, 1 x 1 m quadrats in each zone. The mean biomass for woody species, herbaceous species, and non-vascular (mosses and liverworts, and lichens) in both areas was then compared.

null hypotheses:

1. There is no difference in mean understory biomass of woody species for the ancient riparian zone versus the logged riparian zone; this was tested with the rank sum test (Mann-Whitney).

2. There is no difference in mean understory biomass of herbaceous species for the ancient riparian zone versus the logged riparian zone; this was tested with the rank sum test (Mann-Whitney).

3. There is no difference in mean understory biomass of non-vascular species for the ancient riparian zone versus the logged riparian zone; this was tested with the rank sum test (Mann-Whitney).

Question 4: Does logging significantly alter the species composition of understory lichen biomass in the riparian zones of the LSF landscape?

To address this question, understory lichens (as a taxon group) in the riparian zone (within 10 m of the stream) of both the ancient and logged areas were assessed for %cover (biomass index) in the layer 0 to .5 m high in 60, 1 x 1 m quadrats. The mean biomass for lichens in both areas was then compared.

null hypothesis: There is no difference in mean understory lichen biomass of the ancient riparian zone versus the logged riparian zone; this was tested with the rank sum test (Mann-Whitney).

Question 5: Does logging significantly alter the species composition of understory moss and liverwort vegetation in the riparian zones of the LSF landscape?

To address this question, understory mosses and liverworts (as a taxon group) in the riparian zone (within 10 m of the stream) in both the ancient and logged areas were assessed for %cover (biomass index) in the layer 0 to .5 m high in 60, 1 x 1 m quadrats. Mean biomass for the moss/liverwort group in each area was then compared.

null hypothesis: There is no difference in mean understory moss and liverwort biomass of the ancient riparian zone versus the logged riparian zone; this was tested with the rank sum test (Mann-Whitney).

Results

1. Does a Riparian Zone Exist?

a.	mean riparian understory species richness	= 9.4 **(1.35x >; p<.01)**
	mean lower slope species richness	= 7.0
b.	mean riparian understory biomass	= 81.1 **(1.87x >;p<.01)**
	mean lower slope biomass	= 43.5

Within the LSF landscape, the riparian zone is distinctly different from upland areas in terms of species richness and biomass of the understory vegetation. Both species richness and biomass are significantly higher in the riparian zone by a factor of 1.35 and 1.87, respectively.

2. Does Logging Reduce Understory Diversity in Riparian Forests of the LSF?

a.	mean ancient riparian understory species richness	= 9.4 (NS; p=.9031)
	mean logged riparian understory species richness	= 7.0

b.	mean ancient riparian understory biomass	= 81.1 **(1.54x >;p<.04)**
	mean logged riparian understory biomass	= 52.6

Within the LSF landscape, logging significantly reduced the biomass of the riparian understory by 35% but did not significantly affect the overall species richness of the riparian understory **(note: NS - means "not significant" or the averages (means) were not significantly different according to statistical analysis)**.

3. Does Logging Reduce the Biomass of Understory Woody, Herbaceous and Non-Vascular Plants in the LSF?

a.	mean ancient woody biomass	= 5.8 (NS; p=.1136)
	mean logged woody biomass	= 3.9
b.	mean ancient herbaceous biomass	= 38.7 (NS; p=.6168)
	mean logged herbaceous biomass	= 25.1
c.	mean ancient non-vascular biomass	= 38.8 **(1.73x >; p=.06)**
	mean logged non-vascular biomass	= 22.4

Within the LSF landscape, logging significantly reduced the biomass of the non-vascular plant species in the riparian understory but did not significantly affect the biomass of woody or herbaceous species.

4. Does Logging Reduce the Biomass of Understory Lichens in the LSF?

mean ancient lichen biomass	= 4.6 **(4x >; p<.01)**
mean logged lichen biomass	= 1.1

Within the LSF landscape, logging significantly reduced the biomass of lichens in the riparian understory - by as much as a factor of four or a reduction of 76%.

5. Does Logging Reduce the Biomass of Understory Mosses and Liverworts in the LSF?

mean ancient moss and liverwort biomass	= 21.3 **(1.6x >; p<.04)**
mean logged moss and liverwort biomass	= 13.3

Within the LSF landscape, logging significantly reduced the biomass of mosses and liverworts in the riparian understory - by as much as a factor of 1.6 or a reduction of 38%.

In addition, the understory plant species present in the sampled area of the ancient riparian forest were compared with the understory plant species present in the sampled area of the logged riparian forest (Table 1) and species richness charateristics were compared (Table 2). For every understory characteristic, the diversity of the logged riparian forest was lower than the diversity of the ancient riparian forest ranging from 16 to 80% less.

Table 1. Species list for understory vascular plants in ancient and logged riparian forests in the Lower Spanish Forest of central Ontario

	Presence		
Plant Species	Ancient Forest		Logged Forest
anenome spp.			X
balsam fir	X		
beach fern	X		X
beaked hazelnut	X		X
black spruce	X		
bracken fern			X
bunchberry	X		X
Canada mayflower	X		X
choke cherry	X		X
clintonia	X		X
dogbane			X
dwarf raspberry	X		X
eastern white cedar	X		
false climbing buckwheat			X
fly honeysuckle		X	
fragrant bedstraw	X		X
goldthread	X		X
grass spp.	X		X
indian pipe	X		
jack pine			X
joe pieweed			X
juneberry spp.			X
lady fern	X		X
large leaf aster	X		X
late low blueberry	X		
lichen spp.	X		X
liverwort spp.	X		X
Lycopodium annotinum	X		X
Lycopodium clavatum	X		
Lycopodium obscurum	X		X
moss spp.	X		X
mountain holly	X		
mountain maple	X		X
northern bush honeysuckle	X		X
oak fern	X		X
pin cherry	X		
polypody	X		
rattlesnake plantain	X		
red maple	X		X

rose twisted stalk	X	X
Rubus spp.	X	X
rush spp.		X
sarsparilla	X	X
sedge spp.	X	
sensitive fern	X	X
showy mountain ash	X	
skunk currant		X
snowberry	X	
starflower	X	X
twinflower	X	
violet spp.	X	X
water horehound	X	
white birch	X	X
white pine	X	
white spruce	X	X
wood fern	X	X
yellow birch	X	X

Table 2. Understory plant species richness summary: Logged versus pristine riparian forests

Characteristic	Ancient Forest	Logged Forest	Difference
number of taxa	49	41	16% less
number of unique taxa	17	9	47% less
number of tree species	10	6	40% less
number of unique tree species	5	1	80% less

Discussion

The results of this preliminary analysis of riparian forest understory in the LSF area of central Ontario indicate that (a) a distinct riparian vegetation zone does exist at least along some streams - both species richness and biomass are significantly higher in the riparian zone compared to the upland zone, (b) logging significantly reduced lichen biomass by 76% and moss/liverwort biomass by 38%; and in the logged riparian forest compared with the ancient riparian forest, (c) the number of understory plant taxa was 16% less, (d) the number of unique understory plant taxa was 47% less, (e) the number of tree species was 40% less and (f) the number of unique tree species was 80% less. Unique here refers to taxa or species that were found in either the logged or ancient riparian areas but not the other.

Lichens, mosses and liverworts decreased significantly in the riparian zone due to logging in the LSF. Declines in these species may have negative effects on the riparian ecosystem and other

species that inhabit the riparian zone in the LSF. In particular, these three species groups are ecologically valuable for many reasons (Bonan and Shugart 1989, Bennet and Tiner 1993) as follows.

1. They help to maintain high soil moisture levels.
2. They help to minimize soil temperature fluctuations.
3. Both lichens and the cyanobacteria associated with green feathermosses are important nitrogen fixers (they add nitrogen to the soil).
4. Regeneration of some tree species is positively associated with some species of lichens and mosses.
5. Lichen consumers include moose, deer, northern flying squirrels, snails, slugs, moth caterpillars, mites and termites.
6. A total of 46 North American bird species use lichens for nesting material.

Future riparian forest studies in central Ontario should investigate the variation in characteristics of riparian zones under various forms of management, the adequacy of stream buffer zones for protecting riparian zones, and the need for improved riparian ecosystem conservation policy.

References

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