Acid rain + clear cuts = permanent loss

Nova Scotia's poor forest soil can't recover fast enough

DAVID PATRIQUIN

Smokestack emissions, like these from the Tuft's Cove power generating plant in Dartmouth, leads to acid rain, which worsens the damage done to our forests by clearcuts.

Ever-increasing pressures to clear-cut forests for fibre, biomass and chemical feedstocks tend to ignore their immense ecological and social values.

But even as simple production systems, serious challenges to our forests' sustainability exist.

The broad outlines of this story have been known since the 1980s, when precipitous declines of salmon in many of our Atlantic river systems were traced to increased acidification of surface waters associated with acid rain.

That should have raised alarm bells about forests. Declining salmon and increased water acidity are the equivalent of bad blood tests for watersheds. Something was wrong in the forested uplands that fed those rivers.

Indeed, aquatic scientists knew what was going on: increased acidification was due to a combination of acid rain and the very low buffering capacity of forest ecosystems developed on shallow soils over slates, granites and felsic bedrock.

The bedrock breaks down very slowly and not fast enough to replace basic nutrients, mainly calcium, leached out of the soils by acid rain. So soil calcium levels drop, less calcium goes into surface waters and water acidity increases.

By the mid-2000s, we had quantitative models for the whole of eastern North America showing which landscapes are most impacted by acid rain. Nova Scotia is at the top of the list of 11 states and provinces involved.

We have the poorest soils over the largest area and receive acid rain from the industrial heartlands. Even without clearcuts, forest soils over more than 50 per cent of our landmass are losing more nutrients than are being replaced by nutrients in rainfall and by weathering of rocks.

Southwest Nova Scotia is in the worst shape. Unlike most other regions in eastern North America, which are beginning to recover following 50 per cent reductions in sulfur emissions over the last 30 years, surface waters in many watersheds of Southwest Nova Scotia continue to acidify.

Dissolved calcium has fallen below levels critical for survival of many species of aquatic life. Toxic forms of aluminum have reached levels toxic to fish. Toxic forms of mercury also increase as acidity increases.

Atlantic salmon were simply the most sensitive and first to go. Declines in brook trout (which are more acid-tolerant than salmon), in other fish species and fish predators such as loons will surely follow.

Clear-cutting exacerbates the effects of acid rain by increasing nutrient losses even further through the direct removal in wood and bark. There are more losses through erosion and leaching on land laid bare.

At some point, soil calcium becomes sufficiently low that tree health is affected and re-growth following clearcuts is slowed.

Some species are affected more readily than others. Sugar maple decline has been attributed to acid-rain-induced soil-calcium deficiency. This species is notably absent on our more acid soils.

Recent evidence suggest declines in soil calcium in forests of eastern North America are affecting other species, including some salamanders, herbs, invertebrates and songbirds.

Nova Scotia's Department of Natural Resources recognized the significance of nutrient loss for forest productivity and contracted a world expert to develop a forest nutrient management model to assess sustainability of biomass harvests in Nova Scotia. In 2009, DNR said it would be ready by mid-2010. The model was developed and delivered in 2011.

But, except for an MSc thesis on the topic now posted on a UNB website (only in part because of confidentiality concerns), it has not been made publicly available and it appears no recent decisions regarding harvests have been based on its use.

A DNR official I talked to said the model is still being refined and won't be ready for perhaps five years. In the meantime, clear-cuts continue unabated.

However, we don't really need to assess the nutrient balance of individual forest stands (which is what the model would do) to identify stands which clearly should not be clear-cut because of nutrient losses.

We already know from measurements and modeling which watersheds are in trouble. To clear-cut the poorest lands in these watersheds will reduce forest productivity, while clear-cutting the nutrient-rich drumlins will further undermine these highly stressed aquatic ecosystems.

There should be no clear-cutting whatsoever within watersheds stressed by acid rain.

We are already paying penalties in the aquatic realm. For forests, we can foresee declining growth rates, more disease and insect damage and loss of species.

These reduced forests may still be suitable for biomass harvests

> **"There should be no clear-cutting whatsoever within watersheds stressed by acid rain."**

or as feedstocks for making plastics, and under the present mindset will be harvested until finally they do not re-grow at all.

I have heard already remarks such as, "Some of my clear-cut stands are not re-growing properly." In addition, high blueberry demand is driving conversion of more forest land to blueberries, a final, essentially irreversible, step in conversion of forest to barrens.

The simple fact is we have some of the poorest soils for clear-cut forestry in all of North America and Europe.

That doesn't mean that we can't have bio-diverse, economically productive forests. Witness the few old-growth stands that we still have and successful cases of multi-aged management for hardwood timber.

There are growing markets for non-timber resources from our forests. But it does mean that we cannot clear-cut our forests again and again without penalty.

What happened in the cod fishery is being repeated in Nova Scotian forests, only spun out over a longer period.

Government scientists warned DFO that overfishing was occurring, but there was too much at stake on the fishing side, so they were ignored. In that case, cod stocks collapsed within a few years of the time they might have been saved.

For our forests, under current rotations of 20-40 years (shortened from 80-100), it will take longer to see the results of bad decisions. That doesn't make them any less predictable.

Of course, there is still the acid rain. We need to press Ottawa to speed up the agenda for further reductions in acidifying emissions.

Regardless, we should do our part by stopping all clear-cutting in the watersheds most affected by acid rain.

We owe that to the wildlife with whom we share our lands and to the future generations who will inherit them.

At the very least we need to acknowledge these issues and involve all Nova Scotians in charting a new course forward.

David Patriquin is a retired professor of biology at Dalhousie University. He lives in Halifax.

The article above was published in the print edition of the Chronicle Herald and also online on May 7, 2016. When the CH switched to a new online platform in September of 2018, they apparently lost the archived online materials. The above is a rather poor copy of the print article, so the original submission to the CH is attached below.

Possible Op-Ed David Patriquin.
April 14, 2016

Suggested Title: Last stand for forestry
(Others: Forestry at a crossroad; Of Fish and Forests)

1,054 words

Ever-increasing pressures to clearcut forests for fiber, biomass and chemical feedstocks tend to ignore their immense ecological and social values. But even as simple production systems, serious challenges to our forests' sustainability exist.

The broad outlines of this story have been known since the 1980s when precipitous declines of salmon in many of our Atlantic coast river systems were traced to increased acidification of surface waters associated with acid rain. That should have raised alarm bells about forests. Declining salmon and increased water acidity are the equivalent of bad blood tests for watersheds. Something was wrong in the forested uplands that fed those rivers.

Indeed, aquatic scientists knew what was going on: increased acidification was due to a combination of acid rain and the very low buffering capacity of forest ecosystems developed on shallow soils over slates, granites and felsic bedrock. The bedrock breaks down very slowly and not fast enough to replace basic nutrients, mainly calcium, leached out of the soils by acid rain. So soil calcium levels drop, less calcium goes into surface waters and water acidity increases.

By the mid-2000s, we had quantitative models for the whole of eastern North America showing which landscapes are most impacted by acid rain. Nova Scotia is at the top of the list of the 11 states and provinces involved. We have the poorest soils over the largest area and receive acid rain from the industrial heartlands. Even without clearcuts, forest soils over more than 50% of our landmass are losing more nutrients than are being replaced by nutrients in rainfall and by weathering of rocks.

SW Nova Scotia is in the worst shape. Unlike most other regions in eastern North America which are beginning to recover following 50% reductions in sulfur emissions over the last 30 years, surface waters in many watersheds of SW Nova Scotia continue to acidify. Dissolved calcium has fallen below levels critical for

survival of many species of aquatic life and toxic forms of aluminum have reached levels toxic to fish. Toxic forms of mercury also increase as acidity increases. Atlantic salmon were simply the most sensitive and first to go. Declines in brook trout (which are more acid tolerant than salmon), in other fish species and fish predators such as loons will surely follow.

Clearcutting exacerbates the effects of acid rain by increasing nutrient losses even further through the direct removal in wood and bark. There are more losses through erosion and leaching on land laid bare. At some point, soil calcium becomes sufficiently low that tree health is affected and re-growth following clearcuts is slowed. Some species are affected more readily than others, e.g., sugar maple decline has been attributed to acid rain induced soil-calcium deficiency. (This species is notably absent on our more acid soils.) Recent evidence suggest that declines in soil calcium in forests of eastern North America are affecting other species including some salamanders, herbs, invertebrates and song birds.

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However, we don't really need to assess the nutrient balance of individual forest stands (which is what the model would do) to identify stands which clearly should not be clearcut because of nutrient losses. We already know from measurements and modeling which watersheds are in trouble. To clearcut the poorest lands in these watersheds will reduce forest productivity, while clearcutting the nutrient rich drumlins will further undermine these highly stressed aquatic ecosystems. There should be no clearcutting whatsoever within watersheds stressed by acid rain.

We are already paying penalties in the aquatic realm. For forests, we can forsee declining growth rates, more disease and insect damage, and loss of species. These reduced forests may still be suitable for biomass harvests or as feedstocks for making plastics, and under the present mindset will be harvested until finally they do not re-grow at all. I have heard already remarks such as "some of my clearcut stands are not re-growing properly". In addition, high blueberry demand is driving conversion of more forest land to blueberries, a final, essentially irreversible step in conversion of forest to barrens.

The simple fact is that we have some of the poorest soils for clearcut forestry in all of North America and Europe. That doesn't mean that we can't have biodiverse, economically productive forests. Witness the few old growth stands that we still have , successful cases of multi-aged management for hardwood timber and growing markets for non-timber resources from our forests. But it does mean that we cannot clearcut our forests again and again without penalty.

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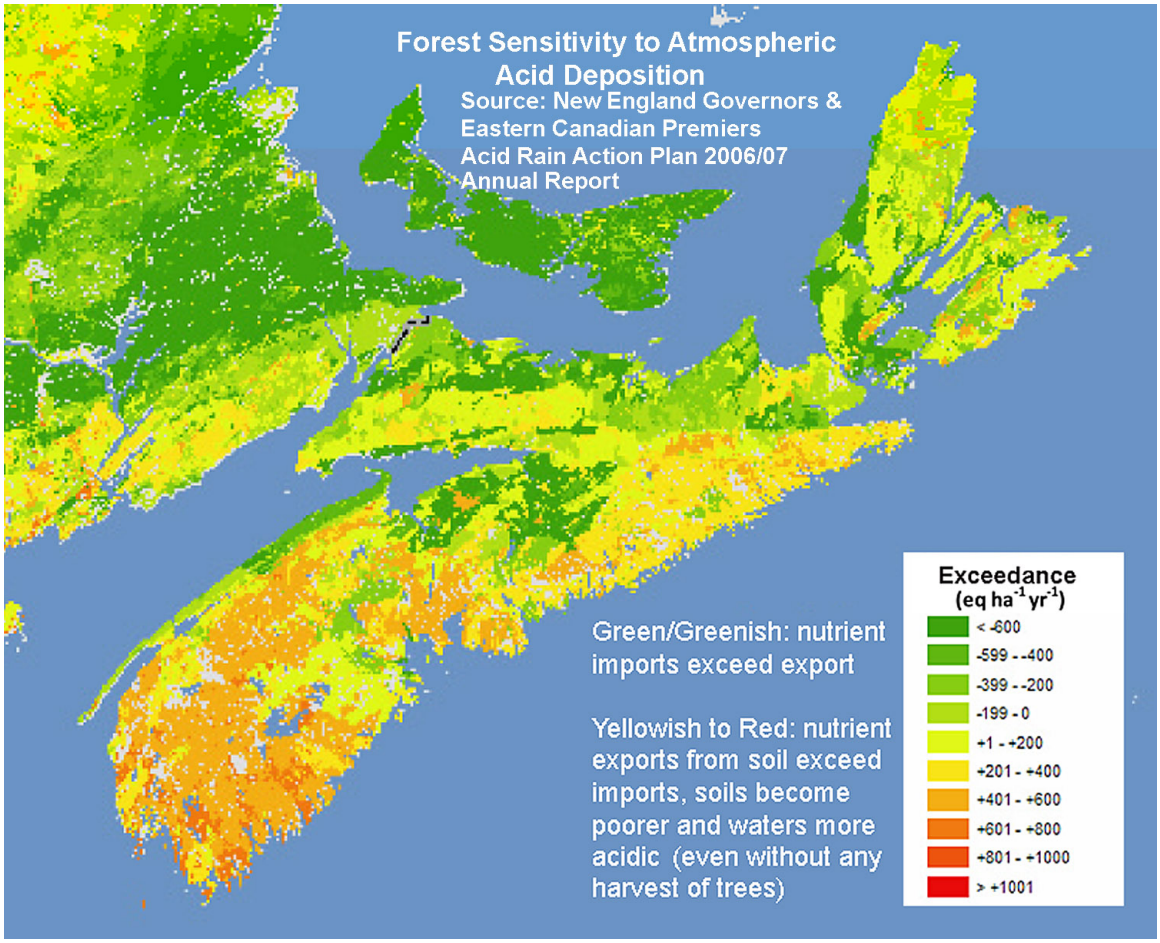
Of course, there is still the acid rain, and we need to press Ottawa to speed up the agenda for further reductions in acidifying emissions. Regardless, we should do our part by stopping all clearcutting in the watersheds most affected by acid rain. We owe that to the wildlife with whom we share our lands, and to the future generations who will inherit them. At the very least we need to acknowledge these issues and involve all Nova Scotians in charting a new course forward.

The piece could be used with or without the map.


Forest Sensitivity to Atmospheric Acid Deposition
Source: New England Governors & Eastern Canadian Premiers Acid Rain Action Plan 2006/07 Annual Report
Green/Greenish: nutrient imports exceed export
Yellowish to Red: nutrient exports from soil exceed imports, soils become poorer and waters more acidic (even without any harvest of trees)
Exceedance (eq ha-1 yr-1)
< -600
-599 - -400
-399 - -200
-199 - 0
+1 - +200
+201 - +400
+401 - +600
+601 - +800
+801 - +1000
> +1001