Reconstructing Reforestation: Changing Land-Use Patterns along the Saint-François River in the Eastern Townships

Stéphane Castonguay and Diane Saint-Laurent

Stéphane Castonguay is the Canada Research Chair in the Environmental History of Québec at Université du Québec à Trois-Rivières.

Diane Saint-Laurent teaches Physical Geography at Université du Québec à Trois-Rivières.

Environmental changes to the Canadian forest followed its economic history.[1] When the colonial economy moved into merchantable timber at the end of the 18th century, large stands of white pine in New Brunswick, Quebec, and Ontario were cleared. By the end of the 19th century, the growth of the sawmill industry and the advent of the pulp and paper industry gave new impetus to the deforestation process, resulting in the cutting of forest species formerly considered undesirable, such as spruce and fir. The situation inspired a nascent conservationist movement that denounced the myth of the inexhaustible forest. To alleviate this "Canadian assault on the North American forests," the conservationists recommended a series of silvicultural measures to protect and regenerate the forest cover. Some provincial governments and pulp and paper companies undertook reforestation projects, but many opted instead to devote their resources to combating

fires, since the forest, they claimed, regenerated on its own. Regeneration could be seen on land cleared for agricultural production that farmers had abandoned after years of meagre yields.

Reforestation, as a process of environmental change, appears then to result from two causes: one related to ecological dynamics, the other to industrial activities and government policies. Distinguishing one from the other is a complex task, however, which we attempt to tackle in this chapter. Our case study describes the reforestation process as it occurred in the Eastern Townships in Quebec in the second half of the 20th century. Our aim is to use historical and geographical approaches to determine how the forest cover re-established itself after the severe clearing of the late 19th century, and whether this reforestation process was of anthropogenic (human-induced) or ecological origin. Of particular interest is the fact that our research on reforestation originated from two distinct projects on flood problems in the Eastern Townships, along the Saint-François River (Figure 15.1). As a physical geographer, Diane Saint-Laurent was looking at the role of precipitation and other climatic factors in modifying the frequency and intensity of flooding events. She started her research with a chronological reconstruction of flooding events, and by collaborating with a historian she was able to find sources for events that occurred before the collection of official data began. As a historian, Stéphane Castonguay employed data similar to that collected by Saint-Laurent, although his concern was related to the perceptions and discourses of social actors, especially as some of them attempted to show that industry was—or was not—responsible for floods. As geographical and historical research proceeded, reforestation appeared simultaneously on our research agendas. We resolved to combine our approaches to understand the role of reforestation in controversies revolving around the role of forest cover in modifying the hydrology of the Saint-François River.

This chapter stresses the importance of collaborative work in environmental history. In particular, we wish to draw attention to the fact that analysis of traditional sources of historical research such as archives and printed materials, when used alone, can hardly account for ecological change. Of course, analysis of the discourses and representations of social actors is the mainstay of the historian's craft, and environmental history is no exception to that rule. From its early days, environmental history grew out of an intellectual tradition that sought to understand the philosophy and politics of human and social relationships to nature.[2] But ecological change involves more than discourses and representations. It is about the soil and trees, air and water, dirt and animals, natural elements and processes that compose an ecosystem. If environmental history relies solely on what humans say or think about ecological change, it loses track of the role of the environment in framing and influencing human discourse, and of the role of human impact on the transformation of the earth. This is why we think that the analysis of traditional sources is greatly reinforced when combined with the geographical interpretation of modes of land use. The use of data from the natural sciences enables a better understanding of how those perceptions are framed and influenced by the environment, what actors attempt to enlist in their dispute, and how human actions and intentions impact the environment. Therefore, an environmental historian who wishes to understand the role of human actions in bringing about ecological change in a given area needs the physical evidence drawn from different disciplines in the natural sciences to portray the material basis of the society–environment interactions. But this is only part of the story. Supplementing analysis of traditional sources with scientific evidence does not mean that the

Figure 15.1 LOCATION OF THE SAINT-FRANÇOIS DRAINAGE BASIN

This map shows the location of the main municipalities of the Eastern Townships and rivers of the Saint-François drainage basin.

Source: This map is reprinted with modifications from Stephane Castonguay, "The Production of Flood as Natural Catastrophe: Extreme Events and the construction of vulnerability in the drainage basin of the St. Francis River (Quebec), mid nineteenth to mid-twentieth century." *Environmental History* 12(4):820–844; published by the American Society for Environmental History and the Forest History Society, Durham, NC.

latter alone is sufficient to discuss ecological change. The natural sciences may provide a description of the change and its immediate cause, but not its proximate cause—that is, the human actions and motivations behind the changes. And as pointed out by Stephen Bocking in the following chapter of this volume, science is both a tool and a subject for the environmental historian. It is a tool when it provides facts to describe the environment and when it points at immediate causes responsible for the changes that the environmental historian wishes to explain, yet it is also a subject in that an understanding of the context underlying the production of scientific knowledge is required. Thus, if one wishes to use scientific literature in crafting

a historical narrative, one must use it critically. One way to do so is to participate in the production of natural scientific knowledge, and this is another reason that collaboration between a historian and a physical geographer provides an interesting opportunity to develop a critical understanding of environmental change.

To demonstrate the fruitfulness of collaborative work in environmental history, we will show how to use a combination of historical and geographical approaches to construct and resolve a problem in environmental history. How do the tools of these two fields strengthen our historical understanding of geographical and ecological phenomena? Before answering that question, we first start by looking at the deforestation of the Eastern Townships and its ecological and human consequences. Then we see how a historian and a geographer addressing different research problems came to identify deforestation and reforestation as key phenomena. By combining their research, the historian and the geographer reconceptualize reforestation to take into account both the discourses about the river landscape and the changes in land use. The end result is to unravel the anthropogenic or ecological origins of the reforestation process of the Eastern Townships, as well as to understand better the relationships of this society to its river environment.

Deforestation, Floods, and Reforestation in the Eastern Townships Region

Logging-based industrialization of the Eastern Townships soared with the Reciprocity Treaty of 1854 and the construction of a railway along the Saint-François River linking Montréal to Portland, Maine. Relying on the water and other primary resources of the area, sawmills multiplied along the river and its tributaries, taking the lumber from the forests of Mont Orford and Mont Mégantic. Settlement of the area, begun in the late 18th century, increased and intensified the clearing of the land, thereby modifying the region's economy and environment within the space of a few decades.[3]

Making use of electrical and chemical technologies rather than steam power, coal, and steel, the second industrial revolution increased this trend and led to greater use of the Saint-François River. The river was harnessed for the needs of heavily capitalized industries such as pulp and paper production, and the generation of hydroelectric energy was used to supply power to growing towns and heavy-machinery industries. Population growth and intensive urbanization along the river increased pressure on the river's floodplains; greater use of the floodplains and a growing number of storage reservoirs gradually transformed the Saint-François River's hydrological regime—that is, its seasonal variations as affected by climatic conditions and anthropogenic modifications—and heightened the devastating effects of ice jams and subsequent flooding. Moreover, the clearing of the riverbanks aggravated the surface runoff problem, creating a rapid rise in river-water levels during heavy precipitation. The riverbanks between the municipalities of Sherbrooke and Drummondville were the most affected by these anthropogenic changes, and this section of the Saint-François River was in fact the one that experienced the largest number of floods.[4]

Floods were not the only "extreme" climatic event attributed to deforestation; so were droughts, although they were less frequent and less spectacular. Even if communities were better able to deal with droughts than floods, the economic and political elite denounced droughts more fiercely; compared to floods, droughts interrupted industrial production for longer periods and affected all manufacturers because of their impact on hydroelectric power generation. Because manufacturing plants needed the river for energy, either directly or through hydroelectric power plants, they had to stop production during low-water periods. In this respect, a drought brought bad press to the area, which sought to be a flagship of Canadian industrial development.[5] It also became increasingly difficult in the early 20th century to attract investors, who could not tolerate such uncertainty.[6] Thus, "natural disasters" like floods and droughts meant different things depending on the phenomenon involved, the victims identified, and the magnitude and nature of the damage.

Faced with such catastrophes, the local elite, the provincial government, and the engineers from the Quebec Streams Commission considered developing the headwater lakes (Lake Saint-François and Lake Aylmer) into reservoirs in order to ensure a constant, year-long flow.[7] However, the construction of two reservoir-dams at the outlet of these lakes in 1918 and 1927 did nothing to decrease the impact of flooding. Though no one blamed the dams, some noted their inability to prevent flooding. Regardless, the primary objective of the reservoir dams was still the continuous supply of water and, as a result, hydroelectric power. Thus, when the region recorded the worst flooding in its history in 1942 and 1943, the community and the local elite started looking for other solutions to regulate river flow. A severe drought in 1948 made the problem even more pressing. Engineers commissioned by the Quebec Streams Commission underlined the need to prevent rainwater from rapidly flowing into the tributaries, whose simultaneous inflows into the Saint-François River augmented flood damage.[8] In that respect, reforestation of the riverbanks appeared to be a long-term solution.

Historical Methods: Interpreting Reforestation Discourse and Efforts

BY STÉPHANE CASTONGUAY

I came to this history initially through an interest in representations of natural disasters. Specifically, I sought to understand how social actors confer a natural character upon these phenomena, despite the fact that the much of the disasters' damage is often caused by human intervention, such as building a dam or constructing houses in a floodplain. The drainage basin of the Saint-François River offered an ideal site for the study because severe floods had occurred on a regular basis since the middle of the 19th century. The short but intensive period of colonization, urbanization, and industrialization rendered the site even more attractive because of the impact of these human activities on the riverine environment.

Reforestation became a central aspect of my research problem when I reviewed the activities of the Sherbrooke Chamber of Commerce surrounding the regulation of the flow of the Saint-François River. At the Bibliothèque et Archives nationales du Québec (BAnQ), I found reports

from the committees set up by the Sherbrooke Chamber of Commerce in 1948 to regulate the flow of the river, prevent flooding, and beautify the river's banks.[9] In addition to the Chamber's corporate members, the reforestation committee brought together stakeholders such as the region's main private power company, the Southern Canada Power Company (hereafter, the Southern), the Association forestière des Cantons-de-l'Est (AFCE), and the Québec Department of Lands and Forests. The composition of the committee enabled me to define a preliminary list of archival series to be searched in hopes of identifying the positions and interventions of the regional stakeholders. I sought to understand reforestation as a way for society to create a landscape that masked the social factors and agents responsible for floods.

There were a number of potentially invaluable collections of sources. The collection of the Southern, whose archives have been in the hands of Hydro-Québec since the 1963 nationalization of hydroelectricity, includes a series of records relating to the forestry division and the land that the company reforested, along with *Contact,* a newspaper intended for the general public. The Quebec Department of Lands and Forests records at BAnQ include annual reports containing a quantitative summary of province-wide reforestation activities by county and region. The AFCE also has its archives at the BAnQ, in a collection comprising minutes of annual reports and executive council meetings. Lastly, at the Sherbrooke Historical Society, I could count on a systematic search of the regional press and the associated indexes, as one can at many local historical societies. I was then able to access articles from a few newspapers over a long period to learn about the events surrounding the floods, and the reforestation work done after the Second World War.

This set of primary and secondary sources appeared sufficiently rich and diverse to provide a good grasp of the subject and allow a critical review of each document. It would allow me to determine the motives of the main protagonists and their roles in the unfolding of the events surrounding the area's reforestation. There were, however, some deficiencies in the documentary collection. For instance, there are no archives for the pulp and paper mills, for a few reasons. The industry consolidated over the years, leading to the liquidation or merger of several companies, with the subsequent disappearance or purging of archives when they were transferred. Furthermore, many companies do not make the archives that they do have available to researchers. I alleviated this problem somewhat by turning to local newspapers and the sector-based press. This is how I was able to find out, for instance, that Canada Paper was involved in the reforestation of 34,000 acres of land at its Windsor Mills site.[10]

A critical review of these primary and secondary sources would enable me to identify the stakeholders' interests and the significance of their actions and views on reforestation. For instance, I read these sources closely to understand better how the stakeholders viewed the ecological relationship between rivers and the associated forest environment, how they assessed the reforestation work in terms of objectives and achievements, and how they determined any anthropogenic or natural origins of reforestation. Of course, it should be reiterated that many of these documents were written by interested stakeholders. I needed to not only approach the sources critically (as with all sources), but also take into account the distance between claims and actions. Furthermore, in the case of reforestation, the end result of planting ought to be checked in the field. But, at the very least, I was confident that certain quantitative and spatial trends could be determined based on the historical documents listed here.

How did the stakeholders choose reforestation as the solution to flow control of the Saint-François River, whether the problems related to drought or flooding? The actions taken by the Sherbrooke Chamber of Commerce, the AFCE, and the Southern originated in a comprehensive document prepared by a committee that recommended the reforestation of the banks of the Saint-François River so that "forests could have a beneficial role in the regulation of the hydrological system, the prevention of devastating ice breakups and the prevention of soil erosion."[11] The fact that the president of the AFCE, a forestry association, spearheaded the document's creation definitely contributed to the reforestation recommendation, but major companies such as the Southern and Canada Paper also took part in the decision, while the Sherbrooke Chamber of Commerce approved it and submitted it to the Department of Lands and Forests.

Following forest theories that had been in vogue since the end of the 19th century, these stakeholders asserted that a forest behaves like a sponge. Obviously, it was in their own interest to believe this. Trees and forest litter slow the flow of surface water during torrential rainfall. These "natural sponges," along with the water table, which benefits from the slower surface water flow, act as reservoirs to prevent droughts. The stakeholders also recognized that reforestation would improve the aesthetic quality of the landscape. They expected the beautification of the riverbanks to boost the region's tourist appeal for people from major Canadian and U.S. urban centres and improve the economy that had been ailing from the decline in manufacturing since the Second World War.

Reforestation appeared, then, as a way to prevent flooding and save a declining economy. How did Southern Canada Power present such a position? First, the Southern had been working on reforesting the site of its power plant at Hemmings Falls, on the Saint-François River, since 1926. Concurrently, it purchased the equivalent of 2,880 hectares of farmland in the area downstream from Drummondville, around the Spicer rapids, to create a land bank to eventually build a new hydroelectric dam. It was only in the 1940s that the Southern began to make systematic efforts to reforest the riverbanks and reduce river erosion—with the added benefit that the trees would also become utility poles for its power transmission systems. The Southern set aside 2,345 hectares to create a forest farm: 700 hectares were reforested, 965 hectares of natural woodlands were kept under forest management, and the rest of the area consisted of wetlands. The company also established nurseries upstream from Hemmings Falls to meet its need for seedlings.[12]

Why did Southern Canada Power associate its power transmission system with the riverside landscape, forests, and wooded banks? The company was aware that its economic growth depended on that of the region. It also used its reforestation efforts to exhibit its contribution to the region's growth and its social and economic progressiveness. In *Contact,* a column titled the "Forestry Corner" provided advice and arguments in favour of reforestation, saying that the practice would prevent water erosion, as well as accelerated sedimentation, which would otherwise contribute to overflowing during the flood period. The newspaper spoke especially highly of the Southern's reforestation efforts, and stressed the need for the region to be made into a hospitable environment. By 1956, the Southern had planted 2,268,166 trees, mainly white spruce and Norway spruce, with an 80 percent survival rate.[13] Once its land was reforested, it sold extra seedlings to the government, which was otherwise unable to meet requests from farmers wishing to create a farm woodlot. By

1960, Southern claimed to have produced 500,000 seedlings for the government. Five years later, Hydro-Québec undertook commercial felling and sold the timber to Canada Paper. The state-owned company also sold more than 1 million seedlings to the Department of Lands and Forests.[14]

One of the other stakeholders involved in promoting this project, the AFCE, sought to increase the forest's viability over a largely deforested area. From its inception in 1943, the AFCE worked in close cooperation with the Department of Lands and Forests, which had been working on reforesting the public woodland on a province-wide basis by setting up a network of nurseries near the lumber limits that had been deforested.[15] However, as the Eastern Townships consisted mainly of private forests, the government did not consider pursuing its efforts there, despite the region's advanced deforestation. The AFCE, which brought together private forest owners and as such acted as a substitute of sorts for the government, became the primary voice of local forestry producers.

Though the AFCE's archives were not extensive, I learned much about the association through local newspapers. The AFCE acted mainly through conferences and its annual general meeting, as well as through the 4H clubs that it set up in the area. Forty-four of these clubs had their own nurseries, and ended up planting over 150,000 trees.[16] Moreover, AFCE representatives travelled throughout the region to encourage farmers to keep a wooded parcel of land on their farms and manage it soundly. Like some American states, the AFCE implemented a certification system for forest farms, establishments of more than three acres in size used solely for tree-planting purposes. There were 129 certified forest farms in the Eastern Townships by 1973.[17] Focused first on major institutional players such as the Southern and Canada Paper, certification extended to smaller farmers and then to municipalities that had acquired a community forest. Starting in 1948 when the town of Saint-Camille de Cookshire was given 1,500 trees by Brompton Pulp and Paper, the community-forest movement reached such towns as Sutton (with 60,000 spruce trees on 1,500 acres of land) and Thetford Mines (with 88,800 spruce on 500 acres).[18] The community forest project was also supported by the Southern starting in 1951, while *Contact*'s "Forestry Corner" was subtitled "A Forest for Every Municipality" to encourage emulation through the establishment of demonstration forests.[19]

The Department of Lands and Forests was less vocal than the AFCE and Southern Canada Power, but its action was no less crucial. Its activities rested on the distribution of seedling plants through its Forestry Extension Services. Any farmer interested in creating a woodlot could turn to the department, whether for seedlings or for technical assistance. In 1946, the government set up a mobile nursery near its extension office in Sherbrooke, with the first 40,000 trees consisting of red pine, white spruce, Norway spruce, cedar, and fir.[20] The minister of lands and forests, John S. Bourque, was responsible for setting up the extension office and nursery. Bourque was the MNA for Sherbrooke, a position he held from 1944 to 1958, and was quite sensitive to the report made by the reforestation committee of the Sherbrooke Chamber of Commerce in 1950. When the Chamber submitted the report of its reforestation committee and placed 15 recommendations on the table, Bourque responded immediately.[21] He acknowledged that the reconstitution of wooded areas improved the regulation of river flow, and noted that the Forestry Service had already carried out most of the actions being requested, such as setting up a nursery in the area, creating demonstration forests, carrying out reforestation work

Table 15.1 Annual Production of the Sherbrooke/Compton Mobile Nursery from 1950 to 1973

Year	Plant Production	Year	Plant Production
1950	75,000	1962–63	—
1951–52	157,500	1963–64	160,000
1952–53	80,000	1964–65	452,000
1953–54	155,000	1965–66	—
1954–55	—	1966–67	—
1955–56	150,000	1967–68	298,000
1956–57	159,500	1968–69	633,000
1957–58	200,000	1969–70	754,000
1958–59	200,000	1970–71	562,000
1959–60	180,000	1971–72	768,000
1960–61	250,000	1972–73	1,546,000
1961–62	166,300		

Source: Department of Lands and Forest of Quebec, *Annual Reports* (1950–72).

on farms, and distributing trees free of charge. As shown in Tables 15.1 and 15.2, the government was actively involved in reforestation (though it must still be determined what became of the seedling plants—i.e., who was using them and where). In addition to the production of trees at the mobile nursery that the government maintained to meet local demand, the extension service was also supervising and inspecting reforestation projects by individuals across the region. Several projects required that saplings be transferred from the Berthierville provincial nursery, in addition to mobilizing industrial nurseries in the area, such as that of Southern Canada Power.

In sum, my research had shown that by 1950 farmers were already actively involved in planting trees and that the government was working on setting up nurseries and distributing the seedlings. Why, then, did the Sherbrooke Chamber of Commerce, the AFCE, and Southern Canada Power raise the spectre of flooding before the government and public to engage the whole region in a reforestation campaign?

Past annual reports of the Department of Lands and Forest enabled me to identify a factor that likely triggered the reforestation campaign: the 1941 amendment to the *Reforestation Act*. Given the potential obstacle of heavy taxation on the reforestation of private land at a time when wood was in high demand, and given the shortage of firewood and construction lumber, the Quebec government added Section 164 to legislation on woods and forests, stating that "As long as there are at least 300 trees per acre, the reforested land will continue to be taxed at the same rate as previously [. . .] provided that it continues to be used for planting trees."[22]

Table 15.2 Reforestation of Private Land in the Eastern Townships from 1942 to 1967

Years	Number of Reforestation Projects	Number of Plants	Number of Inspections
1942–43	3	2,000	0
1943–44	43	82,500	35
1944–45	125	105,000	103
1945–46	205	170,000	88
1946–47	358	478,230	191
1947–48	401	774,960	316
1948–49	347	646,314	362
1949–50	386	580,618	327
1950–51	581	844,320	440
1951–52	754	1,158,400	612
1952–53	836	1,953,320	953
1953–54	970	2,161,627	906
1954–55	953	2,632,840	1,089
1955–56	884	2,057,000	1,171
1956–57	1,057	1,778,535	1,167
1957–58	n.a.	2,722,304	n.a.
1958–59	1,163	2,639,600	1,381
1959–60	1,331	2,889,100	1,592
1960–61	1,745	3,268,050	1,555
1961–62	1,777	3,949,260	1,703
1962–63	n.a.	5,222,800	2,517
1963–64	n.a.	5,350,000	n.a.
1964–65	n.a.	786,000	n.a.
1965–66	n.a.	n.a.	n.a.
1966–67	n.a.	4,840,000	n.a.

Source: Department of Lands and Forest of Quebec, *Annual Reports* (1950–72).

This regulatory amendment was a powerful incentive for the Southern, whose "reforestation efforts" had been at a standstill for the past 15 years, from the time it planted its first trees at the site of the Hemming Falls power station. The tax exemption under this amendment allowed the company to decrease the property tax paid on land that it reforested around Spicer Rapids, acquired in the 1920s for the purpose of building a hydroelectric dam downstream from Drummondville. This tax exemption led Southern Canada Power to create its own forestry division in 1942, an unusual move for a power company. Furthermore, it hired a forestry consultant, Elwood Wilson, who had been widely known in North American conservationist circles at the turn of the century when he set up one of the largest private nurseries in the Mauricie region.[23]

In addition to overseeing Southern's forestry operations, Wilson wrote *Contact*'s "Forestry Corner" column—in which he cheerfully publicized the work of this "major corporate citizen." In the column he also gave advice on planting and denounced reckless cutting in wooded areas. The column showed forest-related views becoming interwoven with social issues such as the farmer's role in soil preservation for the prevention of erosion, the "non-providential" cause of natural disasters (mainly attributed to poor resource management), and the additional revenue that the sale of firewood or lumber represented for farmers whose harvests were subject to the vagaries of weather.

It was also subsequent to the revision of reforestation legislation that the AFCE was created. Reforestation was central to the AFCE's policies. Whether through the growing number of 4H clubs—a concept that had originated in the United States and thrived in Quebec under the banner of the AFCE's parent organization, the Association Forestière Québécoise—or through the direct actions of its manager, the AFCE constantly encouraged reforestation of the Eastern Townships. Through its certification system, it guided and publicized the efforts of everyone from small farmers to large companies.

Reforestation thus brought together powerful stakeholders with diverse and complementary interests, while a growing number of views and institutional means enabled Eastern Townships inhabitants to actually proceed with reforesting the land. But how could the project's results be measured, whether in terms of flood prevention, the implementation of recreation or tourism as a major regional economic activity, or merely as a reforestation tool along the banks of the Saint-François River? What became of the actual practice of planting seedlings and of the plants themselves? To answer these questions, we turn to geography to help describe the transformation of land-use patterns.

Geographical Methods: Understanding Land-Use Patterns

BY DIANE SAINT-LAURENT

My research project initially concerned the role of climatic change on recurring flooding events along the Saint-François River and its main tributaries since the middle of the 19th century. I was able to provide a chronological reconstruction of floods and map them against series of climatic data. However, it is known that the hydrologic regime of rivers can be affected as much by anthropogenic changes as by precipitation. To consider the relative importance of these potential impacts one needs to identify the anthropogenic transformations of the land that may have amplified the magnitude and scope of the floods.[24] Has there been an increase or decrease in agricultural areas at the expense of wooded areas? Has the expansion of urban areas led to the fragmentation of forests or wooded areas? Were gains in wooded area attributable to reforestation efforts or to ecological dynamics?

I characterized and delineated the main anthropogenic changes along the banks of the Saint-François River between the towns of Sherbrooke-Lennoxville and Drummondville, using topographic and forestry maps as well as aerial photographs. Topographic maps are based on aerial photographs provided by federal and provincial government departments, and include a number of descriptive elements such as relief (altitude), building locations, road networks, river systems, and

the location of various infrastructural elements (e.g. bridges, dikes, dams).[25] Besides including all the elements found on topographic maps, aerial photographs are useful for other things, such as evaluating forest cover, cultivated areas, and the density and distribution of urban areas.

I then selected the sets of aerial photographs that showed the most significant changes in the study area. Concurrently, I used forest maps to better assess changes in forest cover over several decades. The forest maps provide information on such matters as the different types of forest cover, species groupings, disturbances, and stages of development. The Ministère des Ressources naturelles et de la Faune (MRNF) creates these maps based on aerial photographs at a scale of 1:15,000. Considering the changes observed on available forest maps and aerial photographs, I chose photographs from 1945, 1966, 1979, 1980, and 2000. To make a valid comparison between sets of aerial photographs, I needed photographs of comparable scale, namely between 1:10,000 and 1:20,000.

The first step consisted of georeferencing the digital aerial photographs—that is, matching their elements to the coordinates of a known reference system (such as longitude and latitude)—using data from the Digital Topographic Database (DTDB). Georeferencing has the great advantage of cleaning up the spatial distortions that result from having taken photographs from an airplane. I created georeferenced photographs using standard aerial photos (Figures 15.2 and 15.3). Standard aerial photos show some distortion as a result of having been taken from an airplane[26] and cannot provide an accurate positioning of surface areas. The georeferenced photographs, on the other hand, provide greater metric accuracy than standard aerial photos, and can thus serve as basic information when delineating types of surface areas. For the data transfer, I used the ArcGIS (ESRI™) software program,[27] which involves integrating a given set of digitized data into a geographic information system (GIS). As shown by Peter Pope in Chapter 3 of this volume, GIS is a tool commonly used in spatial analysis that finds applications in archaeology and many other fields. The second step involved delineating directly on the georeferenced aerial photographs the areas showing major anthropogenic changes, such as forest cutting or the expansion of wooded areas, urban sprawl, or abandoned farmland.[28] Lastly, to facilitate the

Figure 15.2 SOUTH SECTOR OF SHERBROOKE-LENNOXVILLE, 1945

Widespread agricultural activity is evident in this 1945 aerial photograph of the south sector of Sherbrooke-Lennoxville, which also shows forested and urban areas.

Source: © Department of Natural Resources Canada, 2007. All rights reserved.

reading of cartographic materials, I identified changes to wooded areas (gains or losses) on the photographs for the year 2000, along with the growing urban areas of four riverside municipalities: Sherbrooke-Lennoxville, Bromptonville, Richmond, and Windsor.

Examining the area along the Saint-François River between the municipalities of Sherbrooke and Drummondville, one sees a widespread increase in woodland since 1945, most evident near Lennoxville, Richmond, and Windsor (Figures 15.4, 15.5, and 15.6). One also notes gains in wooded areas in the municipality of Sherbrooke (north sector). This expansion of wooded areas often occurs to the detriment of agricultural areas that, more often than not, were abandoned by landowners and have returned to a wild state. Many rural areas in Quebec have experienced this phenomenon of agricultural abandonment.

Figure 15.3 SOUTH SECTOR OF SHERBROOKE-LENNOXVILLE, CA. 1979

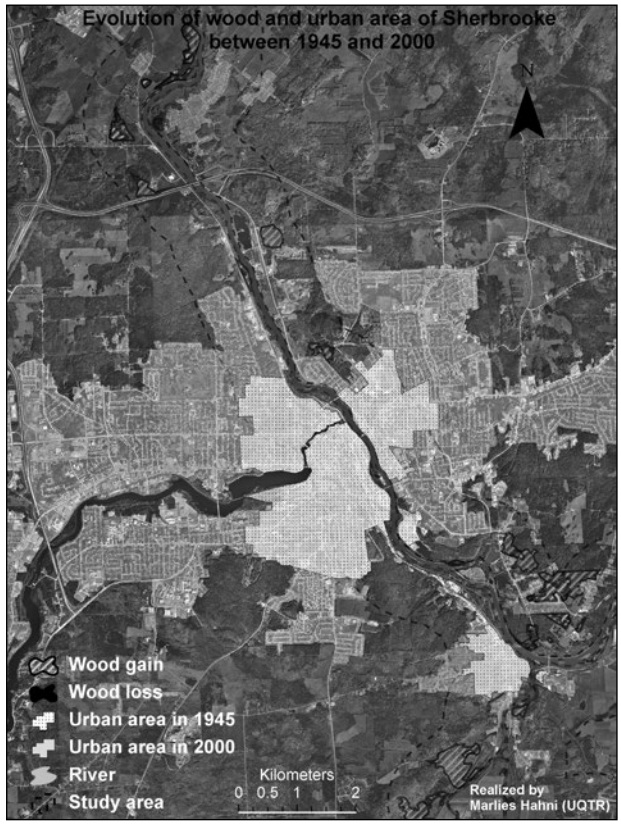
By 1979, many formerly agricultural areas in the south sector of Sherbrooke-Lennoxville had been replaced by urban development.

Source: Photocartothèque québécoise 1979. Ministère des Ressources naturelles et de la Faune du Québec, Gouvernement du Québec, serial number: Q79110-180, scale : 15 000.

Analysis of aerial photographs reveals that, for most of the areas studied, the gains in wooded areas are greater than the losses. From 1945 to 2000, the measured gains were about 12,183.09 km^2 and the losses 733.77 km^2. One hundred and sixty-one wooded areas increased in size during this period, compared to only 24 areas that shrank. The gains were relatively modest from 1945 to 1979, reaching only 2,598.04 km^2, whereas another almost 10,000 km^2 of woodland appeared between 1979 and 2000. This widespread increase in wooded areas late in the century often took place to the detriment of farmland. In other cases, wood gains occurred on riverbanks. Lastly, a total of 24 wooded areas (733.77 km^2) were lost from 1945 to 2000. Residential developments were the principal cause of these losses, as can be seen around Sherbrooke (Figure 15.4).

Though it is relatively easy to note the expansion of wooded areas on aerial photographs, along with the increase in forest density through the natural growth of trees, it is more difficult to recognize which wooded areas are the result of reforestation efforts. The many field visits that I made to the riverbanks lead me to believe that most of these wooded areas resulted from ecological dynamics after farmland was abandoned and changed gradually from fallow land to wooded and forest areas. It can also be noted that the riverbanks ($\pm$5–10 metres) most often remained wooded over the years due to the fact that their vulnerability to flooding prevented the construction of any

Figure 15.4 EVOLUTION OF WOOD AND URBAN AREAS OF SHERBROOKE, 1945–2000



This georeferenced aerial photograph reveals how the extent of wood patches and urban development changed in Sherbrooke from 1945 to 2000, particularly the rapid expansion of its urban areas.

Source: Marlies Hahni, Geographer, UQTR.

buildings. Furthermore, the wooded banks along the Saint-François River are essentially made up of stands of trees that have adapted to wetland conditions, including the silver maple, the dominant species in the region's alluvial plains. The presence of these stands must be attributed to natural regeneration rather than reforestation efforts that mainly rested on the planting of red pine, white spruce, and other coniferous species.

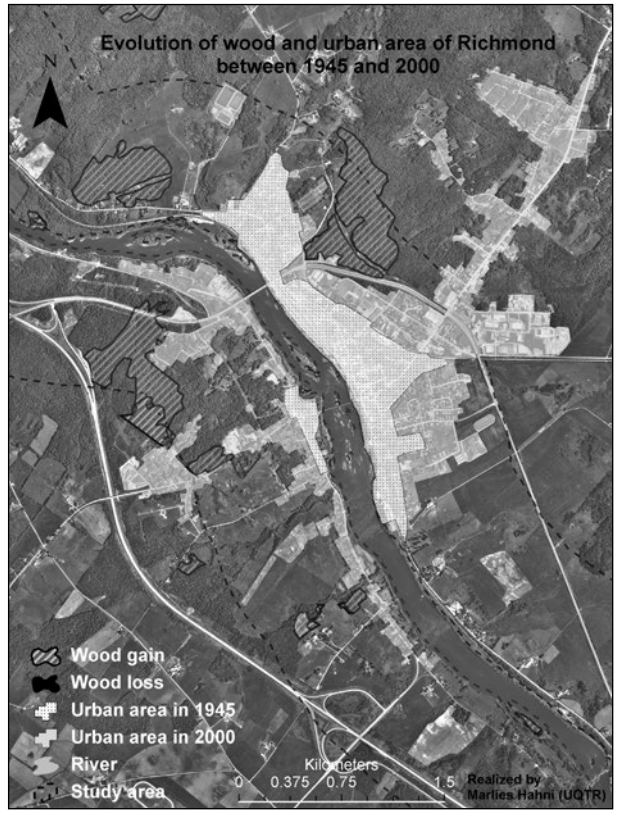
Conclusion

Proposed in the early 20th century as a solution to the problem of deforestation and the shortage of wood material for the pulp and paper industry, reforestation was framed as a means to regulate the flow of the Saint-François River after the disastrous floods of 1942 and 1943 and the drought of 1948. Political, economic, industrial, and forestry stakeholders in the Eastern Townships rallied around a practice that could reduce soil erosion, especially on the slopes of riverbanks which, once cleared, were defenceless against gullying and erosion. But how did these discourses translate on the ground—or, should we say, in the forest? While historical methods revealed the stakeholders' intentions and actions, geographic methods exposed major land-use changes as detected by photo interpretation. Their use enabled us to better determine the material basis for the stakeholders' views and the subsequent changes to land use (such as deforestation and reforestation, agricultural abandonment, and expansion of urban areas). We were thus able to note gains in wooded surface areas recorded along the banks of the Saint-François River and its tributaries. Relying on historical sources, it would appear that reforestation occurred strictly as a result of a campaign initially launched by the Sherbrooke Chamber of Commerce to prevent flooding events by making up for the deforestation of the Eastern Townships. However, when we also incorporate geographical approaches—including field observation and landscape reading—we realize that the growth of trees on the river banks resulted from ecological processes. We thus cannot affirm to what degree—if

any—reforestation was the result of the campaign orchestrated by the Eastern Townships' economic actors.

Despite the scope of our historical and geographical accounts, we still need to clarify several points to answer our research questions. How was the Saint-François River forest landscape formed after the severe clearing of the late 19th century? Which gains in wooded areas were truly attributable to voluntary human action, i.e., tree planting? Which gains in wooded areas were the result of ecological processes or the unexpected consequences of human action (or inaction)? In the event that anthropogenic forces were in fact responsible for new forest surface areas, who was responsible, what did they do, and for what purpose? And even when these environmental transformations resulted from ecological dynamics, can we determine their social causes? For example, can we associate a situation involving agricultural abandonment that would explain the reappearance of trees along the riverbanks with the socioeconomic crises that may have undermined farming activities in the area?

Figure 15.5 EVOLUTION OF WOOD AND URBAN AREAS OF RICHMOND, 1945–2000

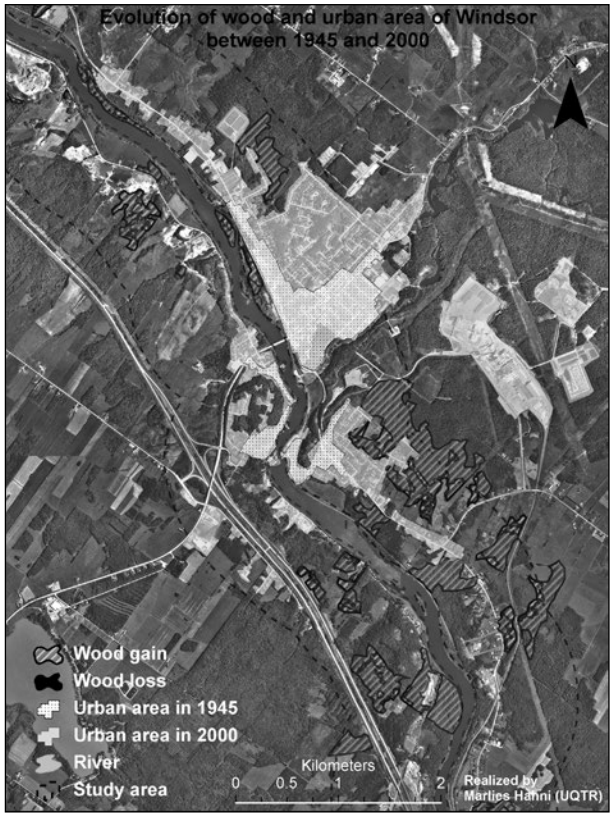


As shown in this georeferenced aerial photograph, from 1945 to 2000 Richmond's urban areas spread along the main roads and highways, even as woodlands grew denser.

Source: Marlies Hahni, Geographer, UQTR.

It seems unlikely that the gains in wooded areas between 1945 and 1979 were the result of the reforestation policies associated with the river flow regulation problem. In fact, these modest gains show that, during this time, tree harvesting continued in private forests and agricultural plots, at least enough to limit substantial forest gains. Moreover, it could be said that the region's logging trade was more or less sustained in order to meet the needs of the relatively high number of pulp and paper mills in the region. This forest harvesting, which was especially intense in the early 20th century in the Eastern Townships, may have contributed to the degradation of riverside environments by way of riverbank erosion, reduction in water quality through timber floating, and recurring floods, but, most of all, it created a severe lumber supply problem in the region.[29] In fact, the situation appears to have acted as a driving force for reforestation efforts in the Eastern Townships, while manufacturers and the economic elite, along with governmental and private forest conservationists, promoted reforestation among farmers so that the latter could supply wood material to sawmills and

Figure 15.6 EVOLUTION OF WOOD AND URBAN AREAS OF WINDSOR, 1945–2000



Especially along the riverbanks, forested areas grew markedly in Windsor during the second half of the 20th century, a change that can be observed in this georeferenced aerial photograph.

Source: Marlies Hahni, Geographer, UQTR.

pulp and paper companies, and also benefit financially from it.

A discrepancy appears between the discourse of reforestation and actual reforestation efforts. On the one hand, the discourse focused on the need to cover the riverbanks with trees to prevent flooding. On the other hand, the distribution of seedlings and reforestation were aimed to set up farm woodlots that were not necessarily located on the riverbanks but would provide farmers with additional income and manufacturers with a local supply. One option required new trees to be kept in place to retain the soil from drifting, while the other required cutting down trees for farmers' profits.

Meanwhile, the reforestation of riverbanks, capable of preventing erosion and the subsequent sedimentation process responsible for overflow, was the result of an ecological dynamic unrelated to any direct, voluntary human action. Reforestation occurred spontaneously along the riverbanks, and planting efforts remained limited there.

While gains in wooded areas on the riverbanks seem to have little to do with the campaign orchestrated in the 1940s, we nevertheless need to understand how and why the reforestation discourse was so prominent in the following decades. Here, an understanding of the economic and social transformations of the Eastern Townships is needed. Reforestation became a popular issue when the Chamber of Commerce designed it as a solution to the problem of flooding. However, a group of stakeholders was already legitimizing some of its actions in the region in relation to these land transformation efforts to ensure a sufficient lumber supply for local manufacturers, from sawmills to pulp and paper mills.

Researchers develop tools, methods, and languages that are (it is hoped) well suited to their disciplines. But these can also be limiting: learning to do something one way can make it difficult to even conceive of doing it another. In this chapter, a historian and a geographer—building on their individual understanding of the processes at work—worked together to tackle issues raised by their research to reveal the human and ecological dynamics of an event. Through his research, the

historian showed that an impressive reforestation effort occurred in the Eastern Townships, in terms of both extension activities by public and private organizations and farmers' acquisition of seedlings, but in areas not previously covered by the geographer. The latter can extend her study by examining the gains in wooded areas across townships that were actively involved in reforestation. Rather than being limited to the study of riverbanks and the role of their erosion in increasing the severity of flooding events, geographical research might seek to understand the impact of reforestation efforts and the forest cover on surface runoff and hydrological regimes. On the other hand, historical research might benefit from this geographical work by seeking to understand the extent of the economic activity generated on the farm by the maintenance of woodlots through reforestation efforts. The interpretation of georeferenced aerial photos would facilitate the identification of counties with net gains in wooded area through the reforestation efforts. Statistical information on these counties drawn from decadal censuses may be used to determine what wood products (firewood, pulpwood, construction wood, etc.) these farmers sold and why they were managing a woodlot. Such work, combined with a study of land tenure using traditional historical sources, would reveal information on the use of the land where forests take form and show the relationship between agriculture and woodlot management. Again, historical research might benefit from the geographical research, this time to understand the ecological changes related to farm abandonment.

Collaborative efforts between historians and geographers can thus provide environmental history with powerful tools to enhance our understanding of ecological changes and human affairs. Collaboration does more than "double" our evidentiary base; it increases our capacity to raise new research questions. Sources, causes, and meanings that we may overlook because we are caught up in our own research thinking can be unearthed by a colleague from another discipline. Moreover, collaboration forces us to expand our thinking: to imagine others' understanding of ecological phenomena and to improve how we communicate our disciplinary knowledge to others.

Discussion Questions

1. Using the conventional aerial photos 1 and 2 (Figures 15.2 and 15.3) from the Sherbrooke-Lennoxville area, can you identify the information that was lost when georeferenced photos were created? What kind of information might have been lost when the original aerial photos were taken?
2. Can you think of other physical evidence that one may use to discuss the environmental changes that addressed in this chapter (and that are addressed in the other chapters of this volume)? What disciplines from the natural sciences should the historian consider? Can you think of other documentary evidence one may use to discuss environmental changes that addressed in this chapter (and is addressed in other chapters of this volume)? What disciplines from the human sciences should the historian consider?
3. The philosopher Thomas Kuhn argued that it is sometimes difficult to compare different theories because they do not share a common measure; he called this "incommensurability." Do you anticipate that this would be a problem if you tried to integrate physical and documentary evidence? Why or why not?

4. The conclusion points to the use of census data in conjunction with geographical data to understand the process of reforestation. Why might you categorize these data as physical evidence? Why might you categorize these data as documentary evidence?
5. This chapter has focused on reforestation, but what other changes in land use might one explore with the georeferenced aerial photos?

Authors' Note

This research was supported in part by grants from SSHRC and NSERC. The authors wish to thank graduate students in environmental sciences Marlies Hahnï and Ariane Drouin for their technical support on GIS and mapping, as well as graduate students in Québec studies Marilyne Lafrenière and Myriam Brouillette-Paradis for research in archival and newspaper records.

Notes

1. Among others, see A. R. M. Lower, *The North American Assault on the Canadian Forest: A History of the Lumber Trade Between Canada and the United States* (Toronto: Ryerson, 1938); Donald MacKay, *Un patrimoine en péril. La crise des forêts canadiennes* (Quebec City: Publications du Québec, 1987); R. Peter Gillis and T. R. Roach, *Lost Initiatives: Canada's Forest Industries, Forest Policy and Forest Conservation* (New York: Greenwood Press, 1986); René Hardy and Normand Séguin, *Forêt et société en Mauricie. La formation de la région de Trois-Rivières 1830–1930* (Montréal: Boréal Express, 1984); Graeme Wynn, *Timber Colony: A Historical Geography of Early Nineteenth Century New Brunswick* (Toronto: University of Toronto Press, 1981).

2. Clarence J. Glacken, *Traces on the Rhodian Shore: Nature and Culture in Western Thought from Ancient Times to the End of the Eighteenth Century* (Berkeley: University of California Press, 1967), a work in intellectual history by a geographer, and Samuel P. Hays, *Conservation and the Gospel for Efficiency: The Progressive Conservation Movement, 1890–1920* (Cambridge, MA: Harvard University Press, 1959), a historical work by a political scientist, as well as Roderick Nash, *Wilderness and the American Mind* (New Haven: Yale University Press, 1967) can all be considered as founding books in the field in the United States.

3. On the Eastern Townships industrialization and deforestation, see Jean-Pierre Kesteman, Peter Southam, and Diane Saint-Pierre, *Histoire des Cantons de l'Est* (Saint-Foy: Presses de l'Université Laval, 1999); J. I. Little, *Nationalism, Capitalism and Colonization in Nineteenth-Century Quebec: The Upper St. Francis District* (Montreal and Kingston: McGill-Queen's University Press, 1989): p. 102; John Derek Booth, "Changing Forest Utilisation Patterns in the Eastern Townships of Québec, 1800 to 1930," Ph.D. Thesis, McGill University, 1971.

4. Diane Saint-Laurent and J.-P. Saucet, "Chronological Reconstitution of Floods of the Saint-François Drainage Basin," *Proceedings of the 3rd Canadian Conference on Geotechnique and Natural Hazards,* June 8–10, 2003, Edmonton, Alberta, pp. 89–93.

5. Peter Southam, "Continuity and Change in Eastern Townships Manufacturing Industry," *Journal of Eastern Townships Studies* 18 (Spring 2001): pp. 5–12.

6. Jean-Pierre Kesteman, *La ville électrique. Sherbrooke 1880–1988* (Sherbrooke: Olivier, 1988).

7. Quebec Streams Commission, "Annexe 1-a, Demande ayant pour objet la Régularisation de la rivière St.-François au moyen de Barrages-Réservoirs d'emmagasinement. Séance tenue le 19 août 1913," *Annual Report* (1914): pp. 77–103.

8. L. Cartier "Comments on the Saint-François River Flood Problem, May 28, 1945," Papers of the Southern Canada Power Company, F 15, vol. 3478, Hydro-Québec Archives (henceforth, HQA), p. 8.

9. "Rapport préliminaire du sous-comité reboisement, comité d'étude du contrôle des inondations de la rivière Saint-François et de ses affluents," Papers of the Chamber of Commerce, P-1, box 29, file 70-4-50, BAnQ-Sherbrooke, March 16, 1950. See also, "Le reboisement s'impose le long de la Saint-François," *La Tribune,* March 17, 1950, pp. 6–7.

10. "La première ferme forestière de l'est du pays à Windsor Mills," *La Tribune,* April 16, 1953, p. 3.

11. "Rapport préliminaire du sous-comité reboisement, comité d'étude du contrôle des inondations de la rivière Saint-François et de ses affluents," Papers of the Chamber of Commerce, P-1, box 29, file 70-8-50, BAnQ-Sherbrooke, March 16, 1950.

12. J. D. C. McArthur, "Some Suggestions for Future Management of the Southern Canada Power Company Plantations at Drummondville, P.Q.," Papers of the Southern Canada Power Company, February 22, 1962, F 15, vol. 3477, HQA.

13. "La ferme forestière de Southern Canada Power Company," *Progrès forestier,* 1 no. 5 (May 1967): p. 3.

14. Raymond Bergeron, "Brief historique des plantations forestières de l'Hydro-Québec à Drummondville, ministère de l'Énergie et des Ressources, région 04—Trois-Rivières," Papers of the Southern Power Company, 1983, F 15, vol. 3477, HQA.

15. Stéphane Castonguay, "Foresterie scientifique et reforestation: l'état et la production d'une 'forêt à pâte' au Québec," *Revue d'histoire de l'Amérique française* 60 nos. 1–2 (Fall 2006): pp. 61–93.

16. "Beau travail d'éducation accompli par l'Association Forestière du Québec," *Contact* 25 no. 8 (April 15, 1951): p. 3.

17. "25 fermes perdent leur titre de ferme forestière en 3 ans," *La Tribune,* May 3, 1973, p. 4.

18. "Forêt de communauté à St-Camille de Cookshire," *La Tribune,* March 5, 1948, p. 4; "Forêts municipales à créer au plus tôt dans notre région," *La Tribune,* October 29, 1948, p. 3.

19. "A Forest for Every Municipality," *Contact* 24 no. 10 (May 15, 1950): p. 6.

20. "L'organisation de cette pépinière est terminée," *La Tribune,* May 18, 1946, p. 3; Department of Lands and Forest, *Annual Report* (1947): p. 51.

21. "Réponse de l'hon. J.-S. Bourque aux recommendations de la Chambre locale," *La Tribune,* April 12, 1950, pp. 4, 6.

22. Revised Statutes of Quebec, 1941, Chapter 93. See also Ellwood Wilson, "Forestry Corner," *Contact* 24 no. 4 (February 15, 1950): p. 8.

23. On Wilson, see Castonguay, "Foresterie scientifique et reforestation," pp. 76–77.

24. P. A. Nelson, J. A. Smith, and A. J. Miller, "Evolution of Channel Morphology and Hydrologic Response in an Urbanizing Drainage Basin," *Earth Surface Processes and Landforms* 31 (2006): pp. 1063–79; B. Schultz, "Flood Management under Rapid Urbanisation and Industrialisation in Flood-Prone Areas: A Need for Serious Consideration," *Irrigation and Drainage* 55 (2006): pp. S3–S5.

25. The National Air Photo Library (Natural Resources Canada) and the Photocartothèque québécoise (Ministère des Ressources naturelles et de la Faune du Québec) are, respectively, the major federal and provincial agencies.

26. The photography axis is not perfectly vertical when the photographs are taken because of the relief on the surface of the Earth.

27. ESRI Canada, 2007. For GIS and Software products, see http://www.esri.com/products.html (accessed November 21, 2007).

28. To delineate the surface areas, I used the ArcMap module by ArcGIS, a commonly used software program in geomatics.

29. Kesteman et al., *Histoire des Cantons de l'Est,* pp. 534–35.

Further Reading

Burel, Françoise and Jacques Beaudry. *Écologie du paysage. Concepts, méthodes et applications.* Paris: Éditions TEC & DOC, 1998.

Gillis, R. Peter and T. R. Roach. *Lost Initiatives. Canada's Forest Industries, Forest Policy and Forest Conservation.* New York: Greenwood Press, 1986.

Hardy, René and Normand Séguin. *Forêt et société en Mauricie. La formation de la région de Trois-Rivières 1830–1930.* Montréal: Boréal Express, 1984.

Knowles, Anne Kelly, ed. *Past Time, Past Place. GIS for History*. Redlands: ESRI Press, 2002.

Lower, A. R. M. *The North American Assault on the Canadian Forest: A History of the Lumber Trade between Canada and the United States.* Toronto: Ryerson, 1938.

Muir, Richard. *Approaches to Landscape.* Toronto: Macmillan Press, 1999.

Theobald, David M. *GIS Concepts and ArcGIS Methods.* Colorado: Conservation Planning Technologies, 2005.

Williams, Michael. *Americans and Their Forests: A Historical Geography*. Cambridge, UK: Cambridge University Press, 1989.

Wynn, Graeme. *Timber Colony: A Historical Geography of Early Nineteenth Century New Brunswick.* Toronto: University of Toronto Press, 1981.