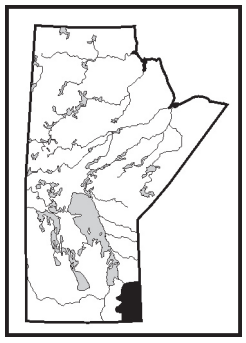
GS-19 A new tree-ring network for studying drought in southeastern Manitoba and northwestern Ontario

by S. St. George[1,2]



St. George, S. 2005: A new tree-ring network for studying drought in southeastern Manitoba and northwestern Ontario; *in* Report of Activities 2005, Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, p. 164–166.

Summary

This project examines the nature of drought in the Winnipeg River basin, which provides nearly half (45%) of the water flowing into Lake Winnipeg and the Nelson River, and is a key component of the hydrological system used to generate electricity in Manitoba. Because power generation is limited by the quantity of water flowing through the system, widespread and severe drought in the basin can significantly reduce the energy available in Manitoba. A combination of instrumental gauge records and estimated flows inferred from tree-ring data will be used to assess how frequently drought occurs in the Winnipeg River basin, and whether or not the lowest observed inflows are accurate estimates of the maximum severity of basin-wide drought. In 2004, fieldwork included the collection of tree-ring samples at 11 locations within the Winnipeg River basin, with the oldest tree being 255 years old. An additional 14 tree-ring sites were established in 2005 within the northeastern and southern sectors of Lake of the Woods, and near Quetico Provincial Park. Future analysis will determine if tree-ring data can be used to estimate the past occurrence and severity of drought in the Winnipeg River system, and place recent droughts within a longer-term context. This information will help us understand how and why droughts develop, and contribute toward producing more realistic assessments of drought risks in the future.

Introduction

Nearly all electricity produced in Manitoba is generated by water power. Hydroelectric generating stations on the Nelson, Winnipeg and Saskatchewan rivers produce roughly 30 billion kilowatt-hours of electricity each year (Manitoba Hydro, 2005), providing the citizens of Manitoba with reliable, renewable energy. Hydropower is also an important source of net revenue for Manitoba through the export of electricity to other provinces and the United States. Because the amount of power generated is controlled by the quantity of water flowing through the system, widespread and severe drought can create significant reductions in available energy, and attendant decreases in revenue from the sale of electricity.

This project examines the nature of drought in the Winnipeg River basin, which is a key component of the hydrological system used to generate electricity in Manitoba (Figure GS-19-1). A combination of instrumental gauge records and estimated flows inferred from tree-ring evidence will be used to assess how frequently drought occurs in the Winnipeg River basin, and whether or not the lowest observed inflows are accurate estimates of the maximum severity of basin-wide drought. This information will help us understand how and why droughts develop, and will contribute toward producing more realistic assessments of drought risks in the future.

This project began in August 2003 and will extend over four years.

Fieldwork to date

Results of the 2004 field season

During the 2004 field season, tree-ring data was collected at 11 locations within the Winnipeg River basin, with most of them falling in an area roughly demarcated by the communities of Kenora, Thunder Bay and Fort Frances in Ontario (Figure GS-19-2). Sampling concentrated on the three longest-lived tree species in this area — eastern white pine (*Pinus strobus*), red pine (*Pinus resinosa*) and eastern white cedar (*Thuja*

Figure GS-19-1: *The Winnipeg River, immediately downstream of Lake of the Woods.*

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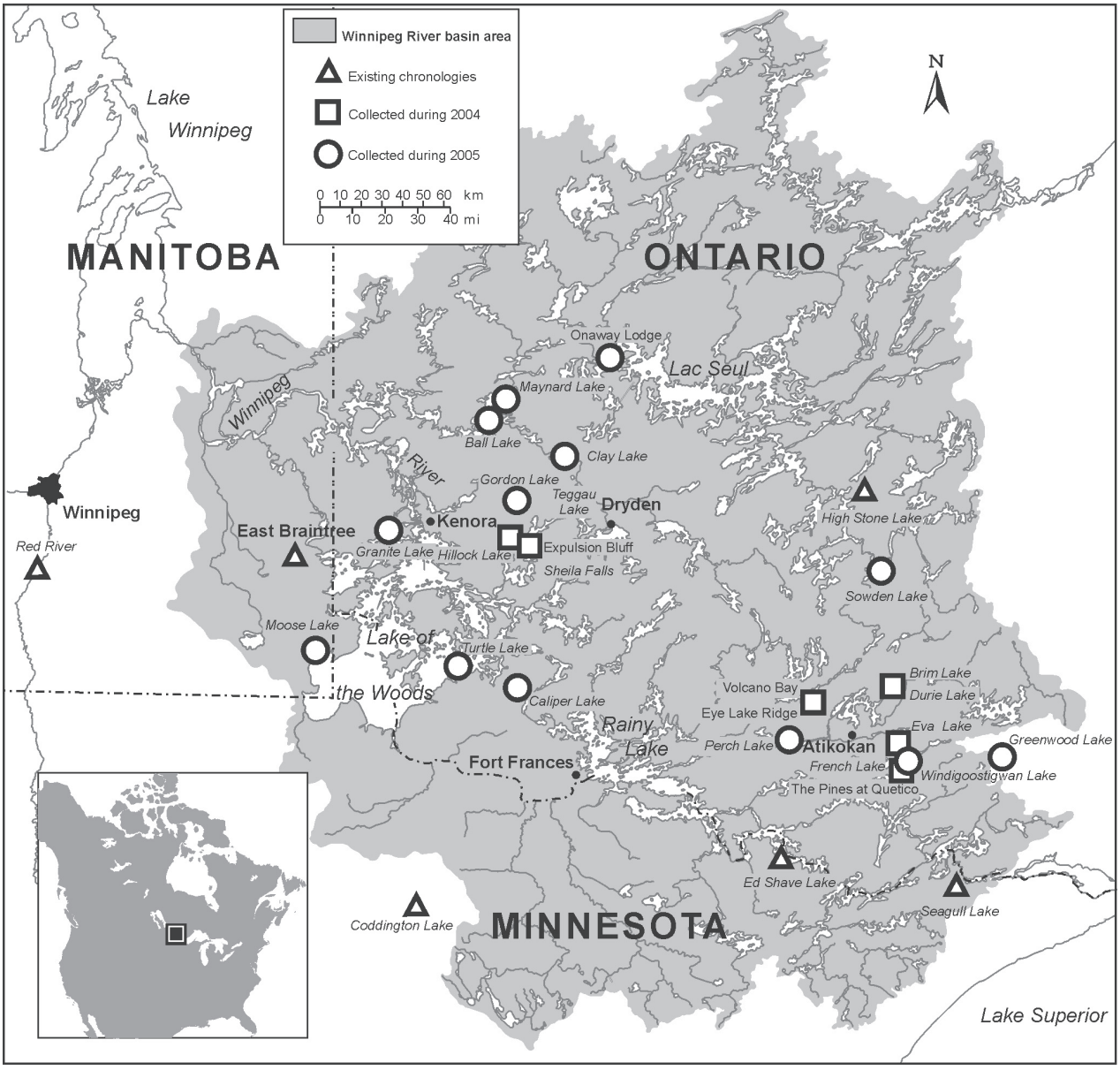

Figure GS-19-2: *Network of tree-ring sites within the Winnipeg River region, including sites collected prior to this project (triangles) and those collected during 2004 (squares) and 2005 (circles). Base map provided courtesy of the Lake of the Woods Control Board.*

occidentalis). Samples from these sites have been processed at the Laboratory of Tree-Ring Research, University of Arizona, and are now ready for measurement and analysis. Ring counts indicate that the median age of sampled trees is approximately 117 years, with the oldest tree having an inner ring date of AD 1749 (255 years old).

The 2005 field season

A two-person crew carried out a second round of fieldwork between August 2 and August 30, 2005, and collected samples from an additional 14 tree-ring sites within the Winnipeg River region (Figure GS-19-2). As in 2004, red and white pine, growing in either pure or mixed stands (Figure GS-19-3), were the primary targets (no additional samples were collected from eastern white cedar). Most new sites were northeast of Lake of the Woods, near the northernmost range of both red and white pine, but samples were also collected at sites within the southern sector of Lake of the Woods, in Manitoba and Ontario, and near Quetico Provincial Park. In general, the sites sampled in 2005 were less obviously disturbed by human activities than those sampled in 2004, many of which were logged during the 20th century.

Future work

Samples collected in 2005 will be prepared for analysis at the Laboratory of Tree-Ring Research, University of

Figure GS-19-3: *Collecting tree cores from red pine (Pinus resinosa) at Gordon Lake, Ontario.*

Arizona. These specimens, along with those collected in 2004, will be measured during the 2005/06 academic year, and the data generated will be used to characterize tree growth in the Winnipeg River region over the last two to three centuries. Subsequent analysis will determine if this data can be used to estimate the past occurrence and severity of drought in the Winnipeg River system, and place recent droughts within a longer context.

Economic considerations

The sale of hydroelectric power generated in Manitoba produced nearly $1.5 billion in revenue during 2004/2005 (Manitoba Hydro, 2005). Provincial income from hydroelectricity is affected directly by hydrological conditions in Manitoba and other jurisdictions upstream. Widespread drought affecting most of the Nelson River basin was cited as the main factor responsible for the Manitoba Hydro incurring a consolidated net loss of $436 million during the 2003/2004 fiscal year (Manitoba Hydro, 2004). Conversely, a return to wetter conditions in 2004 and 2005 was credited with greatly improving hydroelectric conditions throughout the province, and producing a consolidated net income of $136 million (Manitoba Hydro, 2005).

Because the Winnipeg River provides nearly half (45%) of the water flowing into Lake Winnipeg and the Nelson River, its watershed is the most important component of the hydrological system used to generate power by Manitoba Hydro. This project will lead to a better understanding of drought in the Winnipeg River basin — identifying how severe droughts can be, how often they occur and what factors lead to their occurrence.

Acknowledgments

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References

Manitoba Hydro 2004: 2003/04 annual report and 2004/05 first quarter financial results; Manitoba Hydro, News Release, August 11, 2004 (available on-line at http://www.hydro.mb.ca/news/releases/news_04_08_11.shtml).

Manitoba Hydro 2005: 2004/05 annual report; Manitoba Hydro (available on-line at http://www.hydro.mb.ca/about_us/ar_2004/ar_2004_report.shtml).