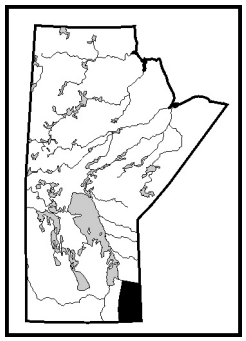
GS-23 Initial collection of dendrohydrological records to study drought in the Winnipeg River basin, Manitoba

by S. St. George[1,2]



St. George, S. 2004: Initial collection of dendrohydrological records to study drought in the Winnipeg River basin, Manitoba; *in* Report of Activities 2004, Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, p. 254–256.

Summary

The overarching goal of this project is to study the frequency, severity and causes of extreme droughts and low flows within the Winnipeg River basin. Manitoba Hydro cited the expansion of drought conditions into the Winnipeg River basin as the main factor responsible for the corporation incurring a consolidated net loss of $436 million during the 2003/04 fiscal year. This project will improve our understanding of severe drought in the Winnipeg River through the analysis of instrumental and tree-ring data, and provide information critical to the management of hydroelectric facilities in Manitoba. Fieldwork in the summer of 2004 established a new network of moisture-sensitive tree-ring sites within the Winnipeg River basin. These data will be used to develop estimates of streamflow in the Winnipeg River basin prior to the establishment of instrumental flow measurements, and thereby provide more accurate estimates of worst-case scenarios used for hydropower management.

Introduction

The overarching goal of this project is to study the frequency, severity and causes of extreme droughts and low flows within one of Manitoba's most important rivers. The Winnipeg River drains more than 125 000 km^2 within northwestern Ontario, northern Minnesota and southeastern Manitoba. Drought conditions in the Winnipeg River basin can have a significant negative impact on tourism, fishing and hydroelectric production. The latter is particularly important, as the Winnipeg River directly influences the production of more than 4 500 MW of hydropower within the system operated by Manitoba Hydro.

Paleoclimatic evidence from western Canada indicates that estimates of drought severity based only on observations made during the 20th century may underestimate the magnitude of worst-case scenarios (St. George et al., 2003). This project is intended to improve our understanding of severe drought through the analysis of instrumental and paleoclimatic data from the Winnipeg River basin. This research will determine if low flows in the Winnipeg River basin are predictable and related to particular atmospheric circulation patterns, and will develop extended records of streamflow and precipitation spanning the last 200 to 500 years. This information will be used to evaluate if the present 'critical drought period' obtained using historical data from the Winnipeg River basin provides a good estimate of the risk of extreme droughts, and also determine the probability that annual, decadal or multidecadal low flows might occur in the future.

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

Fieldwork in 2004

Fieldwork was conducted from July 16 to August 6, 2004, to establish a new network of moisture-sensitive tree-ring sites within the Winnipeg River basin covering the past 200 to 500 years. This collection was carried out by a two-person crew, and included sampling at several locations within a region roughly demarcated by the communities of Kenora, Thunder Bay and Rainy River, Ontario. Prior research programs had developed a limited number of tree-ring records from sites within and around the Winnipeg River basin (e.g., St. George et al., 2001; Briffa et al., 2002; St. George and Nielsen, 2002), but the 2004 fieldwork is the first attempt to deliberately target this region for collection.

The rationale for collecting tree-ring data is to use this information to develop estimates of streamflow in the Winnipeg River basin prior to the establishment of instrumental flow measurements. Because stream gauge records were established in the basin in the early 20th century, one of the primary criteria used to identify sample locations was their potential to include trees older than 100 years. Many sampling locations were selected based on data from stand-age maps provided by Abitibi Consolidated and the Ontario Ministry of Natural Resources.

Samples were collected from 11 sites, with most sites located within the Canadian portion of the Rainy River

[1] Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8
[2] Laboratory of Tree-Ring Research and Department of Geosciences, University of Arizona, Tucson, Arizona 85721

basin (Table GS-23-1). Field counts indicated that the oldest trees sampled were between 200 and 250 years old (Figure GS-23-1). However, most trees were much younger, with most having ages between 80 and 120 years. Many trees were quite large, especially white pines (*Pinus strobus)*, but these appear to be second-generation trees, with enhanced growth due to prior logging.

Specimens collected in 2004 will be prepared at the Laboratory of Tree-Ring Research, University of Arizona, during the fall 2004 academic term. Future collections in 2004 and 2005 will expand this initial network to encompass a greater area across the Winnipeg River watershed.

Table GS-23-1: Site characteristics for tree-ring samples collected within the Winnipeg River basin during 2004.

Site	Site code	Easting	Northing	Elevation (m)	Dominant species	Number of trees cored
Sheila Falls	SL	443009	5505919	401	*Thuja occidentalis*	23
Hillock Lake	HL	436565	5504222	413	*Pinus resinosa*	10
Teggau Lake	TL	451629	5502932	392	*Pinus strobus*	10
Expulsion Bluff	XB	444700	5502500		*Pinus strobus*	10
Brim Lake	BL	636176	5441918	493	*Pinus strobus*	10
Durie Lake	DL	627000	5426000	355	*Pinus strobus*	12
Volcano Bay	VB	587000	5420000		*Pinus strobus*	14
Eye Lake Ridge	ER	595159	5416324	440	*Pinus strobus*	16
Eva Lake	EL	634755	5396794	424	*P. strobus, P. resinosa*	20
French Lake Portage	FL	640188	5392261	465	*Thuja occidentalis*	9
“The Pines” at Quetico	PQ	632188	5390002	411	*Pinus resinosa*	17

Economic considerations

The Winnipeg River currently supports six hydroelectric generating stations in Manitoba, which collectively produce 585 MW of electricity, roughly 11% of total provincial production. The river also provides the largest single contribution to Lake Winnipeg and thereby has an important influence on the production of nearly 4 000 MW from the Jenpeg Generating Station and other stations on the Nelson River. Manitoba Hydro cited the expansion of drought conditions into the Winnipeg River basin as the main factor responsible for the corporation incurring a consolidated net loss of $436 million during the 2003/04 fiscal year (Manitoba Hydro, 2004). An improved understanding of the frequency, magnitude and causes of past droughts and periods of low streamflow across the basin will provide information critical to the management of hydroelectric facilities in Manitoba.

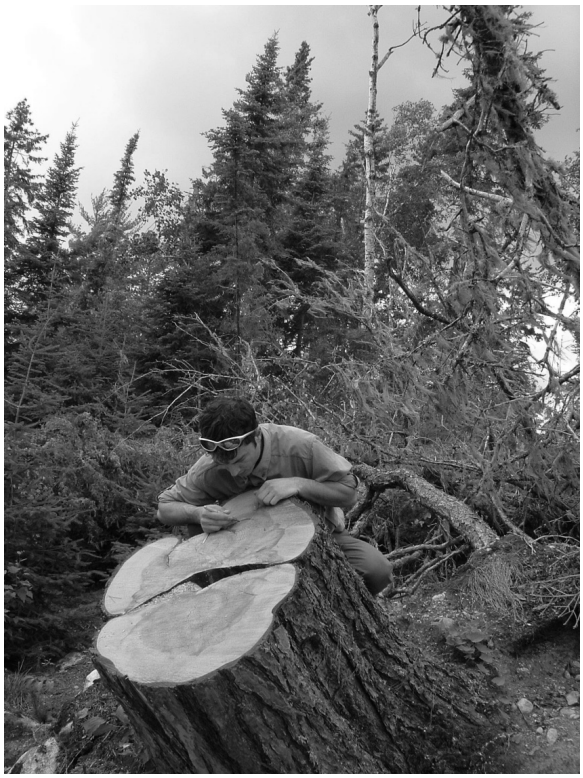


Figure GS-23-1: *This stump was part of a large stand of Pinus resinosa within Quetico Provincial Park. Field counts indicated that this tree was over 220 years old when it was killed in a large blowdown event in July 2003.*

Acknowledgments

Fieldwork in northwestern Ontario was supported by J. Balmat and staff at the Laboratory of Tree-Ring Research, University of Arizona. The Ontario Ministry of Natural Resources and Fisheries and Oceans Canada graciously allowed access within their respective jurisdictions. Stand information was provided by Abitibi Consolidated and the Ontario Ministry of Natural Resources. Financial support for this project is provided by Manitoba Hydro, the Manitoba Geological Survey, and the Prairie Adaptation Research Collaborative.

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