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GEOGRAPHICAL ESSAYS

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Preface

It is with pleasure (and some relief!) that we present this latest issue of *Prairie Perspectives*. We are proud of the quality and variety of scholarship showcased here; the research presented within these covers demonstrates the vigour of geographical research conducted by the faculty and graduate students of the universities that make up the Prairie Division of the Canadian Association of Geographers.

We would like to take this opportunity to thank the numerous reviewers who so ably and efficiently worked with us in selecting and improving submitted papers, and thus helping us to ensure that Prairie Perspectives retains and builds on a reputation of excellence. We really could not produce this journal without their commitment and collegiality.

We also need to thank Mr. Derrick Brown (University of Manitoba) for his assistance throughout the process of producing this issue of the journal, from ensuring submitted papers made it to the right editor, to researching printing methods and costs, to acting as a liaison between authors and editors. And great thanks are due to Mr. Weldon Hiebert (University of Winnipeg) – without Weldon the copy of the journal now in hands literally would not be there. Thanks so very much for being so patient and so proficient in your work pulling together the files we send into something tangible and professional in appearance.

Enjoy, and look forward to Issue 2!

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The Environmental Assessment Process – learning nexus: a Manitoba case study

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Abstract: This research explores opportunities for learning arising from a recent Manitoba EA. The Wuskwatim generation station and transmission lines projects involve the construction of a low head dam and three 230 kV transmission line segments. The EA process included multiple opportunities for public participation, including scoping meetings and 32 days of hearings. Primary data collection relied on participant observation, semi-structured interviews with EA participants, and a review of documentation generated during the EA.

Assessment participants identified a range of learning outcomes, which revealed a number of strengths and weaknesses associated with the EA. Four of these aspects necessitate consideration for EAs. Information must be managed to allow for access, without overwhelming participants. Procedural uncertainty negatively impacts communicative learning outcomes. Access to financial resources by participants is necessary, but not sufficient for ensuring access to alternative perspectives. These findings suggest that although the EA of the Wuskwatim projects was able to better engage the public, additional procedural changes would strengthen the review process and positively impact the learning outcomes of participants.

Keywords: Manitoba, environmental assessment, hearings, transformative learning

Introduction

This research explores the linkages among environmental assessment (EA), public participation, and learning. EA is a policy tool utilized by governments to consider the environmental, social and economic sustainability of projects (Connelly and Smith, 1999). As such, EA has historically required some level of public participation (Wood, 1995; Petts, 1999; Sinclair and Fitzpatrick, 2002; Sinclair and Diduck, 2005).

The utility of public participation in EA decision making is well established in assessment literature (Susskind and Cruikshank, 1987). Public participation ensures that the project reflects the public interest, in both purpose and design (Forester, 1989; Shepard and Bowler, 1997); creates a venue for conflict resolution between participants (Diduck, 1999; Mitchell, 2002); creates a forum for the submission and inclusion of local knowledge in the EA decision (Usher, 2000); provides for a more comprehensive consideration of factors on which decisions are based (Webler *et al.*, 1995); creates an opportunity for citizens to become actively involved with governance (Akkerman *et al.*, 2004); and, allows for learning (Sinclair and Diduck, 2001; Diduck and Mitchell, 2003; Fitzpatrick and Sinclair, 2003).

Of interest to this study are these last two points: active citizenship, and learning. Scholars from a range of disciplines are interested in how to strengthen activities centred on civic engagement (see for example Habermas, 1984, 1987; Innes, 1996; Healey, 1997; Dryzek, 2000; Sinclair and Doelle, 2003; Gastil, 2004). Learning plays an important role in these activities, as democracy relies on an informed citizenship, willing and able to contribute to the systems that govern them (Habermas, 1999; Lange, 2004). In creating opportunities for public deliberation, participants are exposed to different perspectives, and as a result, learn (Young, 1996; Barabas, 2004). Thus learning is necessary for, and an outcome of, public participation in democratic exercises.

Although learning is important to EA (Diduck and Sinclair, 1997; Fitzpatrick and Sinclair, 2003), it is rarely identified as an objective of process design. Thus while, as will be discussed below, participants consider learning to be important to EA, it has not traditionally been central to the underlying objectives of the process.

This research explores the relationship between EA and learning by examining the EA of the Wuskwatim Generation Station and Transmission Line projects (Wuskwatim projects). In understanding participant learning, consideration is given to both the learning outcomes, and the experiences that contributed to these outcomes.

The paper begins with a review of literature surrounding transformative learning, which guides the analysis of learning opportunities. An introduction of research methods, and the specific case study under review, follows. Results first explore the learning outcomes of EA participants, followed by a discussion of the EA experiences that helped shape these outcomes. The article concludes with a discussion of the significance of research findings.

Transformative Learning

Transformative learning is a framework of adult learning and education with roots in the theory of communicative action (Habermas, 1984, 1987) and critical pedagogy (Freire, 1973). In drawing from these theories, transformative learning examines how adult interaction can promote cognitive development and social change. When adults are engaged in social processes, they are introduced to alternative perspectives. As they come to critically engage with these perspectives, learning may ensue. The overarching goal of transformative learning is to "help adults realize their potential for becoming more liberated, socially responsible, and autonomous learners,"(Mezirow and Associates, 2000, 30).

Three aspects are central to transformative learning: experience, critical reflection, and adult development (Merriam and Caffarella, 1999). Prior experience is the foundation of one's existing perspective; current and new experience allows for the introduction of ideas which may affect one's perspective. These experiences serve as the basis for critical reflection. Critical reflection about the process, the content, and one's own assumptions may result in adult development, or learning.

Learning has multiple dimensions. Instrumental learning involves the acquisition of new knowledge and skills, designed to control or manipulate the environment. Instrumental learning "involves predictions about observable events, physical or social, which can prove correct or incorrect," (Mezirow, 1991, 73). Although instrumental learning outcomes are necessary, they are insufficient for transformative learning, which promotes change. Communicate learning is directed at "understanding what others mean and to make ourselves understood as we attempt to share ideas," (Mezirow, 1991, 75). Communicative learning centres on changing one's approaches to situations or points of view.

If a learner is confronted with a major contradiction to an established perspective, a perspective transformation may ensue. A perspective transformation,

> ...is the process of becoming critically aware of how and why our assumptions have come to constrain the way we perceive, understand and feel about our world; changing these structures of habitual expectation to make a more inclusive, discriminating, and integrative perspective; and finally, making choices or otherwise acting upon these new understandings (Mezirow, 1991, 167).

This transformation is facilitated through a sequence of activities that begins with a disorienting dilemma[1], and includes different activities such as critical self reflection, planning a revised course of action and making a decision to act on that course of action. Through perspective transformation, learners become critically aware of how their assumptions constrain their life, and make changes so as to develop and implement a more holistic perspective.

Transformative learning provides a way of understanding learning reflective of the goal of active citizenship, deemed important to public participation. Furthermore, as this framework puts a premium on experience as the context for learning, and interaction as a means of exposure to alternative perspectives, its application to deliberative processes is fitting (Mezirow, 2003). Indeed, transformative learning has been applied to EA by a small but growing number of scholars (Sinclair and Diduck, 2001; Diduck and Mitchell, 2003).

Despite the potential for more deliberative participation, questions have been raised about the ability of this framework to address learning in a cross cultural setting. Issues surround transformative learning's reliance on rational processes, particularly critical reflection, to foster change (Merriam and Caffarella, 1999). A small but growing subset of the literature is working to consider how transformative learning may apply in a cross-cultural setting, including research that examines how culture shapes the learning agenda and curricula of adult learners (Merriam and Mohamad, 2000), discusses the design and impact of a university course based on traditional knowledge (Feinstein, 2004) and documents the challenges experienced by Indigenous learners (Shilling, 2002). More in depth analysis of how culture affects impacts transformative learning processes and outcomes is needed. The focus of this study, however, is to explore how learning outcomes were shaped by EA experience.

Methods

Research was conducted using a case study approach, relying on multiple methods to collect data. I attended nineteen days of hearings between March 1 and April 15, 2004. During this time, participation observation allowed me to meet and engage in dialogue with participants

[1] A disorienting dilemma generates consciousness. Examples of disorienting dilemmas can be epochal such as a natural disaster or a loss of a loved one, or more gradual and graduated in nature, "more of a journey and less of a decision at one point in time,"(Mcdonald *et al.*, 1999, 11).

outside a one-to-one interview setting, observe human interaction, including vocal intonation and body language, not recorded in transcripts, and develop a preliminary understanding of the assessment environment. Second, documentation generated through the EA, including the impact statement, written question and answer exhanges about the impact statement, called Interrogatories (IRs), and over 7,000 pages of hearing transcripts, were reviewed. As part of this process, three public registries located in Winnipeg were consulted: the provincial public registry located in the main branch of Manitoba Conservation (123 Main Street), the public records related to the Clean Environment Commission (305-155 Carlton Street) and the federal public registry located in the regional headquarters of the Department of Fisheries and Oceans (501 University Crescent).

Third, semi-structured interviews were conducted with 16 assessment participants, representing the Clean Environment Commission (CEC), federal and provincial government departments, and organizations engaged in the EA. Interviews, lasting between 30 and 120 minutes, were tape recorded and transcribed. Interviews addressed a range of topics in understanding learning by participants, including questions about how people were involved in the EA, what they expected to learn through the process, what they learned through participation, and what qualities of the process facilitated this learning.

Data analysis used a grounded approach, relying on Nvivo, qualitative analysis software, to organize themes (Qsr, 1999-2002). To ensure validity, draft findings were sent to research participants for review. In soliciting comments, participants were asked to consider if the material reflected their experience with the assessment process.

Case Study

The EA of the Wuskwatim projects was selected as the case study. If approved, the Wuskwatim projects involve the construction of a low head, modified run of the river dam producing 200 megawatts of electricity, and three 230 kV transmission line segments, totaling 247 km (see Figure 1). Power generated at Wuskwatim will be available for export until 2020, when it is projected that Manitoba's firm energy demand will require energy generated at Wuskwatim.

Manitoba Hydro, a provincial crown corporation, is the project proponent. Manitoba Hydro is responsible for providing reliable and economic energy to the citizens of the province (Manitoba Hydro and Nisichawayasihk Cree Nation, 2003). Nisichawayasihk Cree Nation (NCN), a First Nations community situated in northern Manitoba, is the co-

Figure 1: *The proposed Wuskwatim generating station is located southwest of Thompson, Manitoba.*

proponent.. NCN's interest in the projects stem from the siting of generating station, in NCN's traditional territory and resource management area. In 2001, the community approved an agreement in principle to work with Manitoba Hydro to develop the Wuskwatim projects. Subject to final referendum following regulatory approval, NCN has the option of purchasing a 33 1/3 % ownership of the generating station. Therefore, the community (through Chief and Council) acted as a co-proponent of the projects during the EA.

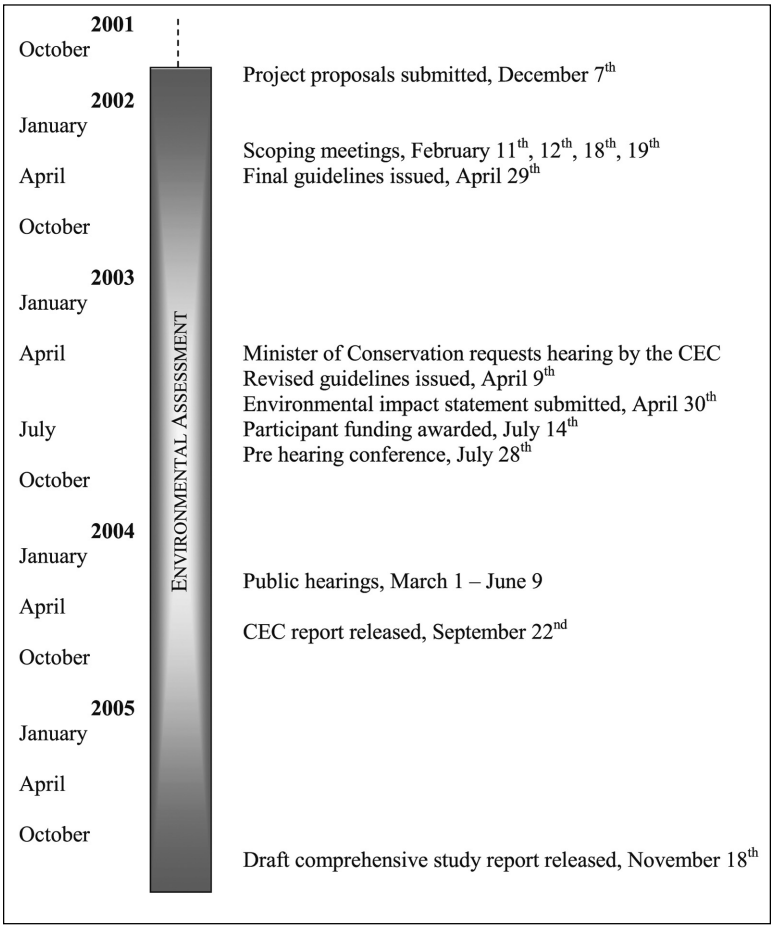
The Wuskwatim projects triggered reviews by three separate bodies:

- the Public Utilities Board (Manitoba) was charged with reviewing the justification, need for and alternatives to the projects,
- the Department of Conservation facilitated an EA under the terms of the Manitoba *Environment Act,* SM 1987-88, c. 26 of Manitoba. The generation station triggered a class three assessment, and the transmission lines triggered a class two assessment. As part of this review process, the Clean Environment Commission (CEC) was directed to gather public comment on the assessment guidelines, and later hold public hearings about the impact statement, and
- the Department of Fisheries and Oceans and Transport Canada conducted a comprehensive study of the generation station under the terms of the *Canadian Environmental Assessment Act* 1992, c. 37, (hereafter CEAA) stemming from the projects' need for fisheries authorization, which involves permission for modifying fish habitat, and its geographic location (within a navigable water).

To avoid a duplication of efforts, regulators harmonized the three review processes. Thus rather than being subject to multiple assessments, the projects underwent one EA. A timeline of the key activities surrounding the EA of the Wuskwatim projects is provided in Table 1. Public participation in the EA was encouraged through opportunities to:

- provide written and verbal submissions regarding the scope of the assessment,
- submit written comments related to the conformity of the impact statement to the guidelines,
- apply for money to help finance participation,
- participate in Interrogatories (IRs),

Table 1: *Timeline of events in the review of the Wuskwatim generation station and transmission lines projects.*



- make verbal presentations, supported by written material, during 32 days of hearings, and;
- submit written comments about the draft comprehensive study report.

This research focused on the provincial EA of the projects, initiated in December 2001 when the proponents submitted applications for the projects, until September 2004, when the CEC issued its report. Forty-two organizations, as identified in Table 2, and numerous individuals were

Table 2: *Organizations involved in the hearings (Clean Environment Commission, 2004). Participants were actively involved in the EA through a numbers of activities, including the scoping sessions, IR exchanges and hearings. Presenters spoke only during the formal hearing proceedings.*

PARTICIPANTS	PRESENTERS
Boreal Forest Network	Assembly of Manitoba Chiefs Secretariat Inc
Community Association of South Indian Lake (*) and the Centre for Indigenous Environmental Resources	Building and Construction Trades Council
Consumers' Association of Canada/ Manitoba Society of Seniors (*) and the Public Interest Law Centre	City of Thompson
Displaced Residents of South Indian Lake	Fox Lake Cree Nation
Manitoba Conservation	Granville Lake
Manitoba Future Forest Alliance	Inco Thompson
Manitoba Hydro	International Brotherhood of Electrical Workers
Manitoba Industrial Power Users Group	Keewatin Community College
Manitoba Métis Federation (*)	Manitoba Justice
Manitoba Wildlands / Canadian Nature Federation (*)	Manitoba Keewatinook Ininew Okimowin
Mosakahiken Cree Nation (*)	Manitoba Water Stewardship
NCN	NCN Youth Members
Opaskwayak Cree Nation (*)	Norman Regional Development Corporation
O-Pinon-Na-Piwin-Cree Nation	Northern Association of Community Councils
Pimicikamak Cree Nation (*)	Operating Engineers of Manitoba
Provincial Council of Women of Manitoba	Sagkeeng First Nation
Pukatawagan Fishermen's Association (*)	Southern Chiefs Organization
Tataskweyak Cree Nation	Swampy Cree Tribal Council
Time to Respect Earth's Ecosystems/ Resource Conservation Manitoba (*)	Thompson Chamber of Commerce
Trap Line No. 18 (*)	Winnipeg and Manitoba Chambers of Commerce
York Factory First Nation (*)	

(*) identifies participants who received funding

engaged in the CEC review of the Wuskwatim generating station and transmission lines projects.

Although representatives of First Nations were actively involved in the EA, this research was not designed to address learning in a cross-cultural context, and there were insufficient data to comment on nuances of learning specific to Aboriginal worldviews (see for example Mcgregor, 1999; Simpson, 1999; Simpson, 2000a, b). However, the breadth of the EA, including the large number of participants, representing a range of interests, and multiple opportunities for participation, made the Wuskwatim projects a rich case for exploring learning.

Learning Outcomes

All participants acknowledged that there is a relationship between learning and EA. As summarized by one participant,

> [Learning] *is the essence of EA. EA is to inform decision making, and you only get informed decision making through what you learned. And the process provides for scientific learning in respect to that particular project[s], and decisions to be taken based on the EA. So absolutely, it is integral to it, it is what it is about* (Interview 20).

As illustrated in Table 3, a variety of instrumental and communicative learning outcomes were identified by participants as having occurred through the EA process. All research participants experienced instrumental learning – the acquisition of new skills or information. Results span two categories of outcomes: legal, administrative, and political procedures; and biophysical, social and economic knowledge.

The most common category of instrumental learning related to legal, administrative, and political procedures. This type of learning is important to a project-specific EA; because it is essential to know how to become engaged, participants must be familiar with how the process functions and the mechanisms through which they can be engaged in the review. Knowledge of procedures can also transfer to other venues, including future CEC hearings and other opportunities for public involvement in democratic decision-making, including hearings convened by the Public Utility Board or the National Energy Board.

Two participants identified legal, administrative, and political learning as both an objective and outcome of participation. Because this was the

Table 3: *Instrumental and communicative learning outcomes identified by participants of the EA of the Wuskwatim project. Quotations are used to illustrate the types of learning outcomes represented by each category. Categories have been modified from Diduck and Mitchell (2003).*

INSTRUMENTAL LEARNING	
Legal, administrative and political procedures	EA process (Interviews 14, 15, 17, 18, 19, 21, 25, 28, 30) – "I mean this is the first generating station, so if another came up within a reasonable amount of time when we still had a lot of the experience around from this one, I think then we could probably design a better review, in terms of making it more expeditious" (Interview 19).
	First Nations consultation – "In terms of section 35 consultation, we learned a lot about what that might be. It is ill defined in the country. We try something, to do as well as we could, given the circumstance, but we certainly learned. We learned a lot about that" (Interview 20).
	Reaffirmation of understanding of process and social dynamics (Interviews 19, 26) – "I wasn't surprised at very much actually, Because once I knew the direction things were heading, I was thinking "Oh, oh, we are going to run into grief." And in most cases that is exactly the way it worked, including the interrogatory process…And I base that strictly on past experience. Why would it be any different this time?" (Interview 19).
Biophysical, social and economic knowledge	Project components (Interviews 16, 23) – "Well I think that we learned everything about the dam. That was a huge learning curve, we went from knowing nothing to knowing so much" (Interview 16).
	Environment– "And on a technical level, we learned information about the North. In fact we are learning about caribou right now, because people's level of understanding, level of appreciation [about this valued ecosystem component] was elevated" (Interview 20).
	Environmental impacts (Interviews 21, 23) – "[E]dge effects, for example, is something I had not really understood…I had enough working knowledge, but the hearings were tremendously helpful in terms of that" (Interview 23).
	Cumulative impacts (Interviews 21, 28) –"I mean I got a whole lesson in cumulative impacts assessment, and the whole issue of … what's the word… when you have got to much and when you decide that. And baseline coverage" (Interview 21).
	Dynamics of northern development (Interviews 17, 22, 24, 29) – "I gained a whole new perspective with respect to Aboriginal people, their issues, their concerns, their passions. And frankly, I quite appreciated it. I thought it was a very important part of the hearing, and a learning for us all" (Interview 22).
	Need for and alternatives to (Interviews 22, 30) – "[One important contribution involved] looking at a different transmission line routing that one of the Commissioners brought to the forum and asked Hydro to address that, the advantages and disadvantages of doing that. So actually through the EA another sort of position or alternative was put on the table" (Interview 22).
	Demand management (Interviews 22, 27) – "[A second contribution was] all the discussion and work that Hydro had done on their demand management and portfolio management alternatives. This [discussion was] based mainly on the good work that one of the funded participants. I think they were positive things that might not have been brought to the fore if we hadn't had a hearing, or maybe more importantly if we hadn't had funded participants to participate in the hearings" (Interview 22).
	Manitoba Hydro (Interviews 15, 27) - "[I prepared, in part, by learning about] Manitoba Hydro and how they functioned, what their development intentions were going to be, what the lines of communication and decisions were between Hydro and inside the Manitoba government" (Interview 15).
	Monitoring – (Interview 28)

Figure 3: *(continued)*

COMMUNICATIVE LEARNING	
Insight into one's own interest	Organizational interest in EA (Interviews 16, 23, 24) – "We are starting to develop a language for talking about environment as a cost, and social-cultural issues as a cost. We are coming to a way to put it together - not always to recognize the two things and keep them separate, but actually be able to some how put them together"(Interview 16).
	How to prepare for future EA (Interviews 16, 30) – "In fact I am writing up a plan right now for the different ways that we would be involved in the future. Because we don't know for sure when it is coming, but we know it will, and it will be in the next five years or so" (Interview 30).
	Strengthening the process (Interviews 18, 21) – "We all learned a fair bit about the general process, and hopefully in a few years I will learn more. But that is a bit simplistic" (Interview 18).
	Organizational effectiveness (Interviews 23, 27) – "I think it probably bolsters [my organization's] confidence in its ability to affect policy, to the extent that the final recommendations reflect some of the evidence that was presented in our intervention" (Interview 27).
Insight into the interest of others	Interactions between government (Interviews 14, 15,19, 20,25, 26)- "We learned about a situation where the expectations of participants were that there would be increased federal participation, so they had expectation of the federal government as overseeing the provincial process, which was not the case" (Interview 20).
	Interaction among different organizations (Interviews 23, 29, 30) – "And, talk about organizational learning, not my organization, but the PUB and Manitoba Hydro, I think have learned a lot from our intervention, and in the last year they have just extensively rammed up their demand management program, and there is just no comparison" (Interview 29).
	Ways of knowing (Interviews 23, 25) – "The other thing that was fascinating to me was traditional knowledge. Now many would argue that it was not put to proper use in this hearing, but we are experimenting with that. And understanding kind of the interplay between traditional knowledge and scientific knowledge was very interesting, and also some insight into the culture of at least one First Nation, maybe actually two" (Interview 23).
	People's capacity to act (Interviews 14, 16, 20, 25) – "And, I think that the other quality I learned is, you know that people surprise you. And I was surprised by the amount of - I probably shouldn't have been - I was surprised by the amount of anxiety and hurting and emotions that were there" (Interview 14).
Communication strategies and methods	How to become better engaged in process (Interviews 21, 27, 30) – "Our organization learned how to help a community get engaged, because they came to us saying they wanted to participate, but they didn't know the first thing about it. So that was really good, and it filtered down through the community" (Interview 30).
Social mobilization	Deficiencies in policy regime (Interviews 27, 29) - "There is another category of information which is m ore difficult to present to the hearing and that is the values based information… What type of community we want to live in, what kind of energy systems do we need to supply the kind of future that we see for ourselves, and are centralized systems of energy production really appropriate for a sustainable society, or will we want more distributed generation in which there is more local control and more local access rather than having these decisions centralized in necessarily rather bureaucratic and technically oriented organizations. And so, trying to get those types of issues incorporated is more difficult" (Interview 27).

first of a series of generating stations to complete an EA in Manitoba, these organizations became involved in the review, in part to contribute to anticipated learning about how to hold hearings. These participants envisioned that the hearings would be a learning experience for all, and wanted to contribute their knowledge of these processes to strengthen the overall EA process. This perspective has resonance with literature related to public involvement in environmental management decisions. One principle of participation documented by Webler and Seth (2000) is the iterative nature of participatory processes. People engaged in public deliberation believe that each process has implications for future processes, and thus considerations should be given to the conditions necessary for future deliberative processes.

Biophysical, social, and economic knowledge are related to the project design and valued ecosystem components (Table 3). Examples of this knowledge include a new understanding of dam construction, caribou, demand management programs, the proponents, and edge effects. This type of learning is essential for understanding the complex issues related to the specific projects under review. Knowledge is acquired through experience; as participants are engaged in the review, they gain an understanding of the technical details surrounding the development. Biophysical, social, and economic knowledge is transferable to other activities. For example, familiarity with northern communities is useful when approaching other developments in the same geographic region as the Wuskwatim projects.

Communicative learning addresses how one approaches situations or points of view. Examples of communicative learning associated with participation in the EA of the Wuskwatim projects addressed four broad categories: (1) insight into one's own interest, (2) insight into the interests of others, (3) communication strategies and methods, and (4) social mobilization. These types of outcomes were experienced less frequently, and by slightly fewer individuals (twelve participants).

Outcomes related to one's own interest focused on the EA process. The first three outcomes address participants' EA performance; the reasons for becoming involved in the EA, steps necessary for being engaged, and opportunities to improve performance. These outcomes build on the legal, administrative, and political outcomes associated with instrumental learning as described above. Rather than focus on specific skill or information about how to be involved, however, the communicative outcomes addressed how to be better engaged in the review. Outcomes included strengthening linkages between an organization's mandate, and the EA, and ways to strengthen these linkages. The fourth outcome also addresses this concept; in identifying what is broadly termed "organizational effectiveness", participants learning outcomes reinforce the theoretical utility of public participation described above. By seeing how their contribution impacted the EA, empowerment ensued.

Outcomes associated with insight into the interest of others reflected the social natural of the learning environment. Participants were exposed to different relationship (between governments, between organizations) and different perspectives (different ways of knowing, and the emotional significance of the issue). These learning outcomes indicate the types of relationships fostered through the EA, which Innes and Booher (2004) suggest is an important aspect of participatory processes. Outcomes further reveal assessment strengths and weaknesses related to EA procedure and access to alternative perspectives, as discussed below.

Communication strategies and methods, again, addressed how participants are engaged in the EA. However, this outcome also adds the dimension of other groups, as outcomes were focused on how to assist other groups to become involved in the process.

Social mobilization outcomes addressed the role of the EA in the arena of resource management. The case study illustrated or in some cases reaffirmed the difficulties associated with project specific application of dialogue; while project specific EA is important, participants recognized a need for civic engagement in the overarching norms that facilitate resource management. As one example, participants expressed a desire to strengthen the environmental planning regime, and enact, develop and reinvigorate institutions that foster learning. As a second example, three participants advocated the need for a strategic approach to energy issues. Rather than addressing the environmental impacts associated with the individual developments proposed by Manitoba Hydro, participants expressed the desire for a comprehensive energy plan, and an EA of that plan.

> *That is inevitably what happens, that these things are done project by project, and taken in isolation, which is what those who stand to benefit from the developments want to see happen. Each project then becomes subjected to a series of rather narrow technical criteria, and it leaves off the table the larger questions* (Interview 27).

Connected to this need for an energy plan is a desire for learning related to Manitobans' use of energy sources. Linked to testimony and evidence surrounding demand management initiatives, steps have been taken on a number of fronts (such as Public Utility Board hearings) to challenge existing perceptions regarding individual power consumption. Absent from this effort is a venue to further efforts directed at promoting sustainable development (Interview 29). Participants are seeking institutional changes in governance systems to advance environmental (in this context energy-based) thinking outside of a project specific EA. This is consistent with literature that supports strategic EA (see for example Gibson (2001)).

Finally, two participants identified learning outcomes that may contribute to perspective transformations. Building on the communicative theme "organizational interest in EA", these participants noted that they became involved in the review not because of an interest in the EA, but rather because of the project context - the project description and/or the process used to review the proposal. The potential ecological impacts of

the projects did not motivate their participation. However, as a result of the EA, these participants came to believe that potential ecological impacts of development were and are inextricably linked with their areas of interest. These interests "all run together. By the end, we were all saying that." Drawing on this change in perspective, the participants suggested they had a newfound interest in EA. Thus these participants came to change the way they understood their specific areas of interest and may ultimately result in participation in future EA processes. If this learning outcome is manifest in future action by the two participants, a perspective transformation will occur.

EA Experience

Learning processes, as conceptualized through transformative learning, are firmly situated in the experiences of participants. As such, learning outcomes are shaped by the learning process, in this case the EA. In understanding the learning outcomes of participants, it is possible to identify various strengths and weaknesses of the assessment process. In other words, learning outcomes provide a lens for understanding the effectiveness of the EA process, both in terms of promoting learning, and creating opportunities for active citizenship (Sinclair and Diduck, 2001; Diduck and Mitchell, 2003) . Drawing from the learning outcomes identified by participants of the Wuskwatim projects, four aspects of the EA necessitate consideration in future EA processes. These themes, grounded in the data include: access to information, information management, procedural certainty, and alternative perspectives.

Access to information:

Access to information is a critical aspect of a participatory process (Hanna, 2000; Sinclair and Diduck, 2005). As described above, the public must be informed in order to effectively participate in participatory processes. Access (or lack of access) at the most fundamental level impacts instrumental learning outcomes, which are necessary for communicative and transformative learning.

One of the most important tools for sharing information with the public is a registry. A public registry is a centralized repository system of information to facilitate orderly and timely access to information related to an EA. As noted above, public registries for the Wuskwatim projects were kept by the province of Manitoba, the Department of Fisheries and Oceans, and the CEC. Each body has different definitions of material that must be included in that record, so each registry includes different material. For

example, federally, the public registry includes all records produced, collected or submitted in relation to the EA (subject to issues surrounding privacy) including public comments, and documents prepared by the government (see s.55 of the *CEAA*). Therefore, this record includes copies of the correspondence associated with the EA, including letters and emails. Provincially, correspondence is not required but is placed on the public record at the discretion of the Director of Environment Approvals (see s. 17 of *The Environment Act*, SM 1987-88, c. 26). Although the provincial public registry included some correspondence related to the Wuskwatim projects, in comparison to the federal record, the provincial registry was lacking.

Once a hearing is announced, all material submitted to the CEC is put on the public record. However, this record, maintained by the CEC, is separate from the provincial (and federal) public registry; evidence submitted to the CEC is only placed on the provincial public registry at the discretion of the Director. The provincial public registry related to the Wuskwatim projects includes little evidence presented at the hearings; consequently, it was necessary to consult all three locations to find all documents on the public record.

At the provincial level, the public registry is available in 14 locations; however, the Department of Conservation only manages the site located at the Main Street Library in Winnipeg. While the Department forwards material to every depository, records are added at the discretion of each site manager. This results in potential inconsistencies in the public record, depending upon which site was visited (also discussed by Sinclair *et al.*, 2002). Additional concerns relate to access to registry sites; assessment participants have noted that certain depots have restrictive hours and lack cost effective equipment necessary for keeping up to date with material related to the EA. Thus the province has clearly made steps to provide access to information; however, access is inconsistent and restrictive depending upon the point of entry.

Past research recommended the use of an electronic public registry to address these issues (Sinclair, Diduck, & Fitzpatrick, 2002). To this end, an online public registry was developed for the EA of the Wuskwatim projects by the provincial government (*http://www.gov.mb.ca/conservation/envapprovals/registries/wuskwatim/*). Although this is a positive step in improving public access to information, it is important to note that the electronic site did not replicate the data available at the Main Street Library location. Only a small subset of information was available electronically; for example, unlike at the physical site, the online registry did not include the proponent's EIS (or links to the document available on Manitoba Hydro's website), government technical reports, correspondence related

to the EA, or the final CEC decision report. In this case, then, participants relying on the electronic public registry were not able to access all public information related to the EA.

Remedy to issues of access to information lies with the development of one central registry system, based on the broadest interpretation of what should be on the public record (in this case the federal definition). In addition to providing copies to various locales, all material should be posted electronically, as partly implemented by the Department of Conservation for the Wuskwatim projects.

Information Management:

Beyond issues of access to information, information management is a persistent concern of EA participants. To learn, participants must have access to a body of material that is accurate and complete (Mezirow, 1991). Furthermore, data should be available in forms that meet participants' needs (Shor, 1993; Hanna, 2000; Fitzpatrick and Sinclair, 2003). As illustrated by the data, information management also impacts the range, depth and tone of learning outcomes associated with participation in EA. Thus information management is essential to learning.

EAs generate a wealth of written documentation and information management is a long standing concern associated with EA (Hanna, 2000; Diduck and Mitchell, 2003). Sinclair and Diduck (2005, 64) observe, "the overly technical language and general lack of readability of EISs and other EA documents … tend to impede broad and active participation." Conversely, plain language documents are insufficient for developing sophisticated technical opinions about the case study. Thus it is a delicate balance to provide comprehensive access to EA information, in a format that eases readability for non-specialists.

Issues surrounding information management were evident in the case study. Proponents often observed that the data generated through the review spanned over ten linear feet. As noted by one, the assumption that all participants were able to review all material related to the EA was unrealistic (Interview 30). However, participants (including Interview 30), also expressed concerns with being able to access the technical information required to develop arguments on a specific EA component.

With respect to public accessibility, participants advocated the use of third party summaries. Reflecting recommendations by Fitzpatrick and Sinclair (2003), these summaries would be available at different points in the EA (e.g., prior to hearings, and as addendums to the daily hearing transcripts), as a means summarizing key aspects surrounding the EA for the general public, and highlighting specific areas of interest for specialists.

Technical documentation requires a different strategy. One potential approach is the use of technical sessions prior to the hearings. Utilized in the EA of the Snap Lake Diamonds project in the Northwest Territories, technical sessions bring all the experts together to deliberate specific EA issues prior to the hearings (e.g., "fish" and "wildlife"). Experts then work to resolve outstanding issues (including data deficiencies, and interpretation of data results), so as to narrow down the list of issues to be deliberated in the public hearings. Minutes (or transcripts) of these sessions are placed on the public record. Thus access to technical information can be balanced with readable, general summaries of the potential environmental impacts.

In the EA of the Wuskwatim projects, information management was further challenged by the Interrogatories (IRs), a new step in the CEC review process. The purpose of this process was to clarify and strengthen information provided in the impact statement and supplementary material. Questions posed by the CEC and participants were forwarded to the proponent (and other participant organizations, excluding government). Four rounds of IRs were issued, resulting in over 500 questions. While some participants felt that IRs were successful in clarifying information provided by proponents, others had concerns about this part of the process. Issues, as they relate to information management include concerns that IRs:

- resulted in duplication of efforts when questions were addressed in existing documentation,
- created scattered trails of documentation surrounding a particular issues, and;
- required additional resources to review and critique the new body of information.

Issues surrounding the IR process were evident as participants discussed learning outcomes associated with legal, administrative, and political procedures. Although the tones varied, most participants expressed some opinion about the IR process. Examples of negative, and positive comments follow.

> *The other thing I learned was that I am not sure that the IR process is an appropriate process for EIA* (Interview 14).

> *[One thing I found useful was]… the written exchange prior to the actual hearing. Because you can try to*

> *narrow down points, and get an actual response* (Interview 29).

Suggestions for improving the efficiency of the IR process include:

- issue only one round of IRs,
- integrate IR responses in a final version of the impact statement, available electronically, and;
- vet IRs through the CEC or its staff, so as to ensure questions are not duplicated by different participants.

Concerns related to IRs embody the basic issues surrounding information management in EA - there is a mass of information that does not quite reflect the needs of participants. As such, access to information becomes limited, despite the quantity of material surrounding the hearing. Thus, as noted by numerous researchers, efforts must be made to strengthen the readability of EA documentation to facilitate participation and encourage learning (Sinclair and Diduck, 2001; Diduck and Mitchell, 2003).

Procedural Uncertainty:

As noted above, the Wuskwatim projects were subject to a harmonized EA, meaning that the projects were subject to one assessment that addressed the needs of multiple review processes. The resultant process therefore addressed the provincial and federal EA legislation (as negotiated under the Canada – Manitoba Agreement on Environmental Assessment Cooperation (2000)) and the *Public Utilities Board Act*, RSM 1987, c. P280. Unfortunately, representatives of federal government departments did not attend the CEC public hearings. Representatives of government, the CEC and non-governmental organizations suggested that procedural uncertainty resulted. One participant observed:

> *the Canada Manitoba Agreement on environmental assessment cooperation is not the easiest agreement to follow* (Interview 14).

Another noted:

> *Another thing we learned was the CEC process – and the Wuskwatim hearings in particular - were in fact not under, or part of, the cooperative EA agreement between Canada and Manitoba* (Interview 15).

This sentiment was reaffirmed by a quotation from the final report of the CEC (Clean Environment Commission 2004, pp.7-8).

> The Commission agrees that the cooperative assessment process in Manitoba is not easily understood and found little evidence of its practical application during the review of the Wuskwatim Projects. The Commission realized little benefit from the cooperative approach that was apparently undertaken in connection with this review.

It is important to clarify that the Canada – Manitoba Agreement on Environmental Assessment Cooperation requires that the two levels of governments (federal and provincial) coordinate the steps involved in the review (e.g., scoping), not participate in each other's EA. Although the provincial legislation deemed public hearings were necessary, the federal process did not; as such, the federal government chose not to participate in the provincial hearings. Nonetheless, this decision was not clearly communicated to EA participants, who identified unmet expectations, and expressed disenchantment with the review process due to this lack of federal participation. Furthermore, despite provisions for common time schedules and decision points, the federal draft comprehensive study was released 14 months after the CEC report. Thus the harmonized process designed to create a clear, one-window approach to project specific EA resulted in increased project complexity and uncertainty.

This procedural complexity and uncertainty was manifest in instrumental learning outcomes related to legal, administrative and political procedures (EA process) and communicative learning outcomes related to both the insight into one's own interest (strengthening the process) and insight into the interest of others (interaction between government). And, like access to information and information management, this procedural uncertainty impacted the range, and tones of learning outcomes.

The proposed revisions to the Canada-Manitoba Agreement on Environmental Assessment Cooperation (2005) do little to address this issue. Although new provisions for conflict resolution mechanisms could, in future, be used to encourage participation, they relate specifically to conflict between the two signatories, not conflict amongst all participants. Nor have any modifications been made to sections regarding how EA processes will be harmonized. The absence of federal government officials during provincial hearings relating to a harmonized EA could be replicated in future assessments. Unfortunately, resolution of this issue lies at the political level. Until the two levels of government effectively cooperate to

deliver a one-window approach to EA, the principles of the Canada – Manitoba Agreement on Environmental Assessment Cooperation (2000/ 2005) will not be addressed, and process complexity and uncertainty will continue.

Alternative perspectives:

As discussed above, learning requires access to alternative perspectives. This is best achieved through broad, active participation in the hearings. The range of organizations involved in the assessment, as identified above, suggests that participants could have been exposed to diverse perspectives. However, an analysis of the recruitment, mandate and composition of each organization is necessary before comments on the representativeness of participants can be discussed (Davies and Blackstock, 2005).

Of greater interest to research participants was the access to alternative perspectives expressed during the hearings. Although public participation was encouraged, the range and scope of issues debated throughout the EA was a concern. Key deficiencies related to the role of government and the public.

In the first instance, a lack of government involvement in the hearings created an environment where participants and the CEC were solely responsible for challenging the proponent's evidence. In some EA hearings, including those established under the federal *CEAA*, and the *Mackenzie Resource Management Act,* 1998 c.25, government assumes the role of an adversary, in that it believes its role is to challenge and test assessment evidence. In this way, various governments rigorously test the proponent's information in the public forum, thereby providing one or more alternative perspectives to the environmental impact statement. For the EA of the Wuskwatim projects, government did not assume this function. The federal and provincial governments completed a technical analysis of the impact statement through their technical advisory committee prior to the hearings. While meeting notes were posted on the public registry, technical advisory committee meetings were closed to the participants, except for the proponent and its consultants.

When it came time for the hearings, government took a hands-off approach to the review. As discussed above, the federal government did not attend the hearings. The provincial government attended the hearings, and gave testimony on two separate occasions. However, it was not active in cross-examining the proponent through this process. As noted in correspondence to the CEC prior to the hearing, this was a deliberate strategy:

> *As you are aware, in order to protect the validity of the CEC independent review, provincial decision-makers cannot take an active role in the hearing process or comment in any substantive way on issues that will ultimately be the subject of their licensing decisions* (L. Strachan, personal communication, February 27, 2004).

By completing their analysis prior to the hearings, in closed discussions, the onus of challenging evidence rests solely on the CEC (who contracted external expertise) and public participants. While this role may preserve the independence of the CEC, it also detracts from efforts to ensure alternative perspectives were explored during the hearings.

Given the involvement of government departments in other EA hearings, it appears that "independence" can be interpreted in a different manner. In these processes, the Minister of the Environment, acts on behalf of the Crown, while government officials attend and participate in assessment hearings. Unfortunately for EA participants, resolution of this issue again lies at the political level.

Participant funding is one mechanism to ensure that alternative perspectives are explored throughout the EA. Indeed, access to financial resources is an important theme in assessment literature (Palerm, 2000; Diduck and Mitchell, 2003). As summarized by Sinclair & Diduck (2005), funding increases the capacity of recipient organizations to engage in the assessment by allowing for hiring of independent technical expertise to aid in the review, and increasing the ability of organizations to prepare for and be active in the different steps of the assessment (e.g., scoping, hearings, etc.). Providing financial assistance allows for increased public participation in the assessment process.

A study of past CEC hearing participants conducted in 2001 recommended that provisions for participant funding established in provincial legislation be implemented (Sinclair *et al.*, 2002) The CEC awarded $876,438 to 11 groups involved in the EA of the Wuskwatim projects, making this the largest financial award for participation in an EA up to this point in time in Canada. Table 4 breaks down funding awards by organization.

Participant funding increases the capacity of organizations to develop arguments, thus providing for access to alternative perspectives. Thus participant funding was used to strength the EA process, in each of the aspects noted above. As summarized by one participant:

> [a]*ll the discussion and work that Hydro had done on their demand side management and portfolio management alternatives issue based on mainly the good work that one of the funded participants brought to the table in that regard. I think they were positive things that might not have been brought to the force if we hadn't had a hearing, or maybe more importantly if we hadn't had funded participants to participate in the hearings* (Interview 22).

Table 4: *Funding awarded through the participant assistant program.*

Consumers Association of Canada/ Manitoba Society of Seniors	$190,000
Pimicikamak Cree Nation	$160,000
Time to Respect Earth's Ecosystems/ Resource Conservation Manitoba	$145,000
Manitoba Wildlands - Canadian Nature Federation	$115,000
Manitoba Métis Federation	$80,050
Opaskwawayak Cree Nation	$60,000
Community Association of South Indian Lake	$60,000
Mosakahiken Cree Nation	$20,450
Pukatawagan Fisherman's Association	$20,450
Trapline #18	$20,000
York Factory First Nation	$5,488

Despite the noted benefits, participants observed that the funding program had shortcomings, specifically related to how money was used by different organizations. Participant funding can be used for a variety of activities related to an EA (as specified in individual funding applications). Funded participants used three approaches to debating the EIS. The first approach involved developing new, independent, research on specific issues to counter the proponent's data. Other organizations presented a critique of the EIS evidence based on existing knowledge. The third approach was to provide a general commentary on assessment issues.

In some cases, this funding contributed to the development of "new" research material related to key components of the impact statement. For example, the record clearly illustrates evidence of independent investigations that include consideration of,

- flow regimes on Missi Falls water structure,
- the edge effect as it relates to proposed transmission corridors,
- alternatives to the advancement of Wuskwatim based on demand management programs, and,

- use of a portfolio approach for evaluating resource options related to the economic impact of a project.

A review of the public record identified only one research report widely available – a study commissioned by Time to Respect Earth's Ecosystems/ Resource Conservation Manitoba (Torrie *et al.*, 2004).

The second approach to EA data involved cross examining the proponent. This process allows participants to question and challenge assessment data and conclusions. This was the most significant way that evidence was tested by members of the public; cross examination of the proponent was conducted on all or part of 21 of the total 32 hearing days.

The third approach to examining the EIS involved a general commentary on specific research issues. This strategy was employed by two general groups – presenters in expressing opinions about the projects, and EA participants. While this strategy, often used in informal hearings, is important for recording the opinions of the general public, when integrated into a formal hearing setting, general presentations are less effective for affecting change. It is important to ensure a broad range of presenters have access to the public review of a project; as such, part of the process must include opportunities for informal presentations. However, when faced with formal hearings, participant organizations could reconsider decisions to employ this strategy as a means of testing the proponent's evidence. In the words of one participant:

> *I usually see the public's role, [to] the extent that they can, to critique the information they have been given and to identify gaps. And what I saw them mostly doing was educating the panel as to the issues out there. And that is valid sometimes, if the panel doesn't have any clue about a topic you are bringing up because it has been completely overlooked and you need to educate them. But I saw it as a real weakness in the presentation of the interveners that didn't actually say, "This paragraph dealing with wind, we disagree with it."...They gave a treatise on wind, for example, and said, "Wind is this, wind is that." I think that it meant that the panel essentially disregarded their information because that panel can only really use information that deals with the documents they have – the assessment. Even though some of it was very interesting, I don't think it was focused on what they needed it to focus on. Although this process may have been an*

> *effective tool for educating assessment participants, it was less effective and did not contribute to a larger body of alternative perspectives* (Interview 30).

As articulated by participants, the first approach was the most successful for both presenting compelling evidence in the public hearing, and promoting learning.

The Wuskwatim projects marked the third time the provincial government allocated participant funding under the *Environment Act,* SM 1987-88, c. 26. As such, there is insufficient data to recommend changes to the overarching provincial program. However, participants identified a number of remedies to strengthen the program results, which would also serve to enhance the potential of EA to promote learning. Two examples include the development of a short course on how to be an effective intervener in the hearings, which would include a component about how to manage resources allocated for participation, as well as additional direction on how to manage participant funding and/or make it through the process (Interviews 15, 16, 21, 23).

While a significant amount of money was provided to the participants of the Wuskwatim projects, findings suggest that access to financial resources is necessary, but not sufficient for effective engagement in EA. Busenburg (2000), for example, observes that, beyond access to money, successful participation is contingent on support from other organizations. Access to alternative perspectives is another aspect that contributes to successful participation, and learning (Diduck and Mitchell, 2003).

The EA of the Wuskwatim projects took steps to encourage alternative perspectives through the allocation of participant funding to EA participants and the use of expertise by the CEC; participation by government in the public review, and a more balanced emphasis on new research by the public would improve this aspect of the EA, and perhaps lend itself to more communicative and transformative learning outcomes by EA participants.

Conclusion

Participants of the Wuskwatim projects experienced a range of instrumental and communicative learning outcomes associated with the EA. This finding supports a growing body of literature that establishes an EA-learning nexus (Sinclair and Diduck, 2001; Diduck and Mitchell, 2003; Fitzpatrick and Sinclair, 2003; Diduck *et al.*, 2005) Unlike other research, including the Manitoba-based Maple Leaf EA discussed by Diduck and

Mitchell (2003), preliminary findings of this case suggest that perspective learning outcomes may have been experienced by two participants. These participants changed their basic assumptions about the relationship between the environment and the economy, which has led them to consider participating in future EAs. Although evidence of this type of learning are promising, they were limited in nature, which suggests that like the Maple Leaf EA, procedural enhancements are necessary.

Exploring the context of the learning outcomes revealed a number of strengths and weaknesses associated with EA. Access to information, as noted by Diduck and Mitchell(2003), and Webler and Tuler (2000), among others, is essential for fair participation and facilitating learning among participants. While EA documentation was available through public registries, the use of one, harmonized, electronically available public registry system would greatly facilitate public access. Likewise, efforts must be taken to provide concise, general summaries of assessment documentation, while still ensuring experts have access to the technical details required to evaluate the project.

The role of government in the EA is less widely debated principle in the EA and learning literature. In the Wuskwatim EA, the absence of the federal government during the provincial hearings resulted in procedural uncertainty and additional assessment complexity. Combined with a generally inactive provincial presence at the hearing, alternative perspectives were limited to those provided through CEC expertise and funded participants. When the approaches undertaken by some funded participants were unsuccessful, access to alternative perspectives was again compromised, impacting learning outcomes. Recommendations for procedural changes could help strengthen public participation and learning in future EAs.

These results support the use of transformative learning as a framework for understanding both the learning associated with participation in EA, and the experiences that contribute to those outcomes. The critical role of experience in framing these outcomes means that understanding participant learning illuminates procedural strengths and weaknesses associated with participation in the EA. As illustrated, the four aspects which necessitate consideration in future processes persist throughout EA and public involvement literature. This research documents that the implications of procedural weaknesses extend beyond their role as barriers to participation; the process has repercussions for both encouraging participation and promoting learning.

Manitoba is making efforts to modify the EA process to meet the needs of participants. Thus the case study can also be considered in a temporal context. Prior to the EA, steps were taken to strengthen

opportunities for public involvement that have repercussions for learning, including the inclusion of public scoping sessions, the initial effort to provide an online public registry, and provision of participant funding. The success of these is illustrated by the number of individuals and organizations involved in the review, and the range of learning outcomes associated with participation in the EA. However, more effort is needed to create a participatory process where information is easily accessible, in a suitable format, that addresses a range of alternative perspectives. Procedural changes suggested by participants, described above address the role of government in the EA, and the need for more direction for participant funding to encourage new evidence. By increasing access to alternative perspectives through the EA process, participants will be exposed to a wider variety of approaches to situations, which may impact how they think about the world, and act within it.

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Ukrainian settlement in Paraguay

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Abstract: Ukrainian settlement in Paraguay was insignificant until the mid-1930s, when immigrants from the Second Republic of Poland began to arrive in considerable numbers. Most of the newcomers were Orthodox from Volhynia, but there emerged in Paraguay a strong Protestant movement among the settlers. A minority were Greek Catholics from Galicia. Most settled in the province of Itapuá across the Paraná River from Misiones, Argentina, where Ukrainians had settled before 1914. This paper examines the religious, economic, social and historical geography of Ukrainian settlement in Paraguay and compares it with Ukrainian settlement elsewhere in the Diaspora. It also considers the evolution of the cultural landscape of Ukrainian settlement in Paraguay.

Introduction

Between 1880 and 1914 hundreds of thousands of Ukrainians from the eastern provinces of the Austro-Hungarian Empire emigrated to western Canada and the eastern seaboard of the United States. In the same period tens of thousands more settled in southern Brazil and northern Argentina, and a few drifted across the Argentinean border to locate in south eastern Paraguay, founding a small community of Ukrainians in South America's most bilingual (Guarani – Spanish) country. This small community of Ukrainians in Paraguay is a little known element of the Ukrainian Diaspora, yet it is one that displays some significant contrasts with other elements of the Ukrainian pioneer Diaspora in Brazil, Argentina, and Canada. The intention here is to offer a brief description of Ukrainian settlement in Paraguay in order to permit some comparisons with the better-documented and more widely known Ukrainian settlements in Brazil (Boruszenko 1971; Lehr and Morski 1999; Morski 2000) and Canada (Kaye 1964; Lehr, 1985, 1991; Luciuk and Hryniuk 1991; Martynovych 1991).

The Beginnings

Mass migration out of western Ukraine began in the 1880s in response to a depressing social and economic situation. Farms in the two provinces then controlled by Austria – Hungary were mostly small, highly fragmented, and inefficient. The system of inheritance whereby land was divided between all the children worsened this situation with the passing of each generation (Himka 1988; Hryniuk 1991) . Seasonal migration to the estates of Prussia developed into migration to the factories and mines of the United States' eastern seaboard by the mid 1880s. Ukrainian agricultural settlement in Brazil began in 1891, to western Canada in 1892, and to Argentina in the early years of the last century. Before the outbreak of the First World War, Canada received over 170,000 Ukrainian immigrants, Brazil absorbed between 40,000 and 45,000 while several thousand settled in Argentina (Boruszenko 1971; Martynovych 1991; Lehr and Morski, 1999). In contrast, Ukrainian settlement in Paraguay was inconsequential before 1914, but during the inter-war period Ukrainians became a part of the mosaic of ethnic settlement there.

Whereas Ukrainian settlement in western Canada has been the subject of a wide range of analysis ranging from historical (Martynovych 1991) and sociological (Swyripa 1993) to geographical (Darlington 1991, Lehr 1991), the geographical literature in English dealing with ethnic settlement in the southern cone countries of Latin America - Brazil, Bolivia, Uruguay, Paraguay, Chile and Argentina - is surprisingly limited. Boruszenko (1971), for example, provides a brief overview of Ukrainian settlement in Brazil, and Lehr, Hryniuk and Pickniki (1998), Lehr and Morski (1999) and Morski (2000) provide some further information and interpretation but most scholarly works are purely historical in their approach and accessible only in Ukrainian or Portuguese. Information about Ukrainian settlement in Paraguay is even less abundant (Cipko and Lehr 2005). Ukrainians are only one of several ethnic groups that settled in Paraguay during the period of frontier settlement from the late 1890s until 1950. The literature concerning settlement of Mennonites and ethnic Germans in Paraguay is quite extensive (Fretz 1953; Kaspar 1980) but material in English that considers the settlement of other groups such as the Ukrainians, Italians and Japanese is still very limited. In part this can be attributed to the difficulty of conducting field research in relatively remote regions, but a greater barrier for Anglophone scholars is the obvious need to have a command of Spanish or Portuguese as the languages of the host cultures as well as the language of the immigrant group being studied.

Ukrainian settlement in Paraguay began in 1910, when Omelian Illia Paduchak, born in 1885 in Rohatyn County, Galicia, entered the country.

He worked first as a labourer laying tramway rails, then purchased a homestead, in which cattle ranching and lumbering were the primary economic activities. In 1923 he married and later settled in Asunción where he later played an important role in the organizational life of the Ukrainian community (*Ukrainske slovo* 1961).

The Ukrainian community in Paraguay had its real beginnings in the 1920s when a number of Ukrainian families who had settled in Argentina re-migrated to Paraguay. Ivan and Iadokha Surkan, originally from the county of Tovmach, Galicia, left Misiones, Argentina in 1922 with their three children, crossed illegally into Paraguay and settled in Urú Sapucai, in the department of Itapúa (Semeniuk, 1999). In May 1925, another four Ukrainian families re-migrated from Argentina: all came from the village of Bludiv, in Volhynia (*Ukrainske slovo* 1971). Still more immigrants crossed from Argentina in 1925-26, The Prendeski family, for example, from the colony of Nueva Ucrania (New Ukraine) came to Paraguay from Argentina in 1926 along with the Datsiuk and Shomansky families, and settled close to Capitán Miranda in what was then all forested area. The Prendeskis, who came from Demydivka in Volhynia, had been told in Buenos Aires that there was no work in Argentina and to instead try their luck in Paraguay (Prendeski 1999). These first immigrants from Volhynia constituted the core of the future colony of Nueva Volyn, or New Volhynia (*Ukrainske slovo* 1971).

Consolidation

Most Ukrainians who settled in Paraguay immigrated in the second half of the 1930s and came directly from Europe. According to Polish statistics, which distinguish by the faith of the emigrants, but not by their nationality, 8,800 Orthodox and 900 Greek Catholics (all of whom were almost certainly Ukrainian) left Poland for Paraguay in the period 1927–38 (*Ma³y rocznik statystyczny* 1939, 53). One study has estimated that altogether approximately twelve thousand immigrants from Poland came to Paraguay in 1927–38, of which 90 percent were Ukrainian (Klarner-Kosinska 2000, 54). These figures suggest that the majority of the Ukrainian immigrants came to Paraguay from the Orthodox regions of Volhynia and Polisia in Poland, and that this group outnumbered their Greek Catholic compatriots from Galicia in the South American republic by about nine to one. This statistic is an unusual one, for rarely does one find cases of an overwhelming majority of Orthodox among Ukrainian immigrants in the New World Diaspora before 1947. Few Ukrainians came from Czechoslovakia (Subcarpathian Rus') or from Romania (Bukovyna and

Bessarabia) (*Anuarul Statistic al României)*.[1] Even after the end of WW II Paraguay did not attract many Ukrainians, probably less than 200, who were looking for a new start in the Americas (Stebelsky 1992).

Many Ukrainians who had settled in Paraguay or who were born there later crossed the border into Argentina, sometimes illegally, so that by 1994 the Ukrainian community in Paraguay has shrunk to an estimated five to eight thousand people (Rubinec and Pawliczko 1994, 455). When the Soviet Union collapsed in 1991, Paraguay failed to attract immigrants from Ukraine. As a relatively undeveloped country, its economy failed to lure those who were seeking economic opportunity in the West and its Ukrainian population was too small to trigger chain migration of relatives from the old country.

Settlement

In Paraguay, Ukrainians settled almost exclusively in the department of Itapúa, which lies on the border with Argentina, close to the town of Encarnación, which is separated from the neighbouring province of Misiones by the Paraná River (Fig. 1). The Ukrainians gave the colonies in which they settled such names as Nova Volyn, Nova Ukraina, Bohdanivka, and Tarasivka, but local laws stipulated against the use of foreign place-names, even transferred toponyms, so settlements were later renamed (Rubinec and Pawliczko 1994). A colony called Nueva Ucrania, however, still exists today, only a few kilometres from present-day Capitán Miranda.

Nueva Volyn was one of the first Ukrainian colonies, founded by largely Orthodox newcomers. It is not clear when the colony was so named, but in 1930 a colonist writing from a place called Boca Picada, "not far from Encarnación," spoke about the desire of settlers to change the name to Nueva Volhynia. He also noted that the settlers had "built nice houses" with well-kept orchards. An Orthodox priest, Reverend Tykhon Hnatiuk, gave "spiritual guidance," had "raised [the] educational level," and had encouraged the settlers to found a Prosvita society[2] (*Ukrainske slovo* 1930). By 1933 a colony bearing the name Nueva Volyn was described as

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[1] Fifty-six Russians also immigrated to Paraguay in 1937 and another fifty-nine arrived in 1938.

[2] The Prosvita Society is a Ukrainian self-help society that promotes literacy and the maintenance of Ukrainian culture and identy. Prosvita Societies were widespread in western Ukraine before 1914 and were also established by Ukrainian migrants when they settled in Canada, Brazil, Argentina and the United States.

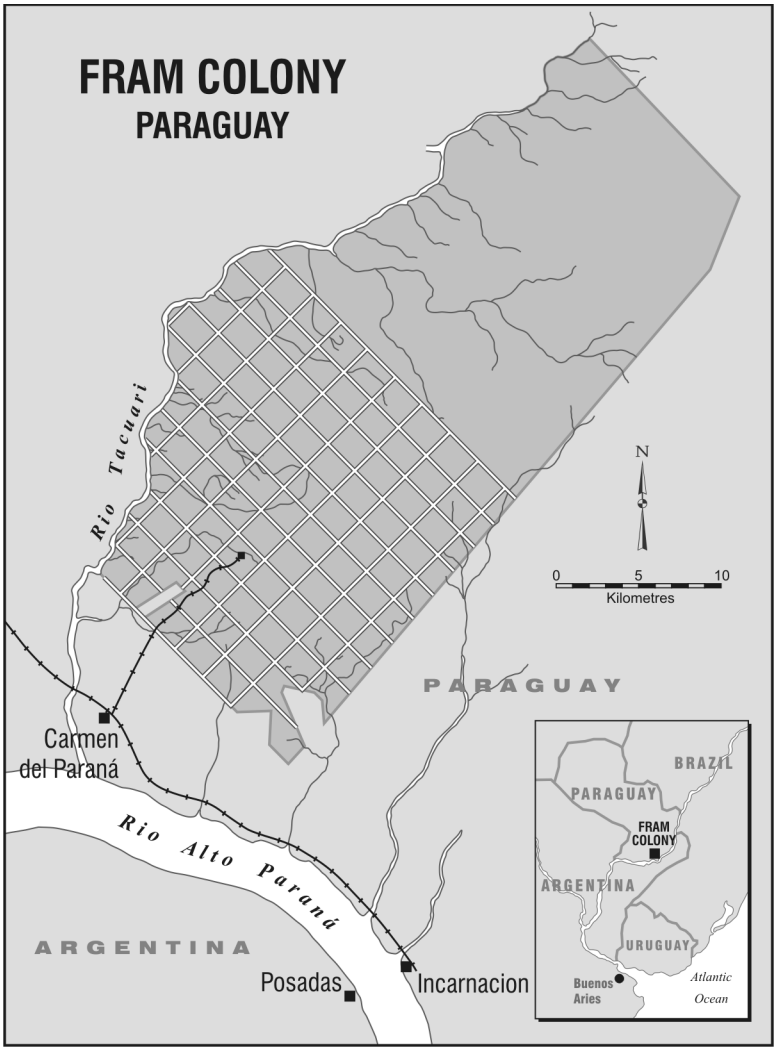

Figure 1: *Colonia Fram, Paraguay.*

neater in appearance than others in the district founded more than a decade earlier. Their economic standard was reportedly no worse than that of other colonists in the area, and they embraced co-operative labour and mutual help. Alcoholism and crime were claimed to be unknown (Hnatiuk 1933). By 1935 sixty families were living in Nueva Volyn, some sixteen kilometres from Encarnación, residing "happily in little houses of the Malo-

Russian [Ukrainian] type." About half the settlers there had bought lots paying from 50 to 60 pesos per hectare, with a 20 per cent cash deposit and the balance on easy terms. The other half leased the land, while a few had been able to buy small holdings of 15 to 20 acres, with a farm house for 1200 to 1800 Argentine pesos (Burr 1935).

With experience, a settler family was able to clear five to six acres of virgin forest a year. Trees would be felled in the summer, allowed to dry, then burned. Once cleared, the ground would be fenced, and then the process of cultivation would begin. The principal crops were corn, manioc, potatoes, oranges, bananas, and rice. Tobacco and cotton, the latter called "white gold" in promotional literature, were the staple cash crops (*Ryl'nyky!* nd.). Spring wheat was introduced in the mid 1930s. Poultry and domestic animals were kept for family consumption (Burr, 1935).

Religion

Rev. Hnatiuk, who had come to Argentina in 1908 to serve Ukrainian Orthodox settlers in the adjacent Argentinean province of Misiones, visited Ukrainian settlers in Paraguay from approximately 1925 onwards (Lavrychenko 1988, 156). After his death in 1943, a period of uncertainty ensued, until Rev. Horlenko, a postwar refugee, came to Paraguay by way of the Philippines. In 1999, the Ukrainian Autocephalous Orthodox Church in Paraguay had seven parishes: one each in Encarnación, Capitán Miranda, Alborada, Colonia Fram, Santo Domingo, Uru Sapucay, and Natalio. Migrants from Fram, who moved to the district in around 1970 after buying land there, founded this last parish in the mid-1990s. A new church was built in Fram in 1988 to mark the Millennium of Christianity in Ukraine (988), and consecrated as the "Sv. Bohoiavlennia" (the Epiphany of the Lord) (Fig. 2) (Semeniuk, A. 1999; Semeniuk, N. 1999).

Ukrainian Catholic settlers used "the spiritual guidance of Basilian fathers from Argentina" until 1948, when the first permanent Ukrainian Catholic priest, the Rev. Ivan Bugera, arrived (Kryvinsky 1969, 125-26). Rev. J. Risinger, a German priest fluent in Ukrainian, has recently served the six Ukrainian Catholic parishes in Paraguay (Rubinec and Pawliczko 1994; Zub Kurylowicz 2002).

Ukrainian settlers also have belonged to other denominations; for example, either faction of the Russian Orthodox Church. Before the close of the 1930s, the head of the Russian Orthodox Church Outside of Russia in Argentina, Archpriest Konstantin Izraztsov, founded parishes in Encarnación and Asunción (Izrastzoff 1968). Ausencio Semeniuk, a Ukrainian immigrant from Volhynia who came to Paraguay in 1937 and

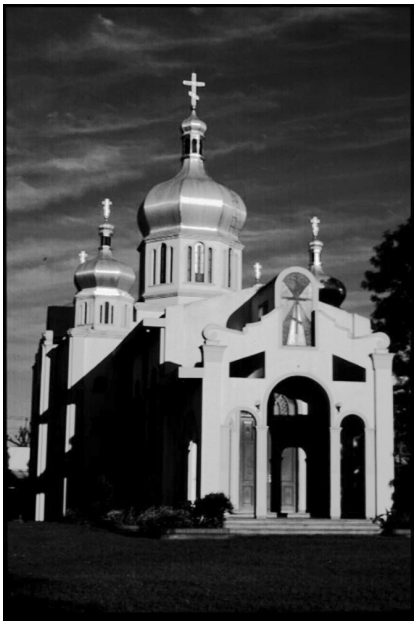

Figure 2: *Sv. Bohoiavlennia Ukrainian Orthodox Church, Fram, Paraguay. (Photo: J. Lehr, 1999).*

settled in the Fram district, when interviewed in 1999 recalled that a Russian émigré priest, Rev. Kliarovsky, would come to the colony to celebrate the Divine Liturgy in Old Slavonic at the end of the 1930s, but that also a Rev. Semeniuk—no relation—would visit as a priest of the Russian Orthodox Church Moscow-Patriarchate (Semeniuk, A. 1999). Currently, there is a single Russian Orthodox church in the department of Itapúa, the St. Nicholas Church in Encarnación (Zub Kurylowicz 2002).

Protestants were among the immigrants of the 1930s, and a Baptist influence became increasingly more pronounced as time progressed. At first Ukrainians, who constituted the majority of the Slavs in Paraguay, joined a Pan-Slavic Baptist association, which in 1947 became known as the Association of Slavic Christian Evangelical and Baptist Churches, but in the 1950s a split occurred, mirroring one in Argentina, which resulted in Ukrainophiles forming their own Union of Ukrainian Baptist and Evangelical Christians in Paraguay. It currently has churches in Encarnación, Fram, and Nueva Ucrania (Fig. 3) (Zub Kurylowicz 2002).

Society and Culture

That the Ukrainian community in Paraguay has maintained its unique identity is remarkable given that it never possessed the cultural homogeneity of many other ethnic groups that settled there. The Mennonites in the Chaco, for example, who have maintained a very strong cultural identity, were isolated from mainstream Paraguayan society both by their inaccessible and remote location as well as by their religious unity (Goodman 2003). Unlike Mennonite settlements, Ukrainian settlements were closer to larger urban settlements such as Encarnación and the town

Figure 3: *Ukrainian Pentecostal Church, Nueva Ucrania, Paraguay. (Photo: J. Lehr 1999).*

of Posadas across the Paraná River in Argentina. They were not protected from 'alien' influences by allegiance to an 'ethnic' church that held hegemony within the settlement area. In Paraguay however, Ukrainians were not subjected to legislation designed to suppress their language and culture, as were Ukrainian communities in Brazil from 1930 to 1945 during the time of the repressive Vargas regime (Lehr and Morski 1999). Their retention of their unique cultural identity was nevertheless remarkable given the small size of the Ukrainian community in Paraguay and the absence of religious hegemony by one of the Ukrainian national churches.

Contrasting the evolution of the Ukrainian settlements in Paraguay with that of Ukrainian settlements in western Canada, where the community was plagued by religious factionalism for decades, also offers insights into the role of religion and homeland relationships in determining social stability and cultural identity within newly-founded ethnic settlements. In western Canada, from the onset of mass-immigration of Ukrainians in 1896, conflict between the Greek Catholics and the Greek Orthodox was a feature of Ukrainian life. When immigrants from predominantly Orthodox Bukovyna settled adjacent to the predominantly Greek Catholic Galicians, their two churches vied for their allegiance. The result was religious factionalism, splits within communities and social dysfunction (Martynovych 1991; Lehr 2003). Although immigrants from both provinces settled in Paraguay, it was at a later time, when events in Europe had

completely changed the religious and political situation in the homeland and so the religious and social situation in Paraguay remained far more stable.

In Canada, Protestant attempts to proselytize among Ukrainian communities further disrupted communities and inflamed passions (Martynovych 1991, 214-236; Lehr 2003). In contrast, within the Ukrainian settlements the religious milieu in Paraguay was relatively harmonious. Evangelical Protestants were Ukrainians from Volhynia, so acceptance of Protestantism did not carry the same connotations as it did in Canada, where Protestantism was seen as an alien force and acceptance of its precepts conflated with attempts at assimilation by the Anglo-Canadian majority. In Canada acceptance of Protestantism was often perceived within the Ukrainian community as synonymous with rejection of Ukrainian heritage (*Kanadijskyi Rusyn* , 3 July 1918; Lehr 2002).

Ukrainians in Paraguay, whether they are Orthodox, Protestant, or Greek Catholic, belong to the Prosvita society. Established in Paraguay in 1937, today it has its headquarters in Encarnación with several branches outside of the city. A pro-Soviet movement, which had adherents in such places as Domingo Bado (where a Ukrainian-Belarusan Reading Club was formed) and Carmen del Paraná (where a Ukrainian-Belarusan Committee to Aid the Fatherland operated), it existed during the World War II years, but declined in the following decade owing to a combination of government repression and re-settlement in the USSR in the mid-1950s in response to a Kremlin-inspired "Return to the Homeland" campaign (Zub Kurylowicz 2002).

Today the Ukrainian community in Paraguay appears to be culturally robust. Many of those who live in the smaller centres are trilingual, speaking Spanish, Guarani (an indigenous language) and Ukrainian. Although the Ukrainian community in Paraguay is perhaps more fragmented along religious lines than are the Ukrainian communities in Argentina or Brazil, the Ukrainian churches still play a significant role in retaining ethnic cohesion. The vibrancy of cultural life is also bolstered by the community's proximity to the larger Ukrainian community across the Paraná River in Misiones. Cultural activities that consciously strive to maintain Ukrainian identity, and which are not associated with religious institutions, include folk dancing and, of course, consumption of traditional Ukrainian dishes such as *pyhory* (*varenyky*) and *holubtsi*, which have become icons of Ukrainian ethnicity, as they have elsewhere in the Diaspora.

Landscape

The immigrants who pioneered in Paraguay before the Second World War transferred many elements of their material culture to the areas that they settled. Most obvious, even today, is the distinctive architecture of the Ukrainian Orthodox and Ukrainian Catholic churches. Even the religious buildings of the evangelical groups proclaim their ethnic affiliation, though through signage rather than architecture (Fig. 3).

In settlements such as Fram and Nueva Ucrania, and in the countryside around them, Ukrainian elements are clearly visible in the design, layout and décor of domestic buildings. As did their counterparts in Canada, Brazil and Argentina, Ukrainian settlers in Paraguay built in the ways that were familiar to them in the old country. The sub-tropical climate necessitated some adaptation of traditional designs just as it did in Brazil. The indoor traditional clay stove (*pich)*, for example, was impractical and redundant in Paraguay, so was placed outside of the house, removing the need for the central chimney that was a hallmark feature of the Ukrainian folk house in the colder climates of Canada and Ukraine (Fig. 4).

In the inter-war period many houses were built using the same construction methodologies that would have been found in Ukraine, or western Canada. Log-construction was common, using post and fill or horizontally laid corner-notched logs, but as elsewhere was concealed by whitewashed or painted mud plaster. The similarity to the architecture of the old country was sufficient to draw comment from visitors to the colonies in the 1930s. At the turn of the twenty-first century, the landscape of Ukrainian settlement still carries a strong ethnic signature, although as elsewhere in the New World Diaspora, older buildings are falling prey to the ravages of time and the pressures for modernization. The Ukrainian impress on the cultural landscape of Itapúa will fade as buildings are slowly replaced but it will be many years before it disappears (Figs. 4, 5, and 6). The traditional style of wagon brought from Ukraine, which in Paraguay, as in Argentina, is known as the 'carro polaco" is still widely used by farmers in the Ukrainian settlements (Fig. 7). Whereas in neighboring province of Missiones, in Argentina, the carro polaco is now seldom used and has become a Ukrainian pioneer icon of sorts, it is still widely employed by Ukrainian farmers in Paraguay (Lehr and Cipko 2000). Its endurance there is partly because of the slower pace of modernization in Paraguayan agriculture and also because Ukrainian farmers in Itapuá find its design to be well adapted to the hilly terrain of the region (Bratuz 1999; Prendeski 1999). The introduction of electricity into the rural areas of Itapúa in the late 1960s has accelerated the rate of change in material culture but it has not yet lead to the abandonment of traditional culinary

Figure 4: *First house of Stefan Bratuz, built ca. 1930, Nueva Ucrania, Paraguay. (Photo: J. Lehr, 1999).*

Figure 5: *Second House of Stefan Bratuz, built ca. 1955, Nueva Ucrania, Paraguay. (Photo: J. Lehr, 1999).*

Figure 6: *Lisnichuk farm house, Capitán Miranda, Paraguay. (Photo: J. Lehr, 1999)*

Figure 7: *Carro Polaco, Nueva Ucrania, Paraguay. (Photo: J. Lehr, 1999).*

Figure 8: *Luba Bratuz baking bread in outdoor oven, Nueva Ucrania, Paraguay. (Photo: J. Lehr,1999).*

practices. In the rural areas, bread is still baked in the outdoor *pich* in the traditional fashion, albeit with a sub-tropical touch as the dough is placed into the oven on a banana leaf (Fig. 8).

Conclusion

The Ukrainian settlements in Paraguay remain a little known element of the Ukrainian pioneer Diaspora. Its location in a less-developed country that lacks the infrastructure and commercial institutions of neighbouring Argentina has made it a less attractive destination for prospective immigrants than other parts of the Diaspora. Although the Ukrainian community had set up a relief committee to assist postwar refugees to resettle in Paraguay, and the Paraguayan government was prepared to allow tens of thousands of Ukrainians to come to the country, more ended up going to other overseas destinations such as Australia than to the land-locked South American republic. Even fewer came in subsequent decades. Even after 1991, when the collapse of the USSR resulted in the lifting of restrictions on emigration from Ukraine, few Ukrainians immigrated to Paraguay.

Although it has not enjoyed the religious unity, nor the recent infusion of new immigrants as have its neighbouring settlements in Brazil and

Argentina, the Ukrainian community in Paraguay has nevertheless kept its cultural integrity to a significant and remarkable degree.

The Ukrainian community in Paraguay also offers a fascinating contrast to the Ukrainian experience in Canada where Ukrainian communities saw religious feuding and a measure of social dysfunction for decades. In any analysis of the Ukrainian pioneer Diaspora an understanding of the Ukrainian experience in Paraguay will be essential for a full comprehension of the role played by geography, history and religion. Even today geographical contiguity, its compact nature, and relative isolation still protect its fragile status as a Ukrainian community in the land that the indigenous people, the Guarani, call the Land of the Crowned River – in their language: Paraguay.

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Provincial dominance: the unique case of Winnipeg

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Abstract: This paper identifies Winnipeg as a unique city within the Canadian urban system. While it is not among the largest cities in Canada, it dominates the province of Manitoba in a way that other capital cities and large cities do not. Statistical evidence for this domination is presented followed by historical reasons for its development. The economic and political effects on Manitoba are discussed. The city should not be discounted because of its decline in position at the national scale.

Introduction

When one thinks of the most powerful cities in Canada, Toronto, Montreal, Calgary and Vancouver quickly come to mind (McCann and Gunn 1998). At the provincial scale however, there is another city that appears to have more influence over its province than any other Canadian city. That city is Winnipeg. This paper will present evidence from the 2001 Census to support this claim. Four historical explanations for this situation will be argued. A review of provincial-municipal relationships across Canada will demonstrate the unique position of Winnipeg within Manitoba. The political structure of the province will further explain a number of actions taken by the provincial government to increase the economic and social importance of Winnipeg. Collectively, these factors give Winnipeg a unique position among Canadian cities.

Much has been written about urban systems and the development of urban hierarchies. Stutz and Warf (2005) review two theories about the development of urban hierarchies. The central place model proposes that urban growth is related to the provision of services to a surrounding urban region. The provision of a wider variety of services leads to an increase in city size. This was demonstrated in the American Midwest by Borchert and Adams (1963), who found an eight level hierarchy of urban

places. The economic base theory attributes city growth to economic activities beyond the urban region. The provision of a larger number of basic activities leads to larger city size. Particularly, cities that provide only primary and secondary economic activities are less likely to grow than those providing quaternary and quinary activities. McCann and Simmons (2000) note a division in the Canadian urban system in which the largest cities are in the heartland and contain most of the quinary and quaternary service industries. Smaller cities are in the hinterland and depend on primary, secondary or tertiary industries, which have lower average incomes and therefore generate smaller multiplier effects within the local economy. Vance (1970) and Burghardt (1971) identified the importance to city growth of a gateway position between a resource area and a market area. The gateway city has a basic function linking its region to the rest of the world and also supports the development of central places in its hinterland.

Ziph (1949) found a statistical relationship between city sizes and their rank in the urban hierarchy. Listing the cities in order largest to smallest and dividing the population of the largest city by the rank of the city in question provides an estimate to the size of that city. Thus if the largest city has a population of 1 million, the second city should be 500,000, the fourth city 250,000 and so forth. An alternative model is that of the primate city. Here, the largest city is at least five times larger than the second largest city and the remaining cities are all rather small, thus a hierarchical structure does not exist.

McCann and Simmons (2002) note that Canada has a weak urban system, with 36 per cent of all its cities in Ontario and Quebec. The relationship to the rank-size rule is also weak. An application of this model to the 25 largest cities in the Canadian urban system finds only eight cities fall within two per cent of the predicted populations. Montreal is 46 per cent larger than expected and Vancouver is 29 per cent larger than expected. Edmonton, Winnipeg and Hamilton are all over 15 per cent larger than predicted. Conversely, Ottawa, Kitchener and Saskatoon are over nine per cent smaller than expected and all of the eight smallest cities are between 24 per cent and 35 per cent smaller than predicted. There are probably a number of factors at work here including Montreal's cultural differences, Vancouver's distance from the centre of the country, and a general migration of people from smaller cities to larger cities (Bourne 2002).

At the provincial level, Ontario with eleven cities over 75,000 population linked to Toronto has the most complete urban system. Quebec has five cities over 75,000 linked to Montreal. Alberta and Saskatchewan both have two large cities and no medium sized cities in the 75-150,000 range. British Columbia has an urban system in the southwest corner of the

province based on Vancouver and Victoria. The Maritimes have a weak urban system. Moncton is the geographical centre for the four Maritime cities: Saint John, Fredericton, Halifax and Charlottetown, but Halifax is the largest city and Charlottetown is smaller than 75,000 (Wallace 2002). Primate cities exist in four provinces: British Columbia, Quebec, Newfoundland and Manitoba. Manitoba has only four urban places of consequence: Winnipeg, Brandon, Thompson and Portage la Prairie. Thompson, as a mining community, is linked to external markets rather than to the other three cities, which have agriculture-based economies (McCann and Simmons 2002). It is this province that will be explored in more detail below.

Statistical Arguments for Dominance

The following analysis examines 21 cities across Canada. These cities represent the two largest cities in each province and the three largest in New Brunswick. In five of Canada's provinces the largest city is also the capital city, thus the capital city and the second largest city were selected in each of these provinces. In four other provinces there is one city larger than the capital. Thus, the largest city and the capital were chosen. New Brunswick has two cities larger than the capital, thus three cities were chosen (Table 1).

The Census defines a Census Metropolitan Area (CMA) as a core urban area with a population of over 100,000, together with adjacent urban and rural areas, which have high degrees of economic and social integration with the core. A Census Agglomeration (CA) identifies one or more adjacent urban places with a population over 50,000. This group of 21 cities includes Canada's eight largest CMAs, all of the other CMAs outside of Ontario and Quebec, and seven CAs. that are significant provincially.

The 2001 Census provides statistics that can be used to measure the relative political power of large cities within their provinces. First, the Census allows the calculation of city population versus total provincial population. Although the provincial governments often provide rural areas with more seats per capita, Lightbody (1995) notes that a large city will still have a larger number of representatives in the legislature and as such more political power. Secondly, the distribution of the remainder of the province's population, and therefore of seats, is also important. A primate city has a larger difference in population between itself and the second largest city and thus has a greater plurality and greater political power. In provinces with two large cities, neither will have as large a plurality either within the province or against the other city (Table 1).

Table 1: *Major Provincial cities in Canada.*

PROV.	CITY	STATUS		POPULATION CMA/CA	% of PROV. POPULATION	Pop. LARGEST CITY/2ND CITY
BC	Vancouver	CMA	largest city	2,048,800	50,8	6.4
	Victoria	CMA	capital	317,500	8.0	
AB	Calgary	CMA	largest city	953,000	32.0	1,1
	Edmonton	CMA	capital	944,200	31.5	
SK	Saskatoon	CMA	largest city	232,600	23.1	1.2
	Regina	CMA	capital	200,500	19.7	
MB	Winnipeg	CMA	capital	681,100	60.0	16.1
	Brandon	CA	2nd city	42,242	3.7	
ON	Toronto	CMA	capital	4,751,400	41.0	4.4
	Ottawa	CMA	2nd city	1,081,000	9.3	
QC	Montreal	CMA	largest city	3,480,300	47.3	6.4
	Quebec	CMA	capital	689,700	9.4	
NB	Saint John	CMA	largest city	127,700	16.9	1.4
	Moncton	CA	2nd city	90,359	12.0	
	Fredericton	CA	capital	54,068	7.2	
PEI	Charlottetown	CA	capital	38,114	43.1	3.6
	Summerside	CA	2nd city	14,654		
NS	Halifax	CMA	capital	356,000	39.6	3.4
	Cape Breton	CA	2nd city	105,968	11.4	
NF	St. John	CMA	capital	175,100	33.7	4.2
	Corner Brook	CA	2nd city	42,000	7.5	

The 2001 Census shows that British Columbia and Quebec have striking similarities. The largest cities, Vancouver and Montreal, contain about half of the provincial population, and their capital cities are about six times smaller than the largest city (Table 1). Among provincial capitals, Victoria and Quebec rank eighth and ninth in terms of proportion of their provincial populations.

Saskatchewan and Alberta both have two cities of approximately equal size, with the capital being the smaller of the two in each case. This pattern reduces the percentage of the provincial population in both the largest city and the capital. New Brunswick is the only province with two cities larger than the capital. Saint John and Moncton are almost equal in size and Fredericton is just 2.3 times smaller than Saint John. Among the provinces, New Brunswick has the lowest percentage of the provincial population in the largest city, and among capital cities, Fredericton has the lowest percentage of provincial population.

Not surprisingly, the capital cities that are also largest cities in their province all have a larger proportion of the provincial population than the capitals that are not largest cities. All of the capital cities that are largest cities also have a larger proportion of the provincial population than do Saint John, Saskatoon or Calgary. Only Montreal and Vancouver surpass four of the capitals that are also largest cities. Winnipeg has the largest proportion of the provincial population of any city in Canada.

A comparison of statistical dominance of the largest city in the province over the second largest city shows that Alberta, Saskatchewan and New Brunswick have the smallest differences. St. John's is slightly more dominant than Vancouver and Montreal, but again, Winnipeg is over 16 times larger than Brandon, a lead that is 2.4 times greater than St. John's over Corner Brook. Further, unlike Vancouver and Montreal, Winnipeg has the added advantage of being the capital city.

The above calculations are based on CMA and CA statistics. Sancton (1994) states that the standard belief in Canada has been that it is best for both economic development and the provision of public services, if the CMA is a single municipal unit. The city's power within the provincial legislature should also be strengthened with a single municipal unit. The continuous growth of urban areas and the more static placement of municipal boundaries make a 100 per cent fit unlikely. In Canada there exists a considerable range in values (Table 2).

In eastern Canada, five of the nine capital cities and largest cities contain between 50 and 60 per cent of their CMA or CA populations. Moncton, the lowest, has been intentionally divided into French and English municipalities by the province (Sancton 1994). High values for Halifax and Cape Breton (Glace Bay/Sydney) reflect newly created boundaries for these cities. The CAs of Summerside and Corner Brook are the two smallest cities in this study and their high values may reflect that they are too small to suffer from any significant urban sprawl.

In Ontario, Quebec and British Columbia there are two-tier governments in the major cities, except Toronto. The city of Ottawa has the highest proportion of its CMA population among two-tier cities, but it has the problem of a CMA divided between two provinces. The unified Metropolitan Toronto has barely half of its CMA population. The cities of Montreal and Quebec have even lower values. Vancouver and Victoria also suffer from being a small part of their respective CMAs within a system that has weak upper tiers compared to Ontario and Quebec (Wallace 2002).

The cities of western Canada all have high values. In Alberta and Saskatchewan cities have been able to expand by amalgamation or annexation of neighbouring municipalities. When the one-tier Unicity of

Table 2: *City population as a percentage of CMA/CA.*

Census Agglomerations		**Regional Governments**		**One-Tier Cities**	
Brandon	96.8	Halifax	99.9	Calgary	92.4
Glace Bay	96.9	Ottawa	72.8	Regina	92.4
Summerside	90.5	Toronto	53.0	Winnipeg	92.3
Corner Brook	78.1	Montreal	30.3	Saskatoon	87.1
Fredericton	58.5	Vancouver	27.5	Edmonton	71.0
Charlottetown	5.3	Quebec	24.8	St John's	57.4
Moncton	1.9	Victoria	23.8	Saint John	56.8

Winnipeg was created in 1972 by amalgamating the city and 12 other municipalities, it contained 99.1 per cent of the CMA population. Growth beyond the city limits over the past thirty years and the withdrawal of the municipality of Headingley from Unicity in 1992 has reduced that figure (Sancton 1994). It now stands at 92.3 per cent, which is still third highest among all CMAs. Brandon is the third smallest CA in the study and has not yet expanded significantly beyond a large territorial annexation made in 1972 (Welstead, Everitt and Stadel 1988).

This section has demonstrated that Winnipeg dominates its province by having the largest percentage of the provincial population of any city in Canada, the largest separation between the largest city and the second largest city in Canada, and over 90 per cent of its CMA population within its municipal boundaries.

Further, status may be obtained as the provincial capital, regardless of size. For example, when speaking about the provincial government, the media often refer to it by mentioning the name of the capital city. Winnipeg is such a capital city.

Historical Arguments for Dominance

The findings presented above are clearly the result of historical events; however there is much discussion as to exactly which historical events are of most significance. Four arguments can be presented to explain the early development of cities on the prairies between 1880 and 1920.

First, Simmons and Simmons (1969) argue that the relative size of Canada's cities is related to factors of site and situation. In western Canada,

the prairie grasslands may be viewed as a triangle with the foothills of the Rockies as the base, and the narrow area between Lake Winnipeg and the United States border as the apex. In Alberta and Saskatchewan there is room for two cities in each province, one in the south (Calgary and Regina) and one in the parkland area (Edmonton and Saskatoon). After the arrival of the railways, Calgary and Edmonton acted as gateways through the Rockies. Regina and Saskatoon had large service areas but no gateway function, and thus are smaller.

In Manitoba there is only room for one major city at the gateway between the Canadian Shield and the grasslands. In the days of the fur trade when water transportation was vital, the confluence of the Red and the Assiniboine Rivers was the most accessible location in the apex of the prairie triangle. It was chosen for the Red River Settlement in 1812. Later, Winnipeg attracted the railway and by 1891 it had a population of over 25,000 when no other community in the west had reached 4,000 (Artibise 1992). Located between Winnipeg and Regina, Brandon has a limited hinterland and no gateway function, thus it had the least opportunity to grow.

Second, Code (1996) places the most importance on the actions of the federal government. The National Policy promoted the settlement of the west, the building of the railway, and the development of east-west trade with special freight rates that made Winnipeg a wholesale centre. These developments stimulated a wide variety of financial and commercial functions as well (Phillips 1981). Brennan (1981) credits community success directly on the railways. Winnipeg had connections to St. Paul prior to the arrival of the Canadian Pacific Railway (CPR). By 1911, Winnipeg was not only a key station on the CPR, but also on the Grand Trunk Railway and the Canadian Northern Railway.

It was generally felt that the CPR would follow a northern route from Winnipeg to Edmonton and through the Yellowhead Pass. The CPR, however, recognized that there was already considerable settlement along this route and therefore that it would be cheaper for them to strike out due west across the empty plains, creating a new line of cities as they went. Later, north-south connections between Calgary and Edmonton, and Regina and Saskatoon would aid in the development of the two sets of twin cities. No similar north-south connections happened in Manitoba.

Third, at the local scale, the decision to move through unsettled territory made it necessary for the CPR to build division points at about 200 kilometre intervals (Phillips 1981). Brandon, Calgary and Swift Current are such points. Speculators were developing communities ahead of the track and the CPR shifted its lines to avoid them. For example, a community was built on the north side of the Assiniboine River just east of Brandon

at the point where the railway was expected to cross the river. Instead, the CPR crossed the river to the east of the community and established Brandon on the south side of the river (Welsted, et al. 1988). Similarly, a community existed on Wascana Creek and the CPR decided to cross the river a few miles to the south, where they established the town of Regina (Brennan 1981).

Fourth, Artibise (1992) attributes the growth of specific cities on the prairies to a growth ideology and boosterism on the part of civic leaders who felt they were in competition with other cities. Phillips (1981) included as important parts of boosterism: claiming city status early, attracting railways, court houses, universities, and other major government functions, and the provision of public services while keeping land taxes low.

While these factors may explain the growth of the five largest cities on the prairies, it does not explain the inability of Brandon to keep up with Winnipeg. Brandon was the second largest city on the prairies until 1906. In 1882 it became the first prairie community, after Winnipeg, to claim city status. It had been founded by the CPR and had attracted the Canadian Northern Railway in 1906 (Welstead et al. 1988). The Brandon Mental Health Centre founded in 1890, had 645 patients by 1910 (Refuiki 1991). Brandon College was founded in 1899 and the city had a courthouse, a municipal water system, ten miles of streetcar tracks, and a municipal airport before WWI (Welstead et al. 1988). Despite all these characteristics, Brandon fell from second place to seventh place by 1916 as new towns in Alberta and Saskatchewan grew faster.

It would appear that all four arguments contributed to urban growth, but community boosterism and railway construction could not overcome some basic elements of site and situation. Winnipeg's gateway function allowed it to dominate Manitoba while Saskatchewan developed twin central place cities and Alberta's central places became gateways through the Rockies to the new port of Vancouver.

Economic Growth of Winnipeg after 1950

The foregoing authors agree that the pattern of prairie settlement was established by 1914. In the decades that followed, economic and political reasons can be identified which account for the differential growth of existing cities. The rapid growth of Calgary and Edmonton can be attributed to increased trade through Vancouver with the opening of the Panama Canal, the development of the oil industry after 1949, and the subsequent rapid rise in oil prices during the 1970s. Diversification into minerals allowed Regina and Saskatoon to grow (Code 1996).

Meanwhile, Winnipeg was losing control of the agricultural economy with the removal of special freight rates, the replacement of the private railways with the Canadian National Railway, the creation of the wheat pools in the 1920s, the Depression and drought of the 1930s and the mechanization of agriculture in the 1940s (Phillips 1981). The loss of wholesale trade to Regina and Saskatoon and to direct mail order from Ontario further hurt Winnipeg during the 1930s. The stagnant agricultural base of Winnipeg caused it to fall from Canada's third largest city in 1921 to seventh place in 1971 (Yeates 1990) and ninth by 2001 (Wallace 2002).

In recent years Winnipeg has grown more rapidly and may again surpass Quebec City. This growth has been due to diversification into aerospace, biotechnology and other industries, and the growth of back office services (Destination Winnipeg 2006). GDP growth has been above provincial and national averages, unemployment has remained low, personal incomes have risen as have housing starts and consumer spending. Airport passenger and cargo traffic have also increased (Destination Winnipeg 2006). An examination of major Canadian cities shows Winnipeg's economy is still dominated by the transportation sector and that communication industries are also important (Wallace 2002).

Brandon has remained dependent on the surrounding agricultural economy and did not prosper from the development of mining and forestry in northern Manitoba (Code 1996). Diversification in Brandon has been limited to new agricultural products such as hogs and potatoes. Tourism and back office jobs have also grown. Simmons and Simmons (1969) note that capital cities tend to grow in good times and bad, while the growth of commercial service centres, such as Brandon, tends to be cyclical. Winnipeg thus continually increased its dominance over Brandon.

Artibise (1990) attributes post 1920 growth patterns to a loss of local control and an increase in provincial control. As the business elite lost control of city councils the importance of the growth ethic declined. Further, the rise in importance to the local economy of national and international firms also decreased local boosterism. The locational strategies of these companies affect local growth but are not based on local concerns. Meanwhile, the provincial governments used conditional grants to direct development. Alberta in particular, used oil revenues to maintain Calgary and Edmonton at roughly the same size.

Code (1996) also notes increased federal government involvement in the west including: equalization payments (1957), the Agricultural Rehabilitation and Development Agency (1961), the Federal Fund for Rural Economic Development (1965), the Department of Regional Economic Expansion (1969) and the Department of Western Diversification (1987). Recent Federal Infrastructure Grants have continued this history of upper level government intervention in local growth patterns.

Provincial Municipal Structures

Interaction between urban areas and their provincial governments is worthy of further investigation. Each of the provinces has a single ministry to deal with municipalities, although there are some variations. Following a Royal Commission in 1967, the province of New Brunswick dissolved its county system and allowed rural municipalities to revert to unincorporated status. The province took over health, education and welfare services, leaving the municipalities with local services only. Beginning in 1992 the province began to amalgamate communities coterminous with large urban areas (Diamant and Pike 1996). Nova Scotia followed a similar path encouraging the inter-urban sharing of facilities (Tindal and Tindal 1995). The creation of regional governments for the Halifax and the Glace Bay/ Sydney areas is the culmination of a process that began with the Halifax-Dartmouth Authority in 1962. Saskatchewan has taken the opposite route. Their 1984 Urban Municipalities Act set the population of an urban area at 100 inhabitants and gives the province more municipal governments per 100,000 population than any other province (Diamant and Pike 1996). The cities of Regina and Saskatoon are eligible for the same grants offered to all other municipalities.

Two provincial governments have decided to divest themselves of most of the costs of municipal government. The Alberta Municipal Act of 1994 consolidated the municipal structure and cut provincial spending on highways and policing. Municipalities were given greater autonomy and authority, allowing them to privatize services if they wished (Diamant and Pike 1996). British Columbia's Municipal Government Act of 2002 gives similar responsibilities and authority to municipalities while reducing provincial grants (British Columbia 2002). In both Alberta and British Columbia, neither capital cities nor the largest cities have special status at the provincial level.

In 1988 the Ontario government created the Office of the Greater Toronto Area (GTA). This is a group of provincial ministers and local mayors assigned to guide the development of Toronto and the Regions of Halton, Peel, York and Durham. The area of the GTA is slightly larger than the Toronto CMA. Sancton (1994) argues that Metropolitan Toronto is too small a unit but political expediency will prevent further changes to the GTA structure. A similar situation exists in Montreal where a Ministerial Committee for the Development of Grand Montreal was established in 1990. This includes the Montreal Urban Community (the island of Montreal) and the surrounding 13 Regional Municipalities (MRC). Grand Montreal is slightly larger than the Montreal CMA. While both of these structures give some attention to the provinces' largest cities, the city remains only a part of a larger metropolitan area.

Once again, Manitoba is unique. The creation of Unicity in 1971 also resulted in the creation of a Ministry of Urban Affairs with the sole responsibility of looking after Winnipeg and allowing it to avoid various provincial rules and regulations designed for smaller municipalities (Sancton 1994). Brandon, although it is the second largest city, was only eligible for grants from the Ministry of Rural Affairs, most of which were designed for much smaller communities. Brandon has had to resort to reviving local boosterism to deal with its urban problems (Horne 2001). The Ministry of Urban Affairs and the Ministry of Rural Affairs were amalgamated in 1999, however, in 2002, the new City of Winnipeg Act gave the city the powers of a corporation, allowing it to undertake actions without specific provincial legislation instructing it to do so (Romanowski 2002). This should provide it with opportunities not available to other municipalities in the province and therefore allow it to maintain if not increase its primate position. Winnipeg is also the only municipality in the province with full time councilors on its city council. In 2005 Brandon's charter was changed to give it greater power over local planning by disbanding the previous planning area, which was dominated by the surrounding rural municipalities (Brown 2006b).

Provincial Involvement in City Growth

The unique situation provided to Winnipeg by the province and other financial advantages described below, reflect the structure of the Manitoba government. There are 57 seats in the provincial legislature of which 31 are in Winnipeg while Brandon has only two. No other urban area has specific representation. Over the past forty years, the party in power has had between 25 and 33 seats. The current NDP cabinet consists of 16 members with ten from Winnipeg including the Premier and Deputy Premier. Both Brandon members are also in the cabinet.

The economic and social advantages given to Winnipeg over the years have not gone unnoticed by those who live outside of the city. Collectively these complaints are summed up in a general protest that the government, regardless of political affiliation, suffers from "perimeteritis", a reference to the circle highway around the borders of the city. This city-centred view became particularly apparent during the Red River flood of 1996 when the highway was used as a control structure to prevent flooding in the city at the expense of surrounding farmland.

Another significant complaint across the province, frequently picked up by the media, relates to health care. Differential payments to doctors who work in Winnipeg compared to those providing the same services

outside of the city contributes to a shortage of specialists in rural areas and not only causes personal distress for the sick and their families, but also forces rural residents, including those from Brandon, to seek medical attention in Winnipeg (Horne 1999). This travel brings additional money into the city at the expense of municipalities across the province. Brandon's MLAs however, point out that the province did provide $58 million for the expansion of Brandon's hospital facilities (Brown 2006a).

Further, when the provincial lottery was established, the revenues were assigned to ten arms-length committees for distribution. Six of these organizations operated province wide, but the other four (The Red River Exhibition Association, Le Festival de Voyageur, the Folk Arts Council of Winnipeg and the Winnipeg Blue Bombers Football Team), were Winnipeg based organizations (Horne 1997). This situation provides more cultural and recreational opportunities to city dwellers than to others, and encourages travel into the city. When the province began receiving complaints about this situation, it moved the lottery funds into general revenues so that it could not be so easily traced to the ten committees, which still exist.

Even when the government tries to appease the non-Winnipeg population, it runs into complaints. The former Progressive Conservative government moved some minor offices to rural municipalities claiming this would create jobs outside of Winnipeg. The logic for some of these moves was questioned. The schoolbook depository was moved to Souris, in southwestern Manitoba, even though most of the schools are located in the Winnipeg area. Significant transportation costs have been incurred in order to create six new jobs in Souris.

In 2006 a Brandon city councilor said he would file a complaint with the Manitoba Human Rights Commission against the provincial government because Winnipeg has two casinos, a horse track, and private wine stores and Brandon is not allowed to have the same economic opportunities (Brown 2006a). Further investigation found that in 2002 Brandon was offered a First Nations run casino but voted the proposal down in a plebiscite. The province gives Winnipeg's racetrack $5 million a year plus a cut of video lottery terminal (VLT) revenues. A proposal to open a track in Brandon stalled when the province refused to allow the requested number of VLTs saying that no new machines were being allowed in the province. With respect to wine stores, a business wanted to open in Brandon but could not obtain a license (Brown 2006b). Brandon's two MLAs, who are cabinet ministers, argue that the former Conservative government opened Winnipeg's wine stores and it is not NDP policy to open such stores (Brown 2006a).

Brandon's mayor added that Winnipeg gets $1.2 million from the province for tourism promotion while Brandon gets nothing. Brandon spends $200,000 annually on tourism promotion. The province provides $2.7 million in operating funds to the Winnipeg Convention Centre but Brandon's Keystone Centre has only been able to get capital grants and some relief of its debt. The mayor also argued that Brandon has not participated in provincial out of province trade trips that include Winnipeg business and civic leaders (Brown 2006a, 2006b).

The provincial government has supported, in principal, the expansion of Brandon's community college. The problem, according to the MLAs has been that while Winnipeg was prepared to share the cost of expanding Red River College, Brandon city council has baulked at contributing to Assiniboine Community College's proposed new facilities (Brown 2006b). The provincial government maintains that it does not favour Winnipeg over other parts of the province. Winnipeg's sheer size within the province makes it inevitable that it will have a wider range of services and therefore more facilities and functions to be supported.

Conclusion

From an historical perspective, Winnipeg was the first city on the prairies, the first capital city, the first railway city, and the gateway of commerce into the mid-twentieth century. While its position at the apex of the prairie triangle proved advantageous in the beginning, it eventually allowed for the development of more service centres near the base of the triangle. When these cities found an alternative access to the world via Vancouver, and an alternative resource base with the petrochemical industry, Winnipeg lost some of its status in the west and an urban system developed in Alberta. However, Winnipeg was able to maintain its dominance within Manitoba where no similar urban system developed.

Indeed, at the provincial level, Winnipeg now has a much greater dominance over its province than is the case for any other provincial capital or major city in Canada. Its diverse economy provides opportunities of continual growth when other Manitoba centres suffer from the cyclical growth of one-industry communities. Further, while Toronto, Montreal and Vancouver are small parts of their CMAs and must compete with surrounding municipalities for economic growth opportunities, Winnipeg includes 92 per cent of its CMA population and still has room for expansion within its municipal boundaries.

Winnipeg's sheer size gives it a commanding voice in the provincial government. For three decades Winnipeg had its own provincial

government ministry, unique in Canada, and under the new City of Winnipeg Act it will continue a special relationship with the province not found elsewhere in Canada. Unlike British Columbia and Alberta, which have chosen to divest themselves of municipal expenditures, Manitoba continues to provide financial support to Winnipeg.

Much of the literature on the Canadian urban system tends to discuss the competition between Montreal and Toronto and the growth of Vancouver and Calgary. Winnipeg's decline in position on the national scale has led to it becoming a historical footnote. However, Winnipeg remains a unique city in the Canadian urban system and one worthy of discussion.

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Bicycle tourism: on the trail to economic development

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Abstract: Bicycle tourism has remained on the fringes of the North American tourism industry while it has been in the European mainstream. A recent increase in bicycle tourism in Canada and the United States, however, has brought this phenomenon to the attention of many jurisdictions, and they are viewing cyclists as a potentially lucrative clientele.

Minnesota began developing a system of bikeways in the 1970s and several trails in their system have developed into popular tourist draws and bicycle tourism has been seen as a great success. This paper discusses the essential ingredients of bicycle tourism and examines the role of trails in tourism development using Minnesota as a case study.

Introduction

A long-time tourism staple in many European countries, bicycle tourism is emerging in North America as a popular and economically viable market. This growth has been restricted to a few geographical areas, and in many cases has been focused around trail networks. According to Lumsdon (2000) there is an increasing latent demand in North America for bicycle tourism, although it has only been successfully developed in a few North American jurisdictions, including Minnesota

Traditionally the mainstream has consumed a mass tourism product based on regeneration and relaxation that has often focused on "sun, sand and sex" tourism or a commercialized version of an area's history and culture. These forms of tourism are generally associated with high costs to host communities, either of a social or environmental nature. In recent decades, however, there has been a change in the market as a public that is better traveled and more discerning is demanding more variety in tourist needs, types and patterns. The "special interest tourism" that has risen

from such demands places an emphasis on the environmental and social aspects of travel and effectively has given rise to the "humanization of travel" (Weiler and Hall, 1992, 2).

Bicycle tourism is increasing in popularity because of its appeal to aging populations and the manner in which it can straddle the boundaries between heritage, adventure and sustainable tourism. Cycling also provides a tourism experience that allows for the participant to enjoy the journey as much as the destination, thus addressing the manner in which modern travel in airplanes and on uniformly designed highways "provides little pleasure or substance" (Siddall, 1987).

This paper will briefly discuss the phenomenon of bicycle tourism and will examine the role trails play in its development. Minnesota, which is home to the largest network of paved trails in the United States, will be used as a case study to further understand what makes trails successful tourism generators and will identify the shortcomings of that state's bicycle network.

Bicycle Tourism: What is it?

Bicycle tourism can be defined as "recreational visits, either overnight or day visits away from home, which involve leisure cycling as a fundamental and significant part of the visit" (Sustrans 1999,1). This definition encompasses various forms of cycle tourism including mountain biking and daytrip cycling.

Mountain biking arguably accounts for most bicycle tourism activity in North America. The sport entered the mainstream relatively recently and over the last two decades has experienced immense growth. Between 1990 and 1992 mountain bike ownership in the United Sates increased 66 per cent. Over a ten-year period the Slickrock Trail in Utah, one of the premier mountain biking destinations in the world, saw its annual ridership increase from 1000 riders in 1983 to 90,000 in 1993 (Morey *et al*. 2002). By 1996 the number of riders increased further to over 113,000 per year (Chakraborty and Keith, 2000).

This paper will focus on the bourgeoning phenomenon of bicycle touring, which can be defined as traveling between points by bicycle for recreational purposes and involving at least one night away from home. Tours can range from weekend trips around a scenic area to months long rides across a country or continent. Such rides may be self-organized or booked through a commercial tour operator and may involve camping, staying at hotels or hostels or combinations of lodging choices.

Bicycle Tourism: Who does it?

Various market-segment studies have painted a portrait of the typical cycle tourist as a middle-aged Caucasian, approaching or at retirement, who is well educated and well paid (Velo Quebec 2000; Maine DOT 2001). This age range encompasses the "baby-boomer" and "grey market" demographics and represents a potential goldmine for many industries. Boomers are the largest age segment in North America and the slightly older "greys" are generally interested in physical well-being and plan on retaining the spending patterns of their younger days (Tuckwell 2004).

Despite the overwhelming influence of the boomer set, it is important to note that cycling appeals to all ages and many different demographics. According to Bangel (1995) "cycle-tourists do not form a homogenous group" (1). They represent all age groups and cycle touring is even carried out by families with children accompanying their parents. Furthermore, cyclists use a full range of accommodations, ranging from campgrounds and hostels to bed and breakfasts and five-star accommodations (Bangel 1995).

Bicycle tourism has traditionally been more popular in Europe than North America, and has been a staple in some countries' tourism economies for decades. For example, some European countries see approximately 4 per cent of their total visitation accounted for by touring cyclists. It is expected that cycling could soon account for upwards of 12 per cent of all European holidays. Britain has developed a large bicycle network already consisting of 5600 kilometers which is planned to top out at 16,000 kilomerters. The British cycle tourism industry is already estimated to be worth $1.4 billion (CAD) (Sustrans 1999).

France is home to the worlds largest and most influential touring club, the *Federation Francaise de Cyclotourism,* which boasts over 115,000 members and an annual budget in excess of 4.5 million Euros (Widing *et al*. 2001). In France the popularity of bicycle touring has been developed over more than a century; in North America, on the other hand, most jurisdictions are starting from scratch.

Developing Bicycle Tourism

Bicycle tourism can offer a sustainable, and potentially lucrative industry for communities in North America, just as it has done in Europe. In order to develop cycling as a tourist activity there are certain route-specific and supplementary needs that must be fulfilled. Route-specific needs include safe, convenient, and attractive routes involving either quiet, low-traffic roads or off-road trails available for only non-motorized

use (Sustrans 1999). It is generally accepted that such routes should be interconnected and offer cyclists the opportunity for circular routes to allow seamless movement throughout the network and minimizing the need for backtracking (Lane 1999).

Supplementary needs would include good scenery, guidebooks, maps and services such as food outlets and bicycle-friendly accommodations (Downward and Lumsdon 2001). There should also be other tourist attractions and activities in the vicinity that the trail can connect, thus offering cyclists an opportunity for other pursuits and diversifying the tourism economy.

Another key to developing bicycle tourism is that cycling should be popular in the area (Cycle Victoria 2001). One of the primary reasons for this is to make motorists comfortable sharing the road with cyclists. A strong presence of bicycle advocacy can also go a long way in helping to create a healthy, bicycle-friendly environment. Also, if the area in question is popular with local cyclists, or already attracting bicycle tourists without widespread promotion, it stands to reason that, with a concerted effort, bicycle tourism could become a viable industry for the area. Minnesota serves as an example of this.

Commercial tours often serve as an introduction to bicycle tourism for many people, and give them the confidence to pursue it further (Weiler and Hall 1992). Market research, however, indicates that there is a general preference towards self-guided trips among bicycle tourists (Fraietta 2004). Thus, commercial trips often act as a springboard for independent touring, and in the U.K the majority of cycling excursions are self-guided (Sustrans1999).

When attempting to attract bicycle tourists the importance of alliances cannot be ignored (Cycle Victoria 2001). Cooperation between tourism advocates, cycling enthusiasts, tour operators, hoteliers, government officials and other concerned parties is a must, whether concerning advertising, lobbying for the construction of bicycle paths, or setting standards for cyclist-friendly accommodation. Promotion and marketing are also vital elements for developing tourism and are used throughout the industry, for attractions ranging from eco-tourism to casinos. In North America there is a void in effectively marketing bicycle tourism.

The question that presents itself is what the role of physical infrastructure, mainly bicycle trails, plays in tourism development. Generally there is a divergence concerning the preferred infrastructure depending on a cyclists' skill level, with more experienced riders using roads, while less experienced cyclists prefer to use trails (Maine DOT 2001). Moreover, when looking to develop bicycle tourism, a system of trails is an invaluable resource because they appeal to a variety of skill levels. Such a system

would offer an attraction for leisure cyclists as well as providing a safe, traffic-free route for more experienced long-distance cyclists. Therefore a system of trails or bikeways, which are roads or paths with bike friendly features, should be considered by jurisdictions looking to cater to bicycle tourists (Barsotti 2002).

It is a long-established fact that successful tourism requires more than first-rate attractions. There must also be services and infrastructure (Roehl 1993). The tourism industry is intrinsically linked to the availability of physical infrastructure such as airports, roads, water networks and many other such services (Mistilis 1999). In the case of bicycle tourism, however, there is a fine line between what is the infrastructure and what is the attraction. The presence of physical cycling infrastructure is not merely present to serve cyclists, it is often the reason why the cyclists are there in the first place. This has traditionally caused an emphasis on physical infrastructure in the bicycle tourism industry resulting in the belief that the construction of a cycling trail without accompanying infrastructure and promotion will attract cycling tourists.

Trails

Bicycle trails are nothing new to North America, although their utilization as generators of a tourism economy is a more recent development. Many municipalities have trails that are used for recreation and commuting. Such trails, however, cannot be expected to generate bicycle tourism. Tourism trails are generally located in rural areas, and travel for long distances. They may pass through towns and villages, and may even travel through major urban areas, but there must be a draw that attracts tourists, and provide something they could not get at home. What features endow a trail to make it a tourism draw? Necessary elements would include natural scenery, cultural or historical landmarks or a quaint rural setting. Trails suitable for tourism may include, but are not limited to rail trails, heritage trails, nature trails, winery trails and river trails (Lane 1999).

Trail networks should be comprised of circular and interconnected routes, and when possible, should be located away from roads and highways with heavy vehicular traffic. This reduces noise and helps create a more enjoyable aesthetic experience (Forester 1994).

Lumsdon (2000) and Forester (1994) both discuss the importance of multi-modal options for bicycle tourism. The option of being able to incorporate different forms of transportation into bicycle tourism is important from economic, environmental and convenience standpoints.

When possible, trailheads should be made accessible by public transportation to help reduce the number of people driving and parking in order to ride their bicycles.

There are numerous examples of successful bicycle trails in Europe. Some notable examples include the Coast-to-Coast Trail in the United Kingdom and the Danube Trail in Germany and Austria. There are also North American cycling trails that have successfully generated tourism, and research suggests that cyclists will travel long distances to use shared-use pathways (Maine DOT 2001) Some notable examples of North American jurisdictions with popular bicycle trails include Minnesota, Wisconsin and Missouri. Minnesota and Wisconsin both have extensive trail networks and see significant numbers of tourists visiting each year to cycle on them. Minnesota boasts over 900 kilometers of paved bicycle trail while Wisconsin is home to over 1600 kilometers of trail, much of which is surfaced with crushed limestone (Wisconsin DNR). The Katy Trail in Missouri has also been a success.

Despite the fact that in many areas, especially in Europe, trails have become important aspects of the tourism landscape, many mistakes have been made in trail planning. Lane (1999) explains,

> *Traditionally, trails were planned by trail enthusiasts, keen walkers and cyclists, often with powerful political ideas and skills. They were inspired people, inspired by the finite nature of the trail idea, coupled with its sense of movement and freedom of nature. The route, and the achievement of that route, dominated the trail making process. But to make trails work for tourism new skills are required (3).*

The new skills Lane discusses include design skills, market assessment, marketing, private sector involvement, product development and partnership approaches.

In the past there has been a "product led" development of bicycle infrastructure which has, according to Downward and Lumsdon (2001), followed three stages: a search for funding, land acquisition and route engineering, and finally, an onslaught of post-launch publicity. This haphazard approach has been largely ineffective and there must be a balance found between infrastructure provision and market-based research. Database information is a vital tool in the development of bicycle tourism. Through the incorporation of physical infrastructure coupled with strong alliances, market research, quality bicycle-friendly accommodations and well-executed promotion and marketing campaigns bicycle tourism has

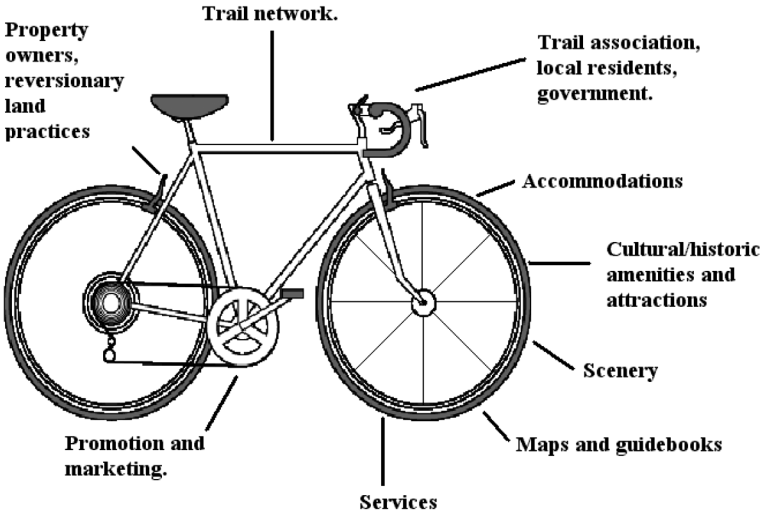

Figure 1: *The essential elements of bicycle tourism development.*

the potential to take hold. Such findings are consistent with the development of tourism in rural areas. According to Wilson et al. (2001) providing a complete package is necessary as opposed to just a primary attraction, in this case, a bicycle trail.

Perhaps the best way to view the necessary ingredients for successful development of bicycle tourism is to use the imagery of a bicycle (see Figure 1). The trail network serves as the basis of the physical infrastructure and can be seen as the bicycle's frame. Trail associations, government agencies responsible for funding and development, local residents and public-private alliances steer the direction of tourism development and can thus be thought of as the handle bars. Supplementary services, cultural and historic amenities, secondary attractions and other factors are vital to the process and can be seen as the wheels. Promotion and marketing efforts drive the development and can be visualized as the drive train of the bicycle. Finally, the negative momentum of reversionary land practices, uncooperative landowners and forms of government "red tape" can be seen as the brakes.

Core Elements Of Bicycle Infrastructure Development

It appears that safe, attractive routes, whether part of the road network or a system or off-road trails, are key to developing bicycle tourism

(Sustrans 1999). Lumsdon (2000) also argues that three core elements of bicycle infrastructure development should be followed, specifically to incorporate sustainability into the development of bicycle tourism. The first element is that "planning and design techniques should make best use of existing resources whilst having regard to minimal impact on the environment" (370). Re-use can include the incorporation of existing transportation infrastructure, such as old railways or lightly traveled highways. Using trails to preserve green space and protect areas from development would also fulfill the criteria of minimizing environmental impact.

Lumsdon's second core element is that "the network should generate positive economic and social impacts for the communities through which it passes" (370). Studies suggest that bicycle tourists prefer to patronize locally owned establishments and can contribute to the economies of small communities (Cope and Doxford 1998). However, it is important to remember that the tourism economy can be a fragile one. The tourism industry goes through periods of prosperity and recession and is susceptible to numerous natural and economic forces.

The third core element is that "the system should have the capability to decrease the number of car-based recreational trips, hence reducing pollution and energy consumption" (Lumsdon 2000, 371). Bicycle tourism only gives environmental gains when bicycle trips are taken instead of motorized trips. Lumsdon points out that cyclists driving cars to trailheads may actually increase automobile trips. On the other hand, these rides may also be used to replace car-borne sightseeing trips. Mozer (2000) also discusses the potential environmental issues surrounding fully supported bicycle tours. Such tours involve vans ferrying riders' equipment between accommodations and support vans combing the route for cyclists who are tired or in need of repairs. This can negate any environmental gains.

Minnesota's State Trails: A Case Study

The state of Minnesota is home to over 900 kilometers of paved bicycle trails; this is the most in the United States of America (Minnesota Trails 2005)[1]. Despite the fact that there has been very little promotion of Minnesota's cycling infrastructure, the state has developed into something

[1]This was compiled by adding the distances of the sixteen state trails with paved surfaces. There are also several trails that feature other surfaces such as limestone. Paved municipal trails are also not included.

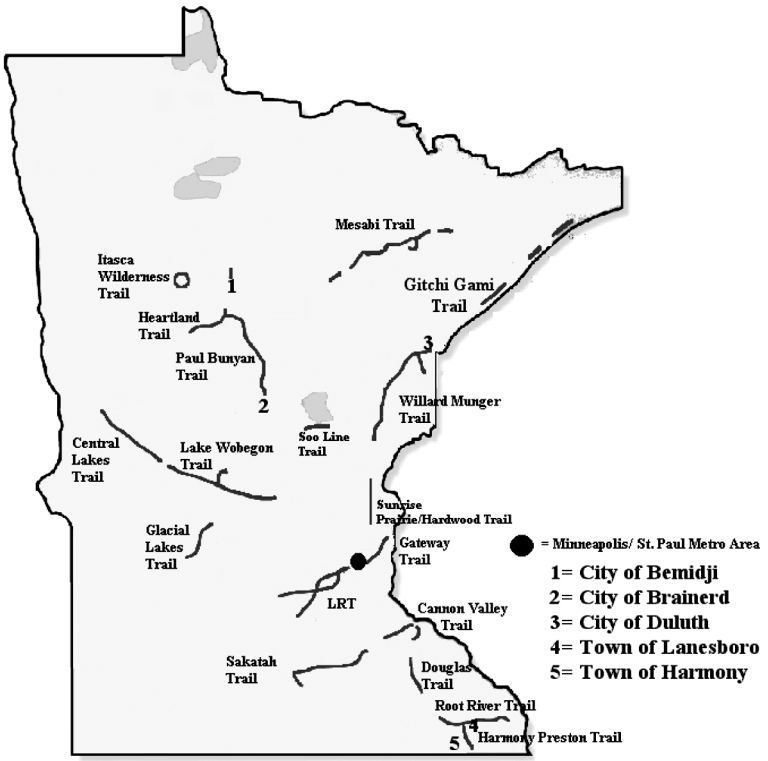

Figure 2: *Minnesota's State Trail Network. Minnesota has the most mileage of paved trails in the United States. Notice the lack of circular routes. Large gaps are also evident, especially on the Mesabi, Gitchi Gami and Paul Bunyan trails.*

of a cycling Mecca and is beginning to develop a strong cycle tourism economy. The growth of bicycle tourism due to trail development has been credited with the revival of tourism in Southeast Minnesota and the revival of some of the small towns in the region (Gunderson 2001). Thus, Minnesota can serve as a case study to showcase the importance of physical infrastructure, such as trails, in the development of bicycle tourism.

Although the state contains over 1900 kilometers of rail trails, it is the over 900 kilometers of paved state trails that are the backbone of the bicycle tourism system (see Figure 2). The trails are multi-use trails open to cyclists, walkers and in-line skaters, and in some cases there are parallel tracks for horseback riding. Several of the trails are groomed for cross-country skiing in the winter.

Cycling, however, is by far the most popular activity on the trails and accounts for 72 per cent of summer use (MnDNR 2000). Cycling is also the most important activity on the trails in terms of tourism, accounting for 88 per cent of tourist use. In fact, while locals tend to view the trails as multi-use trails, in the minds of most tourists they are simply thought of as cycling trails (MnDNR 2000).

Minnesota's trails were developed initially for the use of residents. Their appeal to tourists was seen as a bonus (*Rochester Post-Bulletin* 1994b). Thus, many bikeway plans are designed to link civic amenities. For example, the bikeway in Baxter, Minnesota links all of the town's schools and parks (Meyer 2000). According to the Parks and Trails Council of Minnesota (2005), however, there has increasingly been a focus on tourism and economic development as well as an emphasis on trails' health benefits.

As discussed earlier, one of the cornerstones of successful bicycle tourism development is to have a strong base of popularity to work from. Minnesota is no exception to this rule. Historically, cycling has been popular in Minnesota since the heyday of the late 1800s when the state was considered a "wheelman's paradise." In 1896 Minneapolis constructed its first bike path around Lake Harriet, and by 1902, 57 miles of path existed (Arey 1995).

Through the 1990s, cycling was a pastime for 66 per cent of the state's residents, which is twice the national average, making it the most popular activity in the state (MnDOT 1992). Minneapolis also has the third highest rate of bicycle commuting in the United States (MnDOT 2005). These facts manifest themselves in the fact that bicycle trails are the most requested facilities in government surveys (MnDOT 1992).

One of the factors that has allowed Minnesota to develop bicycle infrastructure is the state's numerous bike-friendly statutes that give local authorities power to designate and create bikeways and paths. These include allowing the prohibition of vehicular traffic on highways and restricting speed limits for motorized vehicles. The state also provides assistance to local units of government for bikeway planning and development (Minnesota Statutes 2004). Thus, small jurisdictions like Stearns County have comprehensive bikeway plans that are designed to provide a coordinated bikeway system linking communities and community assets. Such a plan, when carried out, consists of a mixture of on-road facilities and rail trails (Stearns County 2005).

Three trails have emerged in the Minnesota network as "tourist" trails while the others serve as "local market" trails. The three tourist trails are the Root River Trail, The Paul Bunyan Trail and The Heartland Trail, with the latter two bisecting each other. These three trails comprise over 320 kilometers traversing some of Minnesota's finest scenery as well as

cultural and historic resources. The Paul Bunyan Trail is still incomplete and will only increase in length (Minnesota Trails, 2005). The Root River Trail was first paved in 1988 and since then has steadily increased in length and tourism importance (*Rochester Post-Bulletin* 1994a).

Tourism along Minnesota's State Trails is almost exclusively due to cycling, while locals enjoy a variety of activities including walking and in-line skating (MnDNR 2000). And whether tourists come from within the state or from elsewhere in North America, bicycle touring accounts for 12 per cent of all bike miles traveled in Minnesota (MnDOT 2005).

Development of Minnesota Trails

A unique relationship exists between Minnesota's Department of Transportation (MnDOT) and the bicycle. In the 1970s the Minnesota Department of Natural Resources (DNR) was given the task of developing a system of State multi-use trails, while MnDOT was charged with the task of planning statewide bicycle travel. By 1976 MnDOT was developing its own standards for bicycle infrastructure design. They have now published three editions of statewide cycling maps and two editions of comprehensive design guidelines (MnDOT, 2005). The state bicycle maps color-code the state's highways according to traffic volumes and other factors that affect cyclists. They also indicate the presence and width of paved shoulders. When a department of transportation "embraces" the bicycle as Minnesota's has, the development of bicycle infrastructure is made less difficult than in other jurisdictions (MnDOT, 73).

The state trail system in Minnesota is continually growing, but this is occurring slowly due to a lack of funds. The funding structure for Minnesota trails began in the 1970s and 1980s through the sale of state bonds by the State Legislature. This was supplemented with use of a 2 per cent cigarette tax, which began in 1960s as a "future resource fund" (Parks and Trails Council 2005).

Minnesota's state trails are popular and supported by residents and generally by politicians as well, but the availability of funding has been a restraint on trail projects. For instance, in 1992 state lawmakers passed a bill to create the Blufflands Trail System in the southeast portion of the state. This system would build off the Root River Trail and eventually form a network of trails seamlessly traveling to the Douglas Trail near Rochester (see Figure 2). Unfortunately the bill contained no funding for the project, it was merely a vision, and over a decade later such a plan is far from completion, although some progress has been made. The Root River and Harmony-Preston trails have been expanded and developed over the

last decade, and a hotel was established at the Preston trailhead in anticipation of the town becoming a hub for the trail network (Kiger 2001).

Minnesota's trail network is set apart from cycling trails in most other jurisdictions, including the Missouri's Katy Trail (a nationally recognized success) and Wisconsin's extensive network, because planners in Minnesota have opted to construct paved trails where possible. Although some research indicates that the surface of a trail does not play a major role in user satisfaction or tourism potential (Fraietta 2004; MnDNR 2000), asphalt surface provide a smoother ride and can accommodate slender tire widths, not to mention the fact that after a day of riding on crushed limestone trails a cyclist is coated in dust. The decision to pave the state trails was made because of concerns over rutting that can occur on gravel or limestone trails. Also, unlike its neighbour Wisconsin, Minnesota has no native limestone with which they could economically construct trails (Lundquist 2004).

Minnesota's state trails draw a wide range of users comprising various income levels and age demographics (MnDNR 2000). The three tourist trails see the highest usage intensity of the system, and although several of the trails are heavily used, overcrowding has not yet been a problem on Minnesota trails (MnDNR 2000).

The tourist trails are important tourism draws for their respective regions, and even when there is not enough money to expand them, they must constantly be improved. In a series of surveys carried out by MnDNR (2000) it was determined that the most important priorities for trail improvement, according to trail users, were the availability of fresh drinking water, more public toilets, and pay telephones.

Land Ownership, Rail Banking and Politics

In the United States recreational trails are often constructed on abandoned rail rights-of-way. This is usually made possible under the pretense of rail banking, meaning that the trail is a long-term, but temporary, use that will keep the right of way clear from other forms of development so it can be redeveloped as a rail corridor if future needs require. When trails are constructed using rail banking, however, they can be susceptible to questions of land ownership claims from owners of nearby property. Trails can also face opposition from nearby property owners who feel their rights are threatened by trail users (*Rochester Post-Bulletin* 2000).

Trail development in Minnesota has not been immune to such problems. One such case evolved along the Paul Bunyan Trail, which was developed on a former Burlington Northern rail right-of-way that was

purchased by the Minnesota DNR in 1988. Two families who own property adjacent to the trail have contested the nature of the sale, arguing that when the railway discontinued service in 1985 they abandoned the right-of-way thus losing the property rights (Findlaw 2004). The families erected barricades to block the trail while court battles against the Department of Natural Resources ensued (Burke 2003). Such battles have occurred across the continent and have been fuelled by such groups as the National Association of Reversionary Property Owners. Property owners along a rail right-of-way successfully thwarted an attempt to extend the Root River Trail east to the Mississippi River. Minnesota courts have consistently ruled in favor of the state in cases where property owners protest an existing trail (Parks and Trails Council 2005).

In Minnesota there has also been a constant threat of development encroaching near the trails, which will only increase the number of conflicts between trail users and property owners, as well as damage the aesthetic value of the trails. This could potentially have a negative impact on tourism (*Rochester Post-Bulletin* 1994c).

A scarcity of public funding and the realities of politics can sometimes converge with issues of land tenure resulting in the inability to secure rights of way and fill key gaps in the trail network. The problems being encountered with the completion of the Paul Bunyan Trail through the city of Bemidji serve as an example of this (see Figure 2). Land acquisition has been complicated by the fact that the land needed to complete the trail does not follow a former rail bed and also because it lies on the city's urban fringe, where it faces the risk of being developed (Ruckdaschel 2005b). Currently, cyclists using the trail must navigate their way through the city. Completing the trail is high on Bemidji's list of priorities, but the completion will costs in the neighbourhood of $6.1million (U.S) (Minke 2005).

To facilitate the construction of this trail segment the city of Bemidji has requested that the state float a bond for funding (Ruckdaschel 2005a). The city also proposed a half-cent sales tax for parks and trail improvements, specifically the Paul Bunyan Trail extension, which was approved by city voters but stalled at the state level (Miron 2004). This occurred, it has been argued, because the Republican House Chairman's predisposition against sales taxes led to the proposal's rejection (*Bemidji Pioneer* 2004). These events have frustrated city politicians, residents and trail planners alike because the trail segment in question is the State's biggest, and perhaps most critical missing link. Unfortunately, this link is also the most expensive to complete (Ruckdaschel 2004).

Ongoing Costs

Whenever infrastructure, such as a trail system, is constructed it must be maintained or else it risks falling to ruin. Maintenance funding from the state is currently less than $1 million (U.S.) from the general fund and this is not enough to cover the ongoing costs of repair and maintenance of the system (Parks and Trails Council 2005). Thus, there is a dependence on volunteers' help in maintaining the system. Some trail associations have also implemented modest user fees to help cover costs (Mesabi Trail 2001).

Planning Issues

Trail development in Minnesota has generally followed Downward and Lumsdon's (2001) model of haphazard trail development as the DNR and MnDOT have scrambled to secure railroad rights of way and sometimes fought adjacent property owners to maintain the functioning of trails. Thus, there are several trails in the Minnesota system with severe shortcomings, such as being straight and featureless or simply not connecting any points of particular interest. Examples would include the Central Lakes and Lake Wobegon Trails that closely follow, and are often in sight of, the busy Interstate 94 (Minnesota Trails 2005). Such trails have little tourism potential and serve simply as transportation corridors. They could be useful in the future if Minnesota worked to connect all trails into a cohesive network. Minnesota's trail system has suffered the disadvantage of being developed in stages, thus leaving gaps, bypassing important attractions, and not servicing all desirable areas (MnDOT 2005).

The emphasis on physical infrastructure in Minnesota is also made evident by the lack of marketing and promotion of the trail system. The trails are viewed as an extra amenity for residents and visitors, not a main tourist draw, despite the fact that they have developed into one. Thus there is no widespread promotion of the state's trail system for tourists (Gunderson 2001). Trail organizations and individual jurisdictions are left to do their own promotion, which is often hindered by limited budgets.

Economic Impacts

Despite a lack of promotion, Minnesota's trails have become a considerable tourist draw, especially on the Root River, The Paul Bunyan and The Heartland Trails (see Figure 2). Despite some shortcomings elsewhere in the Minnesota trail system, these trails have managed to

develop the traits of successful tourism generators. According to Lumsdon (2000) successful trails "enhance the overall appreciation of the tourist offering of a destination," while also serving as "an additional visitor attraction in [their] own right" (367).

Minnesota's state trails are one of the only public works that gives positive returns on investment (MnDOT 1992). Out-of-state users spend an average of $25-39 a day along the trails, which is above the national average for trail users (MnDNR 2000; Beeton 2005). It has been argued that snowmobilers spend more money than cyclists on Minnesota trails. This has been refuted, but more importantly, a higher proportion of cyclists come from out of state than snowmobile users (Lundquist 2004). Some small towns along trails have even shifted their focus to the trail as opposed to the highways. For example, the town of Pine River, located along the Paul Bunyan Trail, opened its new tourism office and chamber of commerce in a new building that includes a rest stop and washroom facilities for trail users (Lundquist 2000).

Lanesboro and the Root River Trail

Perhaps the most striking example of the success of bicycle tourism in Minnesota can be found along the Root River Trail (see Figure 2). Lanesboro, a small town of 788 residents in southeast Minnesota, now carries the nickname "The Magical Hamlet," a far cry from its former moniker of "Sewer City." Lanesboro has emerged from its ghost town status of the 1980s to become a popular tourist attraction, and up to 75 per cent of summer business comes from cyclists (Kiger 2002). In the 1980s the town had one motel and one restaurant and "you wouldn't want to patronize either" (Parks and Trails Council 2005). It is now a different story with over 144 lodging rooms and 12 bed and breakfast inns (Kiger 2002). Credit for this resurgence lies solely with the development of the Root River Trail, which according to the Parks and Trails Council of Minnesota (2005), was the only public investment that occurred in that time period. As of 1997, the trail was seeing over 100,000 users per year, up from 16,000 in 1988 (*Rochester Post-Bulletin* 1997a). Long stagnant, the southeast was the fastest growing tourism region in Minnesota by the mid 1990s, thus accounting for one third of the State's tourism (*Rochester Post-Bulletin* 1996b).

Although the aforementioned Blufflands Trail System has not fully come to fruition there have been some important trail extensions and development in the vicinity of the Root River Trail. After the success of the trail in the early 1990s town leaders in nearby Harmony and Preston

became interested in the prospect of a trail connecting their towns to the Root River Trail in hopes of developing tourism economies of their own. The city of Harmony formed a trail commission to acquire land for the trail in 1990 and later handed it over to the DNR for trail construction *(Rochester Post-Bulletin* 1990). In the first decade of its existence the Harmony Preston Trail has generated tourism for the small towns it connects resulting in new businesses and economic opportunities (*Rochester Post-Bulletin* 1998c).

The tourism success in Lanesboro and other communities along the Root River Trail has occurred in an environment of modest expectations with the realization that a bicycle trail cannot be a silver bullet for the problems of a small town's economy (*Rochester Post-Bulletin* 2000). Lanesboro has the appeal of historical tourism because its downtown was very well preserved over decades of rural decline. In essence, the town was lucky because in the 1970s and 1980s it was too poor to demolish its dilapidated core (Wolfe 2001). The town of Preston, for example, demolished a railway turn house due to lack of foresight. In retrospect, townspeople feel that it would have made an excellent trailhead and heritage resource for the community (*Rochester Post-Bulletin* 1998a).

One desirable aspect of bicycle tourism is that bicycle tourists prefer to patronize local establishments as opposed to national chains (Sustrans 1999). Lanesboro has seen impressive growth in the tourism industry for a town of its size, and as this has happened the town has made a concerted effort to steer development in a balanced direction. The town has acknowledged that it cannot sacrifice character for kitsch if it is to remain a popular tourist draw (*Rochester Post-Bulletin* 1997a). Thus the town has worked to incubate local businesses as opposed to attracting national chain outlets. This has been occurring under the constant fear of the town becoming a bedroom community to the nearby city of Rochester, Minnesota. (*Rochester Post-Bulletin* 1994a).

Southeast Minnesota is now in its second decade of trail tourism and some people fear that the area may have become dependant on tourism. Thus, town officials have had to look at ways to diversify the economy of the area, while development pressures have also made it necessary to fight to preserve the town's character. Land values have also doubled in this period causing some residents to fear the town may lose some of the character that made it attractive in the first place (Wolfe, 2001).

The Role of the Minnesota Department of Transportation (MnDOT)

MnDOT has not only embraced bicycles as a mode of transportation, but they have also played a major role in the development of the state's trails as a tourist industry. MnDOT's mission statement makes no mention of tourism or economic development, except for the connection between traffic congestion and economic loss (MnDOT 1992; MnDOT 2000). DOT literature does mention cycling's relation to "economic vitality," however MnDOT's official relationship with cycling does not extend beyond utilitarian travel. Nevertheless, MnDOT has a history of skirting along the edges of tourism development. As early as 1992 the Department was making recommendations for recreational and tourism facilities, including the development of paved trails and shoulders to "maximize the strength of the state's tourism economy." They also propose that "bicycle touring routes continue to be established, improved, mapped and signed in areas of the state that have significant tourism potential" (MnDOT 1992, 41). In 1987 the Department of Transportation (DOT) rated Minnesota highways according to their bicycle suitability; this was a very progressive move at the time. The DOT released a trunk highway study in 1987 that identified over 6000 kilometers of highway suitable for shoulder paving (MnDOT 1987). By 2002 the shouldering project was 80 per cent complete (MnDOT 2005).

This interesting relationship between the MnDOT, essentially the state's highway department, and bicycle tourism culminated in the 2005 Scenic Byways Program. This initiative sets out to identify, maintain, map and mark with signage a premiere system of bikeways that connect existing low-traffic and shouldered roads with off-road trails. The aim of this project is to attract cyclists to the safest and best statewide routes. Scheduled to begin implementation in 2007, the program will utilize some of the trunk highway paved shoulders outlined in the aforementioned 1987 plan (MnDot 1987; MnDOT 2005). Priority will be placed on safe and scenic routes that connect historic and cultural resources as well as the state's three distinct biomes. The program will be based on the concepts of destinations, connection and continuity (MnDOT, 2005).

What makes this program unique is that it is being carried out by the Department of Transportation but is focused on tourism development. This plan also adheres to the elements of successful bicycle tourism development as laid out by Lumsdon (2000), Sustrans (1999) and others. Also of great importance, the program recognizes the importance of partnerships and alliances between public and private entities (MnDOT 2005). MnDOT recognizes that the state has existing infrastructure for

touring and is seeking to work from what is already there. In order to effectively improve safety and economic impacts, they must fill gaps in the network, improve signage and other route amenities as well as develop effective marketing. MnDOT's Scenic Byways Program addresses two of these three issues.

Where To Go from Here

The Scenic Byway program, an initiative of the MnDOT, is a bold step forward in the development of Minnesota's bicycle infrastructure and presents immense opportunity for tourism development. The movement towards integrating the state's secondary highways into a comprehensive statewide bicycle network both removes cyclists from the constraints and limitations of former rail beds while simultaneously making use of existing infrastructure in a new and creative manner. MnDOT has paved shoulder sections with the intention of encouraging cycling in the past (MnDOT 1987; *Brainerd Post-Dispatch* 2002), however this project will aim to make strategic connections needed for a comprehensive bicycle network while including signage and route marking.

To maximize tourism potential, trails need to form a cohesive network and there has always been the intention of doing so in Minnesota (*Rochester Post-Bulletin* 1992a). The incorporation of paved shoulders into the network, however, affords the state the opportunity to do so without having to secure rail rights of way and/or clearing new ones.

Marketing

Minnesota's tourist trails have shown resilience and have remained viable despite flooding, bad weather and devastating fires, including one that destroyed several historic buildings in downtown Lanesboro (Weiss 2002; Weiss 2001a). At the end of the day, however, the future of Minnesota's success in developing bicycle tourism lies with effective marketing. As mentioned, statewide marketing has been virtually nonexistent and there has only been piecemeal promotion of specific trails or regions by individual trail organizations. A statewide approach to marketing and "branding" Minnesota as a cycling destination would be a step in the right direction, as destination branding can serve as a vessel to attracting visitors and expenditures to specific destinations (Snepenger *et al.* 2004).

Missouri's Katy Trail, a 643 kilometer rail trail that traverses the length of the state, developed a cooperative marketing project named Katy Central.

The project was developed by eight communities along the trail to provide better information to trail users as well as attract new users to the trail. Katy Central "allows the partners to pass visitors from one community to the next and encourage longer stays in the Central Missouri area" (Graham 2003).

The formation of Katy Central has allowed the printing of promotional materials such as a full-colour brochure, the purchase of advertising space in selected publications, the development of a survey form as well as a 1-800 number with an answering service and a mail service to process visitor requests. From these resources a database of information requests and usership is maintained (Graham 2003). Such a system could serve as a template for a similar venture in Minnesota.

Conclusions

The three core elements of bicycle infrastructure development, as put forward by Lumsdon (2000), are addressed quite well in the Minnesota system. Existing resources such as abandoned rail lines and underused highways are integral parts of the system. The system has also generated positive economic impacts in the communities as well as social impacts due to its function as a link between communities. The third element of reducing automobile trips is also addressed by the community-focused nature of the trails. The strong relation to MnDOT is also of importance to the third element because of their additional focus on the more practical and utilitarian issues of bicycle transportation.

Minnesota has much of the physical infrastructure in place to generate bicycle tourism, and serves as an example that physical infrastructure can be sufficient to attract users. This example also demonstrates that physical infrastructure in itself can only produce limited results. If the state wishes to fully capitalize on the growing potential presented by touring cyclists, however, it must undertake a concerted effort to improve infrastructure, services and promotion.

The development of bicycle tourism in Quebec may serve as an example for officials in Minnesota. That province has invested in the *Route Verte,* a 4300km bicycle network that encompasses paved trails as well as quiet roads and paved shoulders. Even before it was completed the network was a success and cyclist spending totaled over $93 million CAD in 2003 (Velo Quebec 2003).

There are several aspects of bicycle tourism in need of further research, including bicycle tourists' preference between trails and paved shoulders. The effectiveness of programs such as Katy Central could also be studied in greater detail. Also, assuming Minnesota's Scenic Byway Program is

fully implemented, follow-up research would be of great importance. The effects of any statewide of marketing campaigns in Minnesota would be relevant as well.

MnDOT's Scenic Byway Program is an excellent first step in the process of further developing their bicycle network as a tourism generator and with a concerted marketing effort, perhaps based on the framework of Katy Central, the bicycle network that began with the modest conversion of an abandoned railroad corridor several decades ago could become one of the state's most promising amenities, for both residents and tourists.

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Evidence for unusually wet 19th Century summers in the eastern Prairies and northwestern Ontario

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Abstract: Archival accounts indicate that at least 20 "wet summers", accompanied by high streamflow and high lake levels, occurred from 1800 to 1870. All but one fell within two intervals, 1824-1834 and 1849-1861, during which virtually every summer was "wet". These wet summers contributed to high water levels in Devil's Lake and Moon Lake in North Dakota and provided the antecedent conditions for the large floods of the 19th century. Dendroclimatic evidence from southern Alberta has been interpreted as indicating dry conditions there, suggesting that a dichotomy between the eastern and western prairies similar to that of 2000 may have persisted historically for intervals of as long as a decade.

Introduction

The extraordinary rain and violent storms of June and July, 2005, in southern Manitoba were national news events which produced unusually severe conditions on a number of fronts: widespread standing water on fields which ruined crops, water levels on rivers and lakes which were extreme for the season, dramatic displays of lightening, and swarms of mosquitoes. Although such conditions have occurred in some other years within the instrumental period (notably in 1993), they are unusual. Written records from the pre-instrumental period 1800 to 1870, however, contain numerous descriptions of similar or even more severe summer rainfall in the region from eastern Saskatchewan to northwestern Ontario. This paper summarizes these descriptions and relates them to the general 19th century hydrometeorology of the prairies identified in other studies.

The "data" for the paper consists of eye-witness accounts in historical materials. In many years, the "raininess" of the season can be inferred

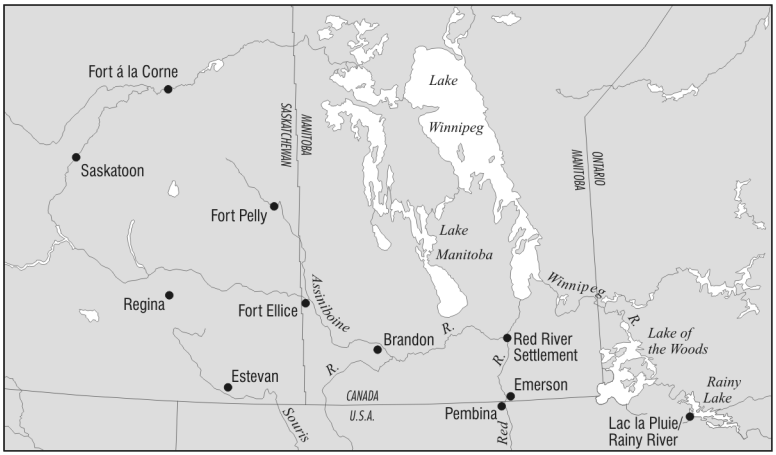

Figure 1: *Location map.*

from the number of days on which rain was mentioned, accompanied by some comments about its intensity and/or duration, or commentary on how abnormally wet the season was. In other cases, the amount of rain may be inferred from descriptions of water levels in rivers, lakes or sloughs, where the testimony of the observers or the timing of the rise indicate that the levels resulted from rainfall rather than the lingering effect of spring snowmelt. High water levels were particularly noteworthy in northwestern Ontario because of their detrimental effect on the wild rice crop, an important food source in the region; in other cases, crops on land were drowned by standing water from heavy rains. Summer bankfull or overbank flows in rivers are significant because of their rarity in the instrumental period. Unusually high water in larger lakes and rivers indicates that wet conditions prevailed over a broad (perhaps basin-wide) area rather than merely in the vicinity of the observer.

Because the argument is based entirely on written documents, the actual words of the observers are crucial to an appreciation of the conditions they experienced. Thus they have been reproduced in as much detail as space permits, but in many years, they are only a portion of the available commentary. The majority of the materials come from post journals and other fur trade documents in the Hudson's Bay Company Archives or diaries and letters in the Manitoba Archives. To avoid a proliferation of references at the end of the paper, the information from post journals or diaries is cited in the text by post or diarist name and year but is listed only once in the references, rather than for each year. File numbers in the Hudson's Bay Company Archives are prefixed by HBCA,

those in the Public Archives of Manitoba by PAM. Individual archival files referred to only once in the text or separately published works are listed in the normal fashion.

Descriptions and Conditions

1806: Alexander Henry's journal (Coues 1965) contains abundant descriptions of very wet conditions in the Red River region of southern Manitoba in the summer of 1806. On June 26, he reported the water in the Red River to be *"extraordinarily high* [from the] *continued storms"* (ibid, 281) and on July 7,

> *the travelling was tedious from the heavy rains… In many places we found several feet of water; every little hollow formed a pond and every rivulet appeared like a river. Our horses often sunk up to their knees in mud, and at times had water up to their bellies...The water* [in the Red] *was very high…*[while attempting to cross to the east side of the river, he] *found the country almost entirely overflowed* (ibid, 285-6).

Such conditions continued throughout the summer. In August, Henry reported that

> [August 13] *this summer's extraordinary rain, having overflowed the low country, has caused the buffalo to resort to the high lands southward...* [August 14] *We found a great quantity of water, and for a long distance our horses had it up to their bellies… This road used to be firm and good but the continued rain of the summer has altered the face of almost everything, and there is now mud and water knee deep.* (ibid, 420-21)

1824: David Thompson canoed from Fort William to Lake of the Woods and back from June 16 to September 6. He recorded rain, much of it hard, on 46 of the 82 days and on a number of the other days observed rain, thunder or lightning at a distance. Throughout the trip he encountered high water, beginning on June 28 when he wrote "*Water is high…all the rivers and lakes are now very high*" (Thompson 1824). On July 22 and 24, he found Rainy River *"uncommonly high"* and *"all inundated"* (ibid). At Lake of the Woods on July 26, he observed *"all low overflowed land"*

and on July 29 *"water in the grass 5 ft deep*". In late August, J.D.Cameron reported that the Winnipeg River was "*exceptionally high*" and "*amazingly high*" at the Pinawa portage (Lac la Pluie Journal 1824/25). Because of the high water "*the rice crop has entirely failed all over the country*" and the fishery failed as well (Lac la Pluie Journal 1824/25). The wet weather extended into Manitoba and eastern Saskatchewan. On August 4, the Fort Pelly Journal reported "*the meadows being so full of water, it is a difficult job to get the hay dried*" (Fort Pelly Journal 1824/25) and on August 15, *"continued rains for some time past made the waters of the River rise five feet above its usual height",* and on the 18th "*the waters of the river continue rising so much, that they nearly reach the top of the bank*", and still on August 21, *"the rains still continued pouring and the river rising more and more."* (Fort Pelly Journal 1824/25). On September 2 at Red River *"the weather continues wet, which has caused the* [Red] *River to raise considerably"* (Red River Journal 1824/25) and rain (frequently heavy) was reported at Red River on 11 days from September 1-16. The Annual Report for the Lac la Pluie District reported *"the high flood of the summer continuing till September- the rice crop was so far injured that the natives of the district could not procure a sufficiency for their consumption."* (Lac la Pluie Journal 1824/25).

1825: On June 20 the Red River Journal reported that wood which had been left on the bank of the Red River was "*now in danger of being carried off by the extraordinary inundation of the river, caused by the late continued heavy rains*" (Red River Journal 1824/25). On July 11, the Red River journal reported *"the floods in the* [Red] *River continue high"* (ibid). On July 30, the Company was "*unable to get the rafts unloaded the beach being still covered with twelve feet of water*" (ibid). Abundant rain continued into September; on September 23, "*owing to the late heavy rains, both rivers have risen considerably"* (ibid). This rainfall must have been very widespread to cause both the Red and Assiniboine Rivers to rise and this is confirmed at Fort Pelly where *"the very high water in summer destroyed all our crops of potatoes and barley and carried off one half of our establishment"* (McDonell 1826). The wet conditions also extended into northwestern Ontario. At Rainy River, August was rainy, water levels were high, and "*the barley failed… owing to the ground on which it was sown, being too long covered with water from the heavy rains in the early part of the summer*" (Lac la Pluie Journal 1825/26). Complaints about the water levels there and comments about rising water continued throughout the fall into early December. This wet summer provided the antecedent conditions for the disastrous Red River flood of 1826 (see below).

1827: At Rainy Lake on May 18 *"from the late heavy rains, the water has risen so high-no sturgeon can be hooked."* (Lac la Pluie Journal 1826/27). June was dry at Red River but July, August and September were very wet. On August 31, the Red River journal reported that *"since the 14th scarcely a day has passed without heavy rains,* [the] *crops are in part rotted on the ground"* (Red River Journal 1826/27). Several comments at the end of the summer indicate widespread, very wet conditions for much of the summer and into early fall.

> [September 13]: *This summer was the most rainy and most disagreeable of any summer within my recollection. One fourth of our time at least was lost by rain from* [York] *Factory to this place. The portages in* [the Winnipeg River] *were in an abominable state… These heavy rains will certainly spoil our wheat...* [September 18]: *Continued rains since my arrival* [on September 13] [October 5]: *Hardly a day passes but what we have had rain sometimes all day…"* [November 30]: *The river is now so very high there is no keeping a net fair in the water.* (Lac la Pluie Journal 1827-28)
>
> [September 8]: *Heavy showers of rain every day*. [September 20]: *Not a day passes without heavy rains…The rivers are greatly swollen by the late rains, as much so, as after the ice went off in the spring, and it is even a difficult matter to go on horseback from one end of the Settlement to the other, the face of the country is so entirely covered with water...* [September 30]: *scarcely a dry day has been experienced since* [Sept. 20]. (Red River Journal 1826/27)

1828: After a wet July, rain fell on a minimum of 14 days in August at Red River, damaging the crops: *"a tolerable* [barley] *crop, except on the low ground which was much destroyed by the water standing on it after the frequent heavy rains."* (Cochran Journal, August 15). On August 22, Cochran reported: *"The most awful night I ever witnessed…The rain which fell…being now standing on the ground…to a depth of three inches."* (ibid). At Brandon House, high water on October 7 frustrated attempts at fishing: *"...several attempts at erecting fish weirs in the Rapid River, which unfortunately proved unsuccessful owing to the unusual height of the waters- The same result…in the Assiniboine River"* (New Brandon

House 1828/29). On October 31, the Lac la Pluie journal summarized the summer precipitation:

> *The water was again extremely high above* [Lake Winnipeg] *particularly within the American Territories, from which not a grain of rice was procured… The rains were* [so] *incessant all summer in this quarter that it injured us in* [the] *crop of potatoes… it is impossible to mow hay in the water…* (Lac la Pluie Journal 1828/29)

1830: The wet weather in this year was mainly in May and early June when crops in the Red River Settlement were damaged or destroyed by abundant rain and flooded fields. On July 29, Rev. William Cochran wrote

> *This spring the whole of the people in my neighbourhood have suffered severely from the heavy rains which fell in May. In the beginning of May, the rain fell in such abundance that the whole surface of the plains was a sheet of water. This obstructed every kind of agriculture for upwards of ten days… After we had sown the wheat and planted the potatoes, the rain fell in such profusion that the ground was perfectly deluged. This continued till it destroyed a large portion of the wheat and most of the potatoes…Since the 15th of June, we have had only one slight shower.* (Cochran 1830).

At Rainy Lake on May 26, "*the water is rising so high-we may be assured there will be no rice*" (Lac la Pluie Journal 1829/30) and on May 20, "*the water is now higher than the high-water year. There will be no rice this year*" (ibid). Although rain was less frequent in July at Rainy River, water levels remained high until late in the month at least; on July 28, the journal reported that "*where they mowed last year there is three foot of water*" (Lac la Pluie Journal 1830/31).

1831: Evidence for excessive rainfall in this summer comes only from the Fort Pelly journal; northwestern Ontario experienced a dry summer. On June 28 at Fort Pelly, *"nearly all the gardens below are destroyed by the high waters* [of the Assiniboine]*"* (Fort Pelly Journal, 1831/32). On July 2, *"the ground is so completely drenched with water that nothing can be done to* [the potatoes]*…the hay ground is also covered with water"*

(ibid) and again on the 19th, *"all the former hay ground is covered with water"* (ibid), causing the reporter to comment on the 23rd *"this is a remarkable summer for rain"* (ibid). On July 9, *"*[a man] *says that the rivers are so high that he had difficulty to cross*" (ibid). On July 23, "*raining most of the day… the river* [being] *so high… there is no possibility of making a barrier*" (ibid). Wet weather continued at least until August 20: *"the rest of us carrying the hay that was lately cut to dry ground as the late rains had almost set it afloat"* (ibid).

1832: On June 14 at Red River, Cochran reported *"heavy and incessant rains are falling in this neighbourhood. The ground is deluged,the wheat and barley look sickly and many potatoes which are planted on wet soil are rotting."* (Cochran Journal) and these conditions continued into July: *"The whole season has been unfavourable. We had heavy falls of rain & hard frost up to the 20th of May… About the 10th of June heavy and constant rains commenced."* (ibid). At Fort Alexander at the mouth of the Winnipeg River, on August 25, *"this summer has been … all along uncommonly cold and rainy…All the low grounds where the hay used to be made is entirely overflowed"* and the "*more than usually violent current"* of the Winnipeg River exhausted the boat crews (Lac la Pluie Journal 1832/33). At Rainy Lake, torrential frequent rain and dangerously high water were reported from May 11 into June. On May 13 there was "*now six feet of water running through the mill*" (Lac la Pluie Journal 1831/32) and after falling somewhat, the water was rising again on May 28. A winter food shortage was anticipated because *"from the height of the water not a grain of rice grew up in any part of the District"* (Lac la Pluie Journal 1832/33).

1833: The Fort Pelly region had a wet summer as the post journal comment for September 7 indicates *"from the heavy and constant rain during the summer this part of the country may be said to have been under water in several places"* (Fort Pelly Journal 1833/34). At Red River, Cochran reported on September 28 that *"*[north winds] *brought such a torrent of rain upon us, as I have never before witnessed, the plains are deluged, and the creeks run as deep as in the spring.*" (Cochran Journal). A comment at Rainy Lake in 1834 (see below) suggests it may have been very wet there as well.

1834: The Assiniboine and Red River basins were relatively dry but northwestern Ontario had a very wet summer. On May 28 at Rainy Lake, "*These two days we have had very heavy rains… without intermission. The river has risen very high… The fields are all overflowed*" (Lac la Pluie

Journal 1833/34). The water was "*uncommonly high*" on June 14 and very heavy rain was reported in the Lac la Pluie journal almost continuously throughout June and most of July, raising fears of failure of the field and rice crops, as the following extracts illustrate:

> June 7: *We have had a great deal of rain during the week. The river still rising. Our fields appears like fish pond*. June 28: *hardly a day in this week but what we have had rain and that in large quantities*, July 12: *The weather since the 4th has been rainy…The field of barley is drowned…there is now not the least hopes of getting any* [rice] *in Lake of the Woods nor in Lake la Pluie,* July 19: *…not a single day has passed during this week but what we have had rain, & at times very heavily*, July 26: *had a great quantity of rain during the week with thunder & lightning* (Lac la Pluie Journal 1834/35). By August 2 *in the lake all* [was] *overflowed* (ibid).

J. D. Cameron summarized the season as follows:

> *The writer reached Fort Francis on the 13th of September 1834, when he found the water excessively high from Lake Winnipeg to Lac la Pluie; and continued so to Fort William. The consequence was a complete failure of rice throughout the country. This had occurred in three successive summers. The farm did not yield much in consequence of heavy rains toward the end of May and the greater part of…June.* (Lac la Pluie District Report 1834/35)

1849: The summer of 1849 in the Red River valley and northern Minnesota may have been the wettest in the entire 19th Century. The weather conditions have been discussed in detail by Blair and Rannie (1994) and Rannie and Blair (1995); the following quotations are only a very small part of the commentary available from the Red River Settlement and the Woods Expedition traveling from Saint Paul, Minnesota, to Pembina.

> June 26, Red River Settlement: *The water is extraordinarily high… all the rivers are inundated. They say that Pembina is drowned and it is believable from the height of the water here. There is already*

> *grain in the water and it doesn't appear to have decided to lower yet.* (Provencher 1849a)
> July 6: *The prairies* [were] *so bad from the drenching rains that had just fallen we were scarcely able to get along. Little drains that usually contain no water, were now almost swimming…* (Woods 1850, 13)
> July 17: *Starting at 12 M, over a level prairie on which the water stood from two inches to two feet deep almost the entire way…we reached Maple River… but the water being much higher now, the bridge had disappeared. There had been such torrents of rain… that the little branches that ordinarily furnish barely a sufficiency of water to allay the thirst of a travelling train were now swimming.* (ibid, 16)
> August 1: *…having been out since the 6th of June, we arrived at Pembina, and found the Red River and the Pembina River with about twenty feet rise in them, and overflowing their banks.* (ibid, 18)
> August 26: *When the expedition first reached Pembina* [on August 1]*, the incessant rains for weeks previous had caused all the rivers to overflow their banks.* (Pope 1850, 34)
> August 28, Red River Settlement: *the water has been so high all summer that there was no way to communicate with Pembina except by water…* [the Woods party] *visited* [M. Belcourt's] *post at Pembina and they had to leave because there was no appearance of a harvest at Pembina; the water covered the fields.* (Provencher 1849b)

1851: On July 15 at Red River, Provencher reported *"already for fifteen days it has been raining, the water* [on the Red] *rises and rises"* (Provencher 1851a). By July 21, *"the abundant rain* [had] *done damage to the grain. The water rises continually and could destroy the crop on the low ground; already this is the case at White Horse Plain"* (Provencher 1851b). White Horse Plain is on the Assiniboine River west of Winnipeg and flooding there indicates that the Assiniboine basin was also receiving abundant rainfall. The abundant rain extended to south-central Minnesota. On the lower Minnesota River, Frank Mayer reported on July 7 that *"this is an unusually rainy season & we are almost daily visited by storms of wind & rain…"* (Heilbron 1932, 177) and found the Minnesota River to be "*higher than it has been for years*" (ibid, 190). On

August 31 at Lac qui Parle, Minnesota, Riggs wrote *"it was one of the very wet summers in Minnesota, when the streams were flooded all the summer through."* (Riggs 1880, 139).

1853: June and early July were very rainy at Red River. From May 28 to July 16, rain was reported on 25 of the 50 days in the Cowan Diaries or the Winnipeg Journal and was frequently described as "heavy", "deluge", "great". Apart from complaints about mosquitoes and a minor comment about wet ground, however, this rain seems not to have affected water levels or crops.

1854: The evidence in this year comes entirely from eastern Saskatchewan and western Manitoba. On June 22 at Fort Pelly they were *"getting no fish from the basket owing to the river* [being] *so high."* (Fort Pelly Journal 1853-54). From mid-June to mid-August, rain fell on about 40% of the days at Fort Pelly and the rivers remained high at the end of July. On a trip to Fort Ellice, Charles Pratt wrote on June 30 *"I* [tried] *to cross the* [Whitemud River] *but I could not, the water so high. I was afraid that we should drown."* (Pratt Journal) and when he reached the junction of the Assiniboine and Qu'Appelle Rivers on July 18 he found *"the rivers very high…got over with great difficulty"* (ibid). Four days later south of Fort Pelly *"…the Assiniboine was so high that it overflowed its banks in some places"* (ibid).

1855: Donald Gunn recorded an astonishing 43.6 inches (1107 mm) of rain at Lower Fort Garry from June through September (June- 10 inches, July-14.6 inches, August- 12.5 inches, September-6.5 inches) (Dawson 1859). Such an amount cannot be easily accepted at face value and there are unfortunately few other documents from that period to confirm or discredit it. On June 19, James Settee at Shoal River near the mouth of Swan River reported a rainy month with "*rains in this month as frequent as I have ever observed both last summer and this which keeps the waters high*" (Settee Journal). At Red River Abraham Cowley noted some thunderstorms and on July 7, when Gunn recorded 3 3/8 inches (86 mm), Cowley "*left [his] wife & family at St. Andrews the road being so very heavy owing to the great rains which have fallen today*" (Cowley Journal). Perhaps most importantly, 10.5 inches (267 mm) were recorded at Lac qui Parle in southern Minnesota in August (United States Patent Office 1861) which compares favourably with Gunn's 12.5 inches at Lower Fort Garry (the other months were not reported at Lac qui Parle). Whatever the exact amount may have been, Gunn's data and the Swan River and Minnesota reports suggest a wet summer over a broad region.

1856: At Fort Pelly on June 12, the rivers were observed to be *"very high owing to this continual rain."* (Fort Pelly Journal 1855-57) and by June 30 at Red River *"the unusual quantity of water which poured into every stream caused serious injury to many of the bridges"* (Oliver 1914, 423). Henrietta Black reported that July at Red River *"...was extremely wet. Our hay ground in the parks, and everywhere else, was drowned."* (Black 1856). In late July and August, Charles Pratt travelled from Red River to the Qu'Appelle River and found high water in all the rivers along his route. On July 30, *"... the Little White Mud River... gave* [him] *no little trouble for its waters being high"* (Pratt Journal). When he reached the Qu'Appelle on August 11, he was surprised to find it in flood and after several days' delay in crossing the river on August 16 *"*[he] *couldn't commence building* [a mission on the Qu'Appelle] *the waters being so high."* (ibid).

1857: On his trip from Fort William to Red River in June, John Palliser encountered abundant rain and high water in northwestern Ontario. After leaving Fort William, he reported on June 20 *"the whole country was at this time flooded by the continued rains"* (Spry 1968, 62). Further west, the party *"left the north shore of Lac la Croix by paddling over a tract of flooded land, pushing our way through the branches of submerged trees until we arrived at a group of lakes at a distance to the north."* (Spry 1968, 72). At Portage du Bois on Lake of the Woods, they *"found the lake waters so much above their usual level that we were able to sail right over* [the portage]*"* (Spry 1968, 100). When Palliser reached Pembina on July 24, he found the Red River to be "*about five feet above its usual level*" (Spry 1968, 100). In August Henry Youle Hind followed Palliser through northwestern Ontario and encountered high water along the whole route. Near Fort William, *"the Kaministiqua River was higher than… had ever been known before at that season of the year."* (Hind 1860a, 31) and near Fort Francis *"the extraordinary height of the water…was seen by the lodge poles of former Indian encampments…* [which] *were under water to the depth of one or even two feet."* (Hind 1860a, 88). On the Winnipeg River, the wild rice crop was drowned, and fishing was difficult. In western Manitoba, Palliser described Whitewater Lake near Boissevain as *"a large lake…said to be of very recent origin. It has no outlet and until 5 years ago water was never known to lodge permanently in this place"* (Spry 1968, 117).

1858: Henry Youle Hind (1860a,b) reported rain on 44% of the days of his expedition from Fort Garry (June 15) to Fort a la Corne on the Saskatchewan River (August 8). His accounts are discussed in detail in Rannie (2006) but the following are representative: near Estevan "*the almost daily*

thunderstorms …replenished the marshes and small ponds [which provide] *an abundant supply of water"* (Hind 1860a, 305), at Fort Ellice *"we have had seventeen thunderstorms in twenty-three days; nearly all were of a violent character, with hail, heavy rain and boisterous winds"* (Hind 1959), and at Fort Qu'Appelle, *"not a day passed without lightening, thunder and generally violent rain of half an hour's duration"* (Hind 1860a, 312). It is not clear that rainfall amount was above normal but the number of storms and days with rain was greater than modern normals.

1860: On June 17 at Red River, Abraham Cowley observed *"a very great quantity of rain has fallen, the valley in our field was so filled with water that it produced quite a rapid current"* (Cowley Journal). On June 28, the Nor'Wester newspaper in the Red River Settlement reported

> *the present has been a rainy month…*[with] *showers throughout at short intervals…The water has risen steadily during the present month, and is now higher than at any time previous this year…* [The mail carriers from Lake of the Woods] *found much of … their route almost impassable- the streams being all swollen into little rivers by the late rains, and the morasses so flooded with water that their men frequently sunk therein up to their breasts. If the wet weather continues much longer, the potato crop will suffer... The water has risen steadily during the present month and is now higher than at any time previous this year* (Nor'Wester June 28).

The rains continued into July at Red River: "*the first half of July… has been a continuance in an aggravated form of the same wet season…"* (Nor'Wester July 14) and in northwestern Ontario: *"*[carrying mail from Fort William and Fort Francis] *Mr. McVicar found the rivers greatly swollen by the heavy rains, and he and his party were compelled to swim several of them with the mail bags on their backs."* (Nor'Wester July 28). On August 31, Samuel Taylor at Red River wrote *"I hear many people say that they never remember such a summer for rain…"* (Taylor Diary).

1861: This was the year of the third largest of the great 19th Century spring floods of the Red River and comments about standing water must be interpreted with this in mind. Nevertheless, there is evidence that the summer was wet. On July 1, the Nor'Wester newspaper noted "*we have had very rainy weather during the past three weeks. The crops are*

suffering somewhat… Very few will be able to commence haymaking at the usual date, July 20, on account of the immense lakes still covering the back pastures" (Nor'Wester July 1). It is unlikely that much standing water from the spring flood would have remained until this late date and it is assumed to have resulted from the rain the newspaper reported. At Fort Pelly, rain was recorded on 14 days from June 1 to July 7; eleven of these were heavy falls (Rannie 2001). At Red River, Samuel Taylor reported heavy thunderstorms on six days in June and on August 31, he referred to the "*wonderfully rainy fore part of the summer*" (Taylor Diaries).

With less confidence, isolated comments from some other years may also be interpreted as indicating unusually heavy rainfall for part of the summer. For example, on August 13, 1814, Peter Fidler observed "*water rising fast in the* [Red] *river these 4 days from rains in the Upper Country*" (Fidler 1814) and on September 13, 1869, the Nor'Wester newspaper noted "*there has been heavy rains somewhere up the country. The Red River has risen* [this week] *some two feet, and we learn that almost all the bridges which crossed the small streams between* [here] *and Georgetown have been carried away*" (Nor'Wester, September 13). A substantial rise in the stage of the Red River in August or September is unusual and must indicate widespread abundant rainfall in the basin upstream. In 1870, Colonel Garnet Wolseley encountered frequent rain on his regiment's trip from Fort William to Fort Garry: *"it has rained upon forty-five days out of ninety-four that have passed by since we landed at Thunder Bay and upon many occasions every man has been wet through for days altogether"* (Wolseley 1870, 20).

Discussion

Interpretation of "data" of the sort presented above is a subjective matter and readers' interpretations of individual years may differ from the writer's. Most convincing are the years in which commentary on rainfall is combined with observations of high water at a season when water levels are normally relatively low. Even allowing for some disagreement about the interpretation of individual years, however, the number of wet summers from 1800-1870 is remarkable. Most striking is their concentration into two time periods, 1824-1834 and 1849-1861, in which nearly every summer was wet (Figure 2). These are almost identical to the "*pronounced wet intervals in the late 1820s and 1850s*" which St. George and Nielsen (2002, 103) identified from dendroclimatic reconstructions in southern Manitoba.

In half of the years, the comments come from at least two of the three regions (eastern Saskatchewan/western Manitoba, the Red River valley

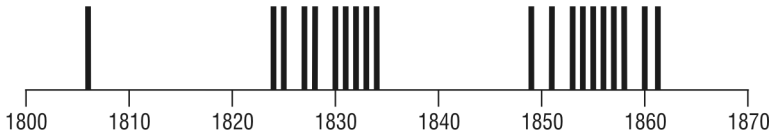

Figure 2: *Years with wet summers.*

and northwestern Ontario), indicating that the wet conditions were widespread. In several of the years where only one region is represented, the spatial extent may be more a reflection of the availability of records than an indication that the rainfall didn't occur in other regions. Furthermore, even in those years, references to high water levels in lakes and rivers indicate that the rainfall was not a locallized phenomenon.

The climatic sensitivity of river regimes in the Prairies and Great Plains has been noted by several writers (Karl and Riebsame 1989; Zaltsberg 1990; Knox 1993; Rowe et al. 1994; Ashmore and Church 2001) who have demonstrated that comparatively small changes in precipitation may produce disproportionately large changes in streamflow. Most have focussed on spring flood potential or annual runoff but their conclusions may apply equally to summer runoff. In 1993, for example, July and August rainfall was 200% or more of normal throughout the region and produced discharges more than an order of magnitude greater, particularly in August when bankfull conditions were approached or exceeded in most streams. At Emerson, the mean August discharge of the Red River was almost ten times the upper quartile August mean discharge and even exceeded the upper quartile monthly means during the peak flow months of April and May (Figure 3). The exceptional June-July rainfall in 2005 produced an equally severe but even broader summer peak (Figure 3). Many of the 19th century comments suggest similarly severe conditions and 1993 and 2005

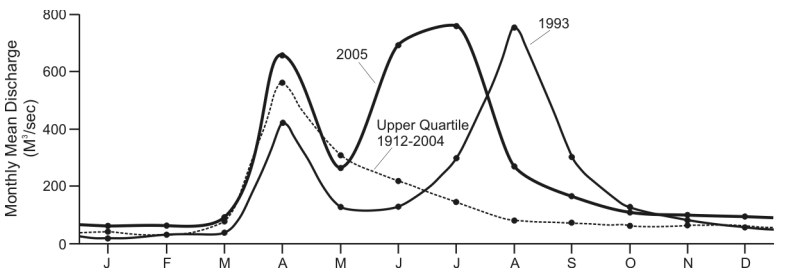

Figure 3: *Monthly mean discharges in 1993 and 2005 and upper quartile of monthly mean discharges 1912-2004, Red River at Emerson.*

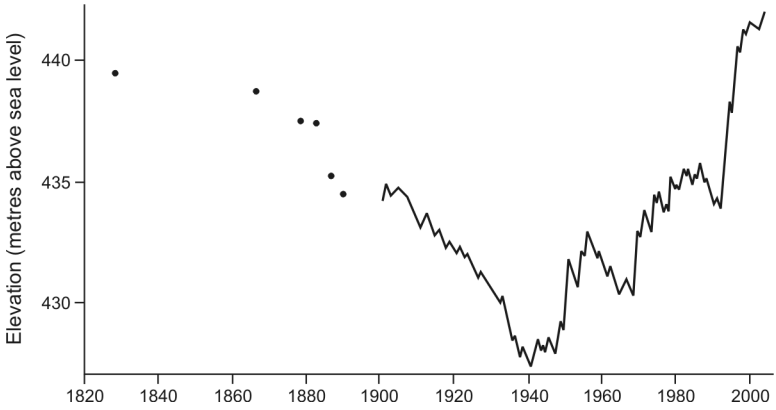

Figure 4: *Water levels, Devils Lake, ND.*

offer possible portraits of the river regimes which dominated the periods 1824-1834 and 1849-1861.

The incidence of wet summers with high runoff proposed in this paper contributes to the understanding of many aspects of the 19th century regional hydroclimate. For example, Clark (1988) used the charcoal content of varves in Demming Lake in northern Minnesota to infer forest fire frequency over the past 700 years. From a substantial peak in the late 1700s (indicating a high fire frequency), his charcoal index fell to the lowest values in the entire sequence (and thus a very low fire frequency) during the time period considered here.

The response of regional lake levels to augmented summer runoff is reflected in the history of Devils Lake, ND (Figure 4). The lake was high at the beginning of surveyed records in 1867 (Figure 4) and probably even higher in 1830 (Upham 1895). After 1867, the lake fell almost continuously to a minimum of 427.1 m in 1940 and although it recovered after 1940, the mid-19th century levels were not reached again until the spectacular recent rise caused by the succession of wet summers beginning in 1993.

The longest lake and proxy climate record in the region is the 2300-year diatom-based salinity record reconstructed for Moon Lake, ND (Laird *et al*. 1996). The period 1800-1860 had the lowest salinity in the entire record (Figure 5) and included a freshwater interval from 1820 to 1835. The high 19th century levels of Moon Lake and Devils Lake would be expected from the precipitation/runoff regime suggested in this paper. The commentators often reported summer lake and river levels to be high, sometimes dramatically so. Runoff from the numerous spring floods, especially those of 1826 and 1852, would have compounded the summer

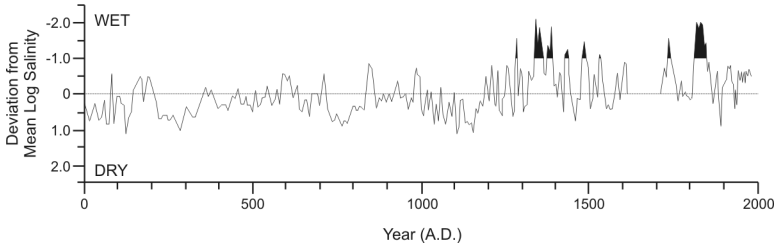

Figure 5: *Diatom-based salinity reconstruction, Moon Lake, ND (redrawn from Laird et al. 2005).*

rainfall and make the high water levels of Moon Lake and Devils Lake even more understandable.

Saturated ground and reduced available basin storage in the previous fall provide important preconditions for spring floods in the region. On the Red River, the very large floods of 1826, 1852, and 1861 were all preceded by wet summers and high water levels in rivers, lakes, swamps and depressions which otherwise might have provided storage for snowmelt in the following spring. The importance of this in the genesis of the disastrous 1826 flood (the largest in more than 200 years of record) was recognized by Ross who was an eye-witness to the event: "*The previous year had been unusually wet; the country was thoroughly saturated. The lakes, swamps, and rivers at the fall of the year were full of water*..." (Ross 1856, 106). Other floods on the Red River in 1815, 1825, 1828, and 1850 (Rannie 1998) and on the Assiniboine River in 1825, 1826, 1829, and 1852 (Rannie 2001) were also preceded by wet summer/fall conditions in the previous year. As a flood-forming factor, this may have been relatively more important in the 19th century when the landscape normally offered greater storage potential than its modern, intensively-drained, counterpart.

The archival evidence for very wet intervals on the eastern prairies from 1824-1834 and 1849-1861 is compelling but they do not appear in dendroclimatologic reconstructions from the western prairies. June-July precipitation for Medicine Hat reconstructed from tree-rings in the Cypress Hills show an unremarkable sequence of above and below median years from 1824-1834 and "*a period of prolonged drought* [from] *1851-1864, when only two years had June-July precipitation above the median*" (Sauchyn 2005, 29). The only first-hand accounts from the western prairies during this period are those of John Palliser in 1858 and 1859. Palliser certainly experienced very dry conditions in Alberta, particularly in 1859, but the excessive rainfall on the eastern prairies reported by Henry Youle Hind in 1858 (see above) is normally overlooked and there is no compelling

evidence for severe drought on the eastern prairies in 1859 (Rannie 2006). Such a disparity between eastern and western prairies is unusual but a dramatic example occurred in 2000 when severe drought in southern Alberta coincided with much above normal precipitation in the eastern prairies and northwestern Ontario. The reconstructed precipitation record for Medicine Hat suggests that such a dichotomy between eastern and western regions persisted for decade-length intervals in the early and mid-19th century.

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Abstract: Leaf Area Index (LAI), an important plant biophysical parameter, is widely used in ecological studies. There is a great deal of interest in estimating LAI and its variation in spatio-temporal dimensions using remote sensing based measurements. Currently, the major limitation of LAI mapping from satellite imagery is that these LAI maps have low accuracy because they are commonly produced from low spatial resolution satellite images (e.g., NOAA AVHRR (Advanced Very High Resolution Radiometer)). Also, NDVI (Normalized Difference Vegetation Index), the Vegetation Index (VI) commonly used to estimate LAI, is less accurate for semi-arid environments due to the spectral signal mixing errors arising from the low vegetation cover. To address these gaps and improve the accuracy of LAI maps, the research addressed the following objectives: (1) to develop an LAI prediction model based on a suitable spectral VI, (2) to produce an LAI map for the Grasslands National Park (GNP) area from a high resolution satellite image, and (3) to assess the mapping accuracy with ground-based measurements. This study utlized LAI measurements collected during the summer of 2005 and a SPOT-4 scene (20m spatial resolution) acquired for the same time frame. The results showed that in estimating a mixed grassland ecosystem's LAI, ATSAVI (Adjusted Transformed Soil-Adjusted Vegetation Index) could provide a high quality LAI map (66.7% accuracy). The methodology developed could be used to study other biophysical variables, for LAI mapping in similar ecosystems, for ecological studies, and for management practice guidance.

Introduction

Leaf Area Index (LAI, maximum projected leaf area per unit ground area), a vegetative structural parameter of terrestrial ecosystems (Fassnacht *et al.* 1997), is strongly correlated with many ecosystem processes and conditions, including evapotranspiration (McNaughton and Jarvis 1983), site water balance (Grier and Running 1977), canopy light interception

(Pierce and Running 1988; Fassnacht et al. 1994), above-ground net primary production (Gholz 1982), and total net primary production (Gower *et al*. 1992). Precise knowledge of LAI in large areas is necessary as input to models of carbon and nitrogen cycling, surface hydrology, net primary productivity, land use change, and land surface climate (Running *et al*. 1989). However, direct measures of canopy structure are extremely labor-intensive, and LAI estimation over large spatial extents is challenging. Remote sensing techniques, particularly with the use of satellite images, may offer a practical means to measure and understand the LAI variation at landscape or higher scales (Running *et al*. 1989).

The fact that reflectance measurements offer the opportunity for "scaling up" from the plot level to larger areas has produced sustained interest over the last three decades in investigations of the radiometric properties of canopies and their relationships to various plant parameters (Perry and Lautenschlager 1984; Friedl *et al*. 1994). Early spectroradiometer measurements of visible and infrared energy identified a strong correlation between the red and near-infrared (NIR) transmittance ratio and measured LAI (Jordan 1969). Chlorophyll absorbs red light energy, therefore, plant leaves have relatively low transmittance (and reflectance) of red energy. In contrast, plant cell walls scatter near-infrared energy, resulting in relatively high near-infrared transmittance and reflectance (Gates *et al*. 1965). These findings suggested that a scanning sensor may provide spectral measurements that are strongly related to the amount of leafy biomass or LAI (Tucker 1979). Subsequently, significant efforts have been made to estimate vegetation parameters in a spatially complete manner (Curran and Williamson 1986) from empirical algorithms relating LAI to spectral vegetation indices (VI) derived from red and NIR reflectance (Turner *et al*. 1999).

While numerous studies have shown a strong relationship between vegetation parameters and VI, these studies have also noted that observed relationships are highly site dependent (Friedl *et al*. 1994). For LAI estimation, the diversity of the suggested LAI–VI algorithms demonstrated a major limitation of the VI approach (Qi *et al*. 2000). These equations differ not only in mathematical form (e.g., linear, power, exponential), but also in their empirical coefficients, which primarily depend on the vegetation type of interest. Studies have been conducted on croplands (Wiegand et al. 1979; Asrar *et al*. 1984), grasslands (Friedl *et al*. 1994; Goetz 1997), shrublands (Law and Waring 1994), coniferous forests (Running *et al*. 1986; Spanner et al. 1994, Chen and Cihlar 1996), broadleaf forests (Badwar *et al*. 1986; Fassnacht *et al*. 1997), and mixed vegetation types (White *et al*. 1997). Red–NIR VI typically increases over an LAI range from 0 to about 3–5 before an asymptote is reached. Therefore, to use the VI

approach, an LAI–VI equation must be established for each vegetation type, which requires substantial LAI measurements and corresponding remote sensing data.

Another limitation of VI is its sensitivity to the non-vegetation related factors such as soil background properties (e.g., Huete 1989; Qi et al. 1993), atmospheric conditions (e.g., Kaufman 1989; Vermote et al. 1990), topography (Holben and Justice 1980; Pinter et al. 1987), and the bidirectional nature of surfaces (Kimes et al. 1985; Deering 1989; Roujean et al. 1992; Burgess and Pairman 1997). Studies have shown that the effects from soil background variations and atmospheric conditions may be minimized by developing improved vegetation indices (Huete 1988; Clevers 1989).

Zhang (2005) investigated the relationships between LAI and satellite data in the mixed grasslands and found that several vegetation indices were highly correlated with LAI in the mixed grassland. Our study continues the investigation of the ability of satellite data to accurately estimate LAI in the mixed grassland ecosystem of Saskatchewan, Canada. The objectives are to develop algorithms for mapping LAI from high resolution satellite imagery and to provide a high quality LAI map with an assessment of its accuracy using ground measurements. The LAI map could, for example, be applied in the development of grassland ecological models and fire management strategies.

Materials and Methods

Study Area and Ground Data Collection:

This study was conducted at Grasslands National Park (GNP) in southern Saskatchewan. GNP is located within the mixed grass prairie biome, within the Great Plains. This biome is a transitional zone between tall grass and short grass prairie (Bragg 1995). The Park consists of two blocks, West and East, totaling approximately 906.5 sq. km. Approximately 340 mm of precipitation is received annually, the majority of which is received in the growing season (May – September). The 1971-2000 mean annual temperature was 3.4°C; the highest mean monthly temperature (18.5°C) is in July and the lowest mean monthly temperature (-13.6°C) is in January (data downloaded from Val Marie Southeast weather station, Environment Canada 2000). The soils in the study area are brown chernozemic clay loam soils (Saskatchewan Soil Survey 1992). The GNP consists of upland, slopeland, and valley grasslands, and the dominant native grasses are June grass (*Koeleria gracilis*), needle-and-thread grass

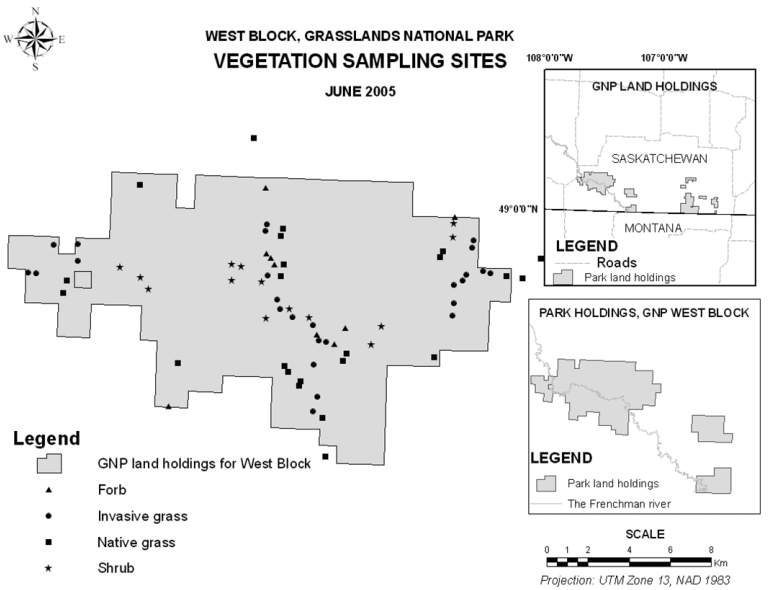

Figure 1: *The study area: Grasslands National Park and surrounding pastures, southern Saskatchewan, Canada, located at the international boundary of Canada and the United States. The Park is composed of two blocks: East and West. The 60 sites used in this study are located in the West block, and are marked with different symbols as shown in the legend.*

(*Stipa comata*), blue grama (*Bouteloua gracilis*), and western wheat grass (*Agropyron smithii*). In addition, invading weed grass species, forbs and shrubs are also widely distributed in the study area. The study sites in the West block of the GNP were in dense and sparse vegetation patches.

A total of 60 randomly selected sampling sites were visited during June of 2005 (Figure 1). These sites included native grass species (e.g., Grama, Needlegrass and Wheatgrass), invasive grass species (e.g., Smooth brome grass and Crested wheat grass), forb species (e.g., Sweet clover), and shrubs (e.g., Snowberry and Silver sage), distributed over the upland, slope land, and valley areas. Each sampling site was dominated by one type of vegetation community. At each of these sites, field sampling was conducted along two 100m transects, perpendicular to each other; one ran north-south and the other east-west. Along each of the 100 m transects, LAI measurements were collected using a LiCor-LAI-2000 Plant Canopy Analyzer (LiCor Inc., Lincoln, Nebraska) with a sampling resolution interval of 10m, for a total of 20 measurements per site. Each LAI measurement was

comprised of one above-canopy reading followed by 9 below-canopy readings within two minutes to avoid atmospheric variation. These (20) measurements of LAI in a site were then averaged to provide an LAI value for the site. The LAI discussed in this paper is a canopy area index or plant area index. The geo-referenced coordinates for each of the site centres were determined with a 6m accuracy using a handheld Geographic Positioning System (GPS). The transect locations were permanently marked on the ground and these coordinates were later digitized into the Park's GIS data layers.

Remotely Sensed Data Acquisition and Processing:

A single SPOT 4 HRV image (Path 37, Row 26) for the study area was acquired for the date of June 22, 2005 (timed about half-way through the ground truth data collection). The satellite image was processed for geometric and radiometric corrections using PCI Geomatica V. 9.1. An accuracy of 0.3 RMS or better (representing approximately 6m or less error on the earth's surface) was ensured in the geometric correction process. Topography distortions were corrected using a Digital Elevation Model (DEM) obtained from the Park's GIS database. Atmospheric and radiometric corrections were conducted based on the improved dark object image subtraction method of Chavez et al. (1991). After correction, the digital number (DN) values were converted to reflectance values.

After preprocessing the image, RDVI (Renormalized Difference Vegetation Index; Roujean and Breon 1995) and ATSAVI (Adjusted Transformed Soil-Adjusted Vegetation Index; Baret et al. 1992) were derived from the NIR and Red bands to estimate LAI:

$$RDVI = \frac{\rho_{800} - \rho_{670}}{\sqrt{\rho_{800} + \rho_{670}}} \quad (1)$$

$$ATSAVI = \frac{a(\rho_{NIR} - a\rho_{\mathrm{Re}d} - b)}{a\rho_{NIR} + \rho_{\mathrm{Re}d} - ab + X(1+a^2)}, \text{ X=0.08} \quad (2)$$

RDVI is a hybrid index between DVI (Difference Vegetation Index) and NDVI (Normalized Difference Vegetation Index), and combines the advantages of DVI for low vegetation coverage and NDVI for high vegetation coverage (Haboudane et al. 2004). The ATSAVI index was developed to consider the actual gain (a) and intercept (b) values of the soil line and an adjustment factor X, which is set to minimize background

effects (X = 0.08 in the original paper by Baret and Guyot 1991). Therefore, these two indices have strong theoretical bases to estimate LAI in locations with soil background variations. In addition, these two indices have been demonstrated to be good LAI indicators when using ground hyperspectral data in the same study region (He et al. 2006). Therefore this study tested ATSAVI and RDVI to estimate LAI. In order to match remote sensing data with LAI values for each site, we extracted and averaged the pixel data along the perpendicular transects within the sites, thus, the average LAI of a vegetation community was compared with the average VI derived from pixels representing that same vegetation community.

LAI Map Development and Evaluation:

Forty of the 60 sites were used to build the linear regression models between VI and LAI, and the remaining 20 sites were used to evaluate the models. The models have been validated by Jack-Knife cross validation. This Jack-Knife validation approach is implemented by withholding one sample and building the regression model using the data from the remaining samples. The process of removing one sample from the dataset was repeated until all samples had been withheld. Root mean squared error (RMSE) and map accuracy (MA) have been calculated to evaluate the models' accuracy for mapping LAI. The RMSE and MA can be computed as:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \hat{x}_i)^2} \quad (3)$$

$$MA = (1 - \frac{RMSE}{\frac{1}{n}\sum_{i=1}^{n} x_i}) \times 100.00 \quad (4)$$

where n is 20 (sites), i is each site sequence, x_i is measured LAI and $\hat{x}_i$ is LAI calculated from the regression model. The LAI map was developed using the regression model with the highest levels of accuracy.

Results and Discussions

LAI Data:

Table 1: *LAI descriptive statistics.*

Number of sites	Mean LAI	Range LAI	Min. LAI	Max. LAI	Std. Deviation
60	1.25	3.41	0.44	3.85	0.59

The standard deviation of 0.59 and the large range for LAI (0.44 - 3.85) demonstrates the spatial variation of the grassland land cover at the different sites. At the Park, the high LAI values (3.85) are generally seen in areas with invading grasses, forbs and shrubs, and lower LAI values (0.44) occur in the badlands or the salt valleys. The study shows that the LAI value averages to 1.25 for the mixed grassland, indicating the presence of low vegetation cover.

Relationships Between Vegetation Indices and LAI:

Forty sites were chosen to build regression models to assess the relationships between the two VIs (RDVI and ATSAVI) (Figure 2). Note that the two points which appear to be outliers are valid points representing high vegetation density in the invading grassland and shrub sites. Regression results demonstrated quite strong relationships between LAI and the two vegetation indices; the ATSAVI and RDVI model r^2 values were almost the same, with 0.64 and 0.63, respectively. The results are consistent with another study from the same area (Zhang 2005). In Zhang's study (2005), the ATSAVI is the second best LAI indicator, explaining 51% of LAI variation. The strong relationships between VIs (ATSAVI and RDVI) and LAI also demonstrate that the amounts of components such as litter

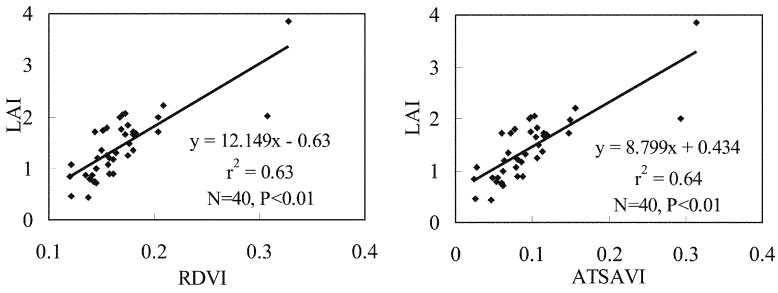

Figure 2: *Regressions between LAI and the vegetation indices (RDVI and ATSAVI).*

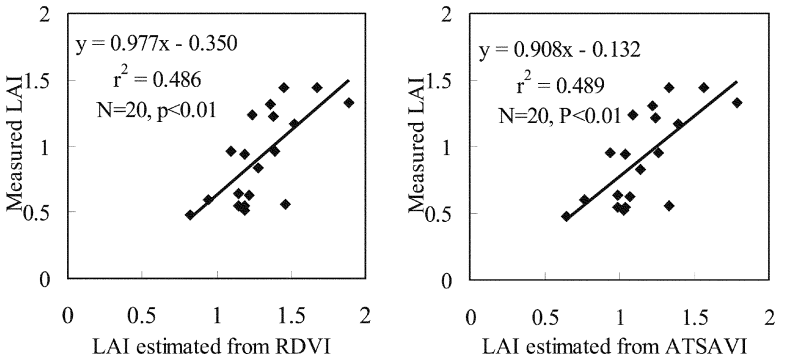

Figure 3: *The relationships between measured LAI and estimated LAI.*

and bare ground have little effect on the relationships when used with the selected indices. Since the 40 sites also include different terrains and plant communities (native grass, invading grass, forbs, and shrubs), the LAI estimation could be applied to the whole range of plant communities and the entire study area.

Model Assessment and Mapping LAI:

Remotely sensed data from the 20 sites not included in the regression analyses were used to assess the regression models. Figure 3 shows the relationships between measured and estimated LAI values. For both VI, the coefficient of X (0.997 for RDVI, 0.908 for ATSAVI) indicates that the regression models estimate LAI quite well, although LAI was slightly underestimated. The r^2 values for the ATSAVI and RDVI models are essentially the same, at 0.489 and 0.480, respectively. The ATSAVI model had a lower average error, a lower RMSE, and higher map accuracy than the RDVI model in estimating LAI for the 20 sites (Table 2). Overall, then, the results indicate that ATSAVI has a slight advantage over RDVI in estimating LAI.

Table 2: *Assessment of the regression models used to estimate LAI.*

	Average error	RMSE	Map accuracy
RDVI	0.858	0.411	53.9%
ATSAVI	0.771	0.297	66.7%

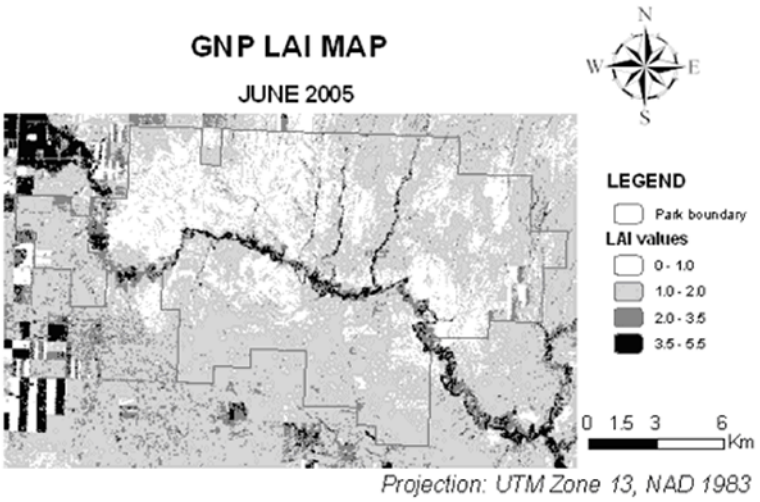

Figure 4: *LAI map produced from SPOT imagery using the ATSAVI-LAI regression model*

Thus, based on these results, we chose ATSAVI to develop the LAI map for the West Block of the GNP. In the final map product (Figure 4), the white color within the Park holdings represents low LAI values and lower vegetation. Light grey represents LAI values ranging from 1 to 2, which account for a majority of the Park area. Higher LAI values (2.0 - 3.5) are represented by dark grey and the highest LAI values associated with more vegetation cover are represented by the darkest tone. In general, areas with the highest LAI values are along the river banks and the lowest LAI values are towards the northwest part of the Park. The results are reasonable, given that the river banks have higher levels of moisture able to support more grass and that the sparsely vegetated badlands are located in the northwest

Conclusion

In this study we selected two vegetation indices, ATSAVI and RDVI, to estimate LAI and to prepare an LAI map for the West Block of the Grasslands National Park, Saskatchewan, Canada. The results of the linear regressions demonstrated strong relationships between LAI as measured by a Plant Canopy Analyzer and the selected vegetation indices. Further

assessment of the accuracy of the regression models indicated that for a Northern mixed grassland ecosystem, ATSAVI was better at estimating and mapping LAI than RDVI. The accuracy of the LAI map derived from ATSAVI was calculated to be 66.7% and this map represented quite well the spatial distribution of the vegetation. It was seen that the higher LAI values were along the river banks where there are higher levels of soil moisture for plant growth, and lower LAI values were produced towards the northwest part of the Park where there is more sloped and sparsely-vegetated ground.

The study has demonstrated the feasibility of exploiting remote sensing data to provide park managers with landscape scale information on the spatial variation of a biophysical condition (*i.e.* LAI) of the grasslands. We believe that further applications of this study could benefit ecologists by helping to determine whether non-adaptive grazing management will ultimately result in overgrazing. Furthermore, wildfire management and prescribed burning programs could adopt LAI maps effectively, to update fuel load information for extensive rangelands. Conservation groups, government organizations, and managers in the Great Plains region could take advantage of LAI maps derived from imagery, to monitor important biophysical properties of the grasslands, for sustainable wildlife and critical habitat management.

Acknowledgements

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Second homes Russian/Ukrainian style

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Abstract: Although much has been written recently about second homes in Europe, North America and the Antipodes, there is a noticeable gap in the literature in that the second homes of Russia and Ukraine have been almost totally overlooked in geographical and closely related academic writing. This paper makes a preliminary effort to address that gap through an examination of the 'dacha' – the Russian equivalent of the summer second home. The paper is based on a review of literature and recent field research undertaken around several cities of central Ukraine and Russia. The research reveals that there is a long history of second home usage in these areas and that the dacha has a variety of distinctive styles and functions that can broaden both our understanding of the second home phenomenon and urban food production.

Introduction

The dacha is an interesting phenomenon and it is somewhat surprising that it has been so greatly overlooked in the western geographical literature. Given its long history and that references to dachas are relatively widespread in Russian cultural history and the dramatic literature (e.g., Pushkin, Chekov, Gorki, among others), this oversight is perhaps even more surprising. The dacha in its simplest form may be described as "almost invariably a dwelling that is used intermittently, most often in the summer or on weekends. It stands on its own plot of land, is located out of town , but generally lies within reach of a large urban center (sic)" (Lovell 2003,1). In other words, it is the Russian/Ukrainian equivalent of western culture's second home. However, as we shall see, the dacha is similar to its counterparts in other parts of the world in having a variety of functions. Its uses are varying and dynamic, generally evolving, with changes in form and function occurring within the wider framework of societal change.

Conceptually then, the dacha phenomenon can be grounded firmly in the now voluminous geographical literature dealing with the rural-urban fringe and placed in the framework of the "city's countryside" as laid out by Bryant and others (Bryant, Russwurm and McLellan 1982; Bryant and Johnston 1992). This zone of mixed land uses in the outlying areas surrounding cities has been identified by a variety of names including: the peri-urban fringe, the near-urban zone and, most recently, post-suburbia. The latter term, attributed to Kling, Olin and Poster (1991) was originally used to describe the change in physical form of the urban fringe to that of a de-concentrated mixture of urban, recreational and rural land uses, whereas Lucy and Phillips (1997) use the term "post-suburban" to describe the "time period which is succeeding the suburban era and which includes several spatial forms, including a sprawling exurban rural pattern which is of much lower density than most suburbs" (Lucy and Phillips 1997, 260). Space does not permit an exhaustive review of the copious literature relating to this zone of activity and land uses outside the city. Suffice to say that the variety of land uses in the zone include virtually every type of economic and recreational function. Furthermore, they are present in a myriad of physical forms and development densities. The vacation cottage, second home, or dacha can be one of the more peripherally located of these forms, although a great many of them are readily accessible to the city dweller (Muller 2004).

There is now a fairly considerable academic literature on second homes, however, there are very few references to dachas. For example, Coppock's (1977) classic, but now somewhat obsolete work, makes fleeting reference to the popularity of second homes in eastern Europe and the Soviet Union (Coppock 1977, 31), while Wolfe, in Coppock's book, draws attention to the workers' summer resorts on the Black Sea (Wolfe, 31). However, neither author uses the word 'dacha' in referring to these second homes. Similarly, other more recent, relatively comprehensive works (Gallent and Tewdwr-Jones 2000; Gallent, Mace and Tewdwr-Jones 2005; Hall and Mueller 2005; McIntyre, Williams and McHugh 2006) pay scant attention to the second home phenomenon in countries of the former so-called Eastern Bloc. One notable exception is Lowell's (2000) recent work, a thorough history of the dacha, but this has received little acknowledgement or recognition in the recreational and geographical literature relating to second homes and exurbia.

Lowell points out that another of the important functions of the dacha has been the production of food and, of course, the agricultural component is another essential element of the rural-urban fringe. Again, there is now an extensive and rapidly growing literature on urban and peri-urban agriculture. Much of this has focused on the importance of small-scale

agricultural production to supplement the food requirements of urban dwellers in near-subsistence economies in developing countries (Losada, Martinez, Vieyra, Pealing, Zavala, and Cortes 1998; Moskow 1999; Drescher, Nugent, and de Zeeuw 2000; Bryld 2003). However, with rising concerns about sustainability, organic foodstuffs and alternative systems of food production and distribution, there is increasing attention being paid to such topics in the more developed economies. The burgeoning literature focusing on such topics as short food supply chains, farmers' markets and community gardens reflects this (see, for example: Drescher *et al*. 2000; Morris and Buller 2003; Baker 2004; Watts, Ilbery, and Maye 2005). These activities are concentrated in areas with ready access to cities, just as are dacha communities. The current study has emerged from earlier investigations into second homes and their role in the urban sphere of influence (Selwood and Tonts 2003; 2004).

The principal objective of this paper is to help familiarise geographers with the dacha concept. In doing so, it will provide a brief history of dachas, giving some insight into their evolution, the factors contributing to their widespread distribution and the various forms and functions that they have assumed during their emergence as distinctive components of the urban periphery. The discussion will then turn to a brief description of some preliminary empirical research undertaken during the summer of 2005, the main purpose of which was to gain a first-hand, albeit preliminary, appreciation of the dacha phenomenon and to determine the feasibility of a more substantial investigation. The paper then concludes with a discussion of current trends in dacha use, giving some consideration to their potential impact on future urban development. Some consideration is also given as to whether we can learn anything from the dacha concept that might be applied in a western peri-urban setting.

Origins: The Pre-Soviet Era

The dacha's origins are essentially generic in that the symbiotic relationship between urban populations and their temporary exodus to the countryside has been going on for millennia – at least as far back as classical Roman times when the more fortunate citizens of Rome took time away from their urban pursuits to enjoy the amenities of country life in their villas, these frequently being located on their latifundi, or agricultural estates. It is also interesting to note that more recent systems of land allocation have taken this relationship between urban and rural property into account in providing larger land parcels, often as reward for services

Figure 1: *Peter the Great's dacha at Peterhof.*

to the state, to be designated for villas and agricultural activities on the peripheries of cities (Selwood 1981; Keppie 1983; Dyson 1992).

The specific origins of the Russian dacha stem from very similar practices as those carried out in Imperial Rome when its loyal officers were rewarded with gifts of property from the state. In fact, the very word dacha derives from the Russian word "podacha" meaning a gift (Wheeler, Unbegaun, and Falla 1998, 289). Its adaptation into the Russian lexicon to refer to a summer home is widely agreed to have emerged at the time of Peter the Great (Lovell 2003). Indeed, one source has it that Peter himself adopted the word in specific reference to the summer home he had built for himself on the shores of the Gulf of Finland outside St. Petersburg. This small palace, reminiscent of Dutch architectural style, he was said to have called his dacha, or "Little Dutch House" (Guide 2005). The structure still exists (Figure 1), although it is now known as "Monplaisir," and is now only a small part of the property at Peterhof, where Peter subsequently built his much grander palace after the manner of Versailles, which now dominates the estate.

Regardless as to whether Peter was himself responsible for determining that the word dacha would be used to describe a summer home, he was nevertheless very instrumental in causing the phenomenon to take hold. Not only did he put pressure on his court to develop similar summer estates on the outskirts of St. Petersburg, but the growing middle class of the city began to emulate his actions, albeit at a more modest scale, but in

increasing quantity. During the nineteenth century, large numbers of dachas appeared along the banks of the Neva River and at other locations in the vicinity of the city. Although occurring somewhat later, the dacha concept shortly thereafter spread into the environs of Moscow and eventually into Ukraine as far south as the Crimean Peninsula where the Polish nobility had already established country estates in the eighteenth century. By the late 1800s, dachas had been adopted by a broad spectrum of society, sought after "… by everyone from craftsmen to aristocrats; accordingly, dachas varied enormously in size, level of amenities, and cost." (Lovell 2003, 61). The swelling summer populations in the areas containing dachas, which had by this time been greatly extended by railway construction, in many instances had changed the character of the rural economy from that of a peasant agrarian society to that of a tourism oriented system catering to a growing number of seasonal dacha dwellers, or 'dachnicki'(Lovell 2003, 113).

The Soviet Era

The dacha concept not only survived but continued to expand and evolve despite the disruption and turmoil of the Revolution and the Soviet regime. Party bosses, workers and other privileged citizens took over the more comfortable dachas that had been appropriated by the regime and numbers of dacha cooperatives were created in part to overcome the desperate housing shortages that occurred with urbanization. In 1928, a guidebook published for the vicinity of Moscow indicated that there were already around 300 settlements in the area that were second homes to summer vacationing Muscovites (Lovell 2003, 130). Continued expansion during the inter-war period saw the further development of numbers of spacious dacha settlements devoted to various members of the Bolshevik and Soviet elites. For example, Peredelkino, founded in the 1930s and only a half-hour train ride from Moscow, is known for its writers and was once home to such authors as Kornei Chukovsky and Boris Pasternak (Lovell 2003, 154-156). More remotely located, hidden in pine forest on the Moscow River, is Nikalina Gora, originally established as a dacha cooperative of the Workers of the Academy of Sciences and Arts. This settlement was once favoured by such eminent composers as Prokofiev and is still occupied by prominent musicians, although Nikalina Gora, like other more prestigious dacha settlements, has been 'invaded' by '…a panoply of Russia's political and business elite" (Anonymous 2003, 44).

Soviet housing policy, which concentrated on the construction of high density apartments in urban areas, served only to increase the demand

for dachas as people of all but the poorest classes looked for temporary escape from the city. However, at around the same time, the dacha's function began to broaden from that of a place for the consumption of recreation to that of a place of production as urban workers looked for alternate food supplies to supplement the meagre offerings available in the cities. This situation was of course greatly exacerbated during World War II, when food shortages became even more severe. Factories and other enterprises frequently organized garden cooperatives to enable their workers to produce food for their personal consumption. Not only did food production become a requirement, it became commonplace for owners to construct basic accommodation on their plots. Successive food and accommodation shortages, often of crisis proportions, led to the continued expansion of this new form of dacha through the Brezhnev era, extending into Gorbachev's period of administration and beyond. Nevertheless, leisure, status and escape from the city persisted as important components of many people's perceptions of the dacha.

It is evident that the popularity of the contemporary dacha is in line with the more widespread movement towards counter-urbanization, wherein the dacha is but one element in a range of housing forms extending beyond the compact urban centre (Lovell 2003; Zavisca 2003). Recent estimates of dacha ownership indicate that the practice is widespread throughout Russia, especially around the smaller cities. However, a high proportion of the inhabitants of the larger cities have plots of land. Clarke, for example, reports that 21% of Moscow households and 27% of St. Petersburg's households have plots (Clarke 2002, 3), while Lovell (2003) and Zavisca (2003) estimate that there are well over 1,000,000 dachas in Russia alone. Because of the long period of Soviet domination over Ukraine, it is reasonable to assume that the dacha is similarly popular there, even though Russia and Ukraine are now independent republics.

The Research Methodology

Due to financial and time constraints, the amount of empirical data that could be gathered for this study was necessarily limited, largely based on informal interviews with dacha owners and local officials, anecdotal reports, and relatively few opportunities for on-site examination of dachas. Most of the fieldwork was undertaken in Ukraine within the orbit of Kyiv and supported by direct observation of dacha developments in Russia located along the river and canal system linking Moscow and St. Petersburg. The field component of the research thus followed a roughly north-south transect through western Russia and Ukraine and was pre-

determined by an itinerary put together for other personal reasons. I soon learned that there would be no simple or ready means available for gathering comprehensive statistics on the numbers and distribution of dachas in Ukraine. This was because there were none that were readily available. The country in 2005 was, and still is, in a delicate and relatively unstable political situation. Furthermore, the administration was still very much in the throes of dealing with privatization, not just of real property, but of many other aspects of the economy. Dealing with the dacha situation was not therefore a particularly high priority on the administrative agenda. In addition, it became clear that enquiries from strangers were often regarded by officials with some suspicion. As a result, the research was conducted on an informal basis and relied heavily on local, personal observations. However, this was supplemented by a search of available English language literature, and extensive references to local real estate websites, in both English and in Russian and Ukrainian translations.

Dacha Settlements in Ukraine

It quickly became apparent that having access to a dacha was an important part of the Russian/Ukrainian lifestyle. Even before leaving Winnipeg, I was informed by acquaintances having connections with the region that they had friends or relatives there who owned a dacha. During the flight to Kyiv, my seat-mate, now living in the United States, was happy to tell me about his father's dacha where he would be staying during part of his family visit. The young fellow, aged about thirty, informed me that his father had bought the waterfront dacha property about 15 years previously, on the edge of Kyiv, roughly 40 minutes drive from the city. The father had acquired the land for recreation purposes as an escape from town, although he had grown some vegetables there during the food crisis and collapse of the economy during the early 1990s. Originally there was no building on the property, but on weekends over the years the father had progressively built up a wooden, then stone cottage to which he was still making additions. My informant observed that his siblings were not so keen on the place and did not spend much time there, except to visit with their parents (Seat-mate, 2005). The widespread distribution of dachas was made clear to me even as we drove from Kyiv/Boryspil Airport about 30 kilometres east of the city. Part of the route was a grand, divided highway, flanked by woods, but every so often our driver drew our attention to the presence of numerous dachas, visible through breaks in the trees. The great majority of these were tightly clustered, sitting on

smaller, suburban sized lots, with a wide variety of building forms and styles, some quite rudimentary, but others fairly ornate structures.

Ukrainian regulatory authority pertaining to land operates at three levels, similar to the Canadian system. At the national level the Department of Agriculture establishes broad questions of policy, while the regional and local levels are responsible for urban, rural and communal jurisdictions, along with the administration, interpretation, and application of the national directives. With respect to dachas, these were subject to policies established at the national level, while the regional and local administrations determined allocations, management and local rules. Clearly, there had been little consideration given to planning controls or regulation of the building fabric at the local level. These first impressions became increasingly entrenched with greater exposure to the dacha phenomenon.

Dachas at Hlevakha

Hlevakha, is a small town with a population of around 9000 people located about 30 minutes south of Kyiv and readily accessible to the capital city by train (Figure 2). Associated with the town and adjacent to the railway line is a large dacha settlement consisting of some 2015 dacha plots on 150 hectares of land. 'Garden Community No 1', the first of three such communities, was created in 1957 for workers with the Transport Department, the Bank and other ministries and factories. The two other dacha communities, both of about the same size, were created shortly thereafter, all of them administered by the local council of Hlevakha which is subordinate to Vasylkiv regional council.

'Garden Community No 1' is subdivided on a basic grid, with each dacha plot being about 5 sotok in area (one sotok is 1/100 of a hectare = 100 square metres). The lots were originally unserviced, but in the late 1990s and later, electricity, gas, and most recently, water lines were installed, providing piped water during the summer months. There is garbage pickup twice a week and liquid sewage is held in containers that are emptied periodically, but sanitary sewage is still reliant on on-site disposal and composting. Furthermore, in the winter water has to be drawn from wells up to 150 metres deep. However, because services are now available and with privatization, people are now permitted to stay on their dachas year round, (Community Garden Manager, 2005). I attempted to obtain a map and copies of the general regulations pertaining to the community and its administration, but was refused, being told that I would have to apply to "Intelligence" for such material. (The manager was an older man of about

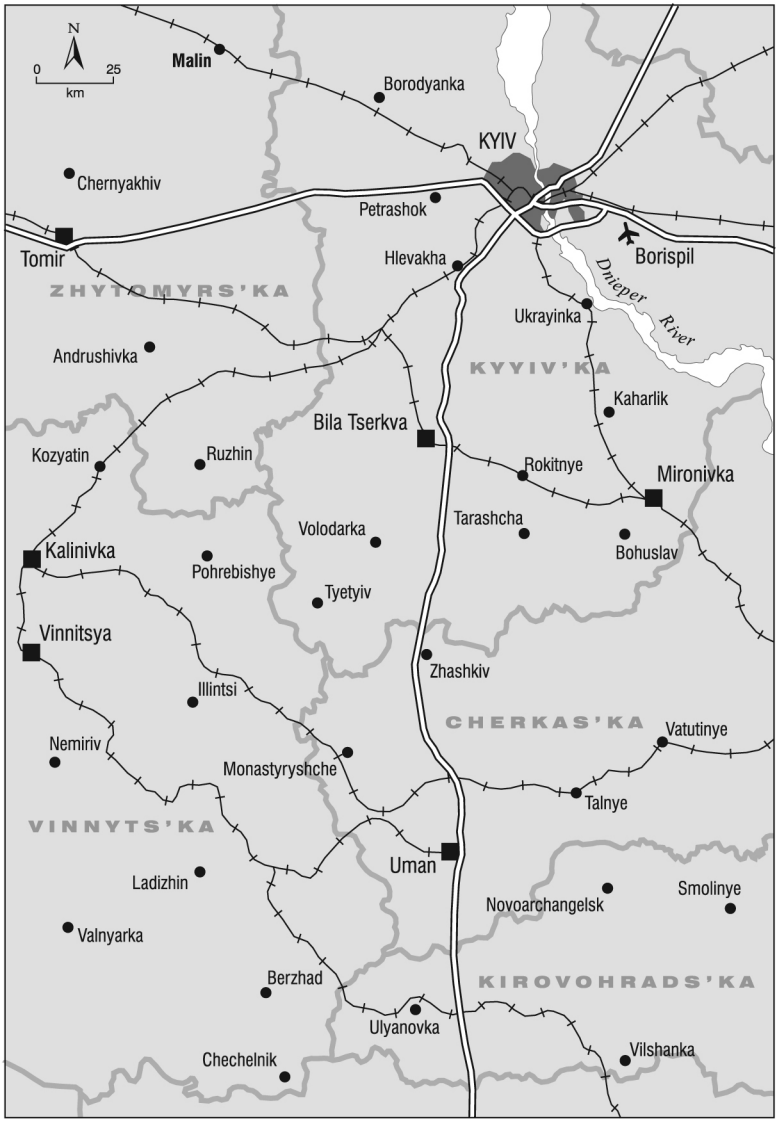

Figure 2: *Locational map central Ukraine, Kyiv region.*

70-75 years of age, and I was informed by my interpreter that his refusal was probably a carryover from the Soviet era). A notice board at the main entrance to the community did, however, carry a variety of regulations, including one that instructed people to maintain safe clearances between tree branches and power lines. There were also helpful hints on the notice board giving advice on planting procedures and general maintenance of the garden plots.

The density of development was quite high, because the lots were quite small, being only about 500-600 square metres each in area. It being July when I did my survey, the properties were covered with lush, verdant vegetation, often making it difficult to pick out the buildings. There were a great many fruit trees, with almost all plots carrying several each. Both vegetables and flowers were present in abundance, although the proportions of each varied between properties. What was very evident, however, was that a great many of the dachas were being used primarily for the consumption of recreation, rather than for food production (Figures 3 and 4).

I interviewed one lady who was in the process of building an additional wing on her already substantial brick dacha. She (Dacha lady (a) 2005) told us that it was to contain a fully equipped bathroom and toilet. This was in addition to a steam bath-house located on the property. Her father, a transport department worker, had acquired the dacha in 1957 when they were first made available. He had obtained it primarily for recreational purposes, although he had also produced some vegetables from the garden. Another profitable pastime at the dacha had been his rabbit farm. Currently, the garden is devoted mostly to flowers of which the lady is justifiably proud, telling us that she was successfully growing roses from cuttings from a bouquet she had recently been given. However, the plot is inter-planted with a variety of vegetables including carrots, onions, cabbages and beets (just for summer consumption). There are also several fruit trees on the property. She told us laughingly that although the dacha was for recreational use, she was a slave to it because of the time it took her to maintain her garden, adding that even when she trotted off to the outside toilet in the morning she could not help but tarry on the way to pull a few weeds from the plot. She now lives with her husband on the property year round, commuting into Kyiv each day to her job in the city. The couple has turned over their city apartment to their sons. She informed us that there had recently been a rapid upsurge in prices for dachas in the community. According to her, they had virtually doubled in value over the past couple of years and were being picked up by buyers as soon as they became available. A run-down, unimproved dacha could still be obtained for about $6,000 US. equivalent, but a fully appointed

Figure 3: *Older dacha, Hlevakha.*

Figure 4: *Newer dacha, Hlevakha.*

modernized property would fetch around $100,000 US. Presently, however, there is an embargo on property transfers until government administrators catch up with the situation (Dacha lady (a) 2005).

Dachas at Monastyryshche

Part of the fieldwork was undertaken in the westernmost area of the Cherkasy oblast (Figure 2) in the vicinity of Monastyryshche, a small town some 200 kilometres almost directly south of Kyiv and 25 kilometres west of the main autobahn highway between Kyiv and Odessa. This highway now brings the town to within three hour's travel time of the Ukrainian capital, just close enough to make it accessible for the weekend, but too distant to be attractive to people with no previous ties to the place. Monastyryshche is so named because of its ecclesiastical origins, but its economy more recently has been based on its role as a service center for the surrounding agricultural district and a couple of important factories developed during the Soviet era. One of these, a steam boiler manufacturing plant, was said to have been the second largest of its kind in the Soviet Union, employing several thousand workers. More detailed information on the economic and demographic structure of the town was difficult to obtain. Statistics were hard to come by, partly because none had been compiled, but where there were statistics, the administrators were reluctant to give anything but the most general figures. Overall population figures for the Region have been slowly declining (see Table 1) to a total in 2003 of some 39,000 population, incorporating Monastyryshche, boasting only about 9,300 people (down from its maximum size of around 15,000 when the town's factories were in full operation); villages 26,000; and Tsybuliv (urban-type community, urban village) 3,800 people. According to the administrative officers, the population decline can be attributed to the loss of factory employment, out-migration and deaths exceeding births in the villages by a ratio of 10:7.

Informal discussions with administrators from the local Cadastral Department (2005) (answerable to the State Land Committee of the Ministry

Table 1: *Monastyryshche Population Change*

Year ending	Population
2001	40,600
2002	39,100
2003	39,700
2004	39,300

of Ecology and Environmental Protection and Architect's Department) revealed that there are only two areas in the vicinity of Monastyryshche where there are dachas. Both areas contain only a limited number of plots: the exact number of plots in each is unknown because no survey plans exist, but are estimated to be between 100 and 200 in total. In addition, there are three extensive areas where people can obtain 'field lands' of about three hectares in area per person. Many of these 'field lands' originated when the collective farms were disbanded and the workers were allocated land parcels to allow them to continue working the land. Originally, only the farm workers were deemed eligible, but the privilege was subsequently extended to all the inhabitants of the commune. However, the 'field lands' cannot be built on, nor can trees be planted on them. Conversely, town (suburban) plots of up to 10 sotok in area can be purchased, but not for just a garden; construction of a dwelling must be begun within two years of purchase. Currently, land releases and transactions are 'on hold' to allow the system to be put into better order, records brought up to date and previous claims and applications to be considered. At this juncture, solely transfers due to inheritance and privatization are being processed, and then only when people are prepared to pay the costs of surveys and documentation. Because of the declining population in the district, there is currently very little demand for land. A field survey and interviews with the local authorities indicated that many land parcels lie vacant inside the town and in the villages, as well as among the garden and dacha plots. Nevertheless, it was very apparent that most of the dacha plots in closer proximity to the town were used primarily for food production, although there was an element of recreation or consumption associated with the activity. Several 'dachniks' were observed and interviewed on an informal basis to gain more insight into these activities.

Valya (2005) has two dacha plots located about three kilometers from town. One plot is registered to her and the other to Alyona, her daughter. Valya became eligible for them because her husband worked as an engineer at the local factory while she was a teacher at the factory's nursery school, and the factory workers were given dachas as part of the wider dacha scheme. Since the collapse of the Soviet Union and the factory commune in the early 1990 s, the dachas are now rented from the local Council. The rent is nominal, only 50 kopeks (about the cost of a half loaf of bread) per sotok, with the larger parcel containing five sotok and the smaller has just four. On these plots Valya has a number of fruit trees, including sweet and sour cherries, apples, pears, apricots, walnuts as well as red and black currents, raspberries and strawberries, gooseberries and grapes. These are eaten fresh, made into jams or compotes, or frozen for consumption

Figure 5: *Valya's garden plot, Monastyryshche.*

later in the year. She also grows a wide range of vegetables. Potatoes are a critical staple, with onions, beans, peas, zucchini, squash, carrots, beets and cabbage also being important. Garlic, mint and dill grow seemingly at random throughout the plots (Figure 5). Salad vegetables, such as lettuce and radishes are also regularly harvested. Even without watering, the dacha yields enough to supply most of Valya's personal needs, as well as those of her daughter and son-in-law. As in many other plots, flowers add another dimension to Valya's property. In her case, perennials and bulbs, including tulips and narcissi, bring delight and beauty to the garden. They also provide her with cut flowers for her apartment. Given the large numbers of 'babas' who hawk their garden produce, including vegetables, fruit, berries and flowers in the local markets and at the entrances to city subway stations, it is very evident that the dacha plot can also provide an income supplement to those who are living at close to a subsistence level. Despite Clarke's (2002) assertions to the contrary, this suggests that those living at or close to subsistence gain significant, even if minimal, sustenance from their garden production. Tho Seeth, Chachnov, Surinov, and Von Braun (1998) also insist that there will continue to be significant dependence on garden plots for domestic food supplies for the foreseeable future.

Since her forced retirement, Valya now lives in Kyiv where she has found other work. However, she has retained her apartment in Monastyryshche, because she expects to return there eventually, since she feels that it is her permanent home. She spends her weekends and

Figure 6: *Valya's storage shed and root cellar, Monastyryshche.*

holidays there so as to be able to escape from the city and to work her dacha. Because of its proximity to town, Valya does not stay at her dacha. There are no dwellings located on her properties, only small sheds which are used for garden tools, storage and the like (Figure 6). However, one has a root cellar, enabling her to stock up with vegetable supplies well into the winter period. This was not the case on a number of the other dachas which boasted dwelling houses.

Down the track a few plots away there are several more very small, but substantial brick-built cottages. One of these was owned by a man from Kyiv who spent his entire summer at the dacha (Figure 7). Another man from Monastyryshche visited his dacha daily, while another lady and her partner spent the entire summer at the dacha and returned there daily during the winter to look after their livestock (Figure 8). This dacha was very intensively developed, containing a variety of fruit trees, a heavily cropped vegetable garden, along with about a dozen chickens, geese, ducks, rabbits and a goat for milking. The five sotok property produces virtually enough for survival, except that the plot is too small to yield sufficient potatoes or grain. Fruit production is surplus to their needs, but there is no local market because most of the locals produce their own. Local prices for cherries are a mere 3 hryvna for 8 kilos, whereas Kyiv prices are 10 hryvna per kilo. Even so, the trip to Kyiv is not worthwhile, because of the small amount of surplus. Instead, their children who come to visit the dacha and lend a hand with the work are able to take home

Figure 7: *Brick summer dacha, Monastyryshche.*

Figure 8: *Brick year-round dacha, Monastyryshche.*

some produce with them. The parents evidently enjoy their life on the dacha, despite the hard work involved in getting up every morning at 5:30 and 'toiling' all day (Dacha lady (b) 2005).

Nevertheless, the parents are looking forward to privatization, when they expect to be given their plot of land. Once the property is transferred into their ownership, they anticipate being able to move there permanently, although sanitation is very basic. Their water comes from a shared well on the neighbour's property and there is an outhouse at the end of the garden. Sewage disposal consists of composting of the garden and animal waste, while human waste is dealt with by burying it in a low spot on the dacha property as is common practice in the villages. Nevertheless, they are busily fixing up the interior of the home, converting the former single room into two even smaller rooms, one a bedroom and the other a kitchen/living area. There is a root cellar and a tiny attached barn, just large enough to accommodate the goat. However, the small space inside the dacha is partly compensated for by the use of outside spaces as extensions of the living area. For example, the lady who was interviewed was relaxing during the mid-afternoon at a chair and table placed under an arbor of trees - this 'siesta' also helping to compensate for the morning's early start.

Current Developments

Privatization and the greater freedoms associated with perestroyka have brought about greater prosperity to many people of Russia and Ukraine. Consistent with this has been the trend towards more and better housing and more pretentious dachas (Figure 9). Among the most striking impressions one has of the cityscapes of Moscow, St. Petersburg and Kyiv, are the number of building cranes on their skylines and the massive numbers of new apartments under construction (Figure 10). However, for the most part, the new construction is patterned after what is already in place. Therefore, block after block of new high-rise towers, or great slab blocks of multiple stories continue to be the principal forms of residential development available to the city dweller.

Real estate promoters are attempting to cash in on the allure of the dacha. One notable example is the advertisement of a luxury block of condominiums as "Close-By Dachas - Elite Living Quarters" located not far from Poklonna Hill in inner Moscow (Close-By Dachas 2004). Encouraged by the planning authorities, conventional suburban tract developments are also appearing on the outskirts of Ukrainian cities that are catering to the burgeoning demand. According to Kyiv's deputy head of the office of the city's chief architect "We now only invite companies to

Figure 9: *Newer dachas along the Neva River outside St. Petersburg.*

Figure 10: *New apartment construction, Kyiv.*

bid on integral construction projects…It's the only way to develop the countryside'" Currently, within a 30 kilometre radius of Kyiv, there are at least eight "cottage villages" in various stages of development (Braychenko, July 2005, 5). In the rather quaint words of the RED Consulting Company's recent (2005) promotion of its 'Petrushki' cottage village, located at Petroshok, some 20 km west, or 40 minutes drive from Kyiv off the Kyiv-Zhitomir highway (Figure 1):

> There is a norm for all civilized mankind already - to work in the city and reside outside its limits. The residing at your own house far away from noise, bustle and mad speed of megapolis gives a wholesome effect on your health, pacifies heart and prepossesses for creation.
>
> Private country house is one of major elements of inviolability of your private life being so necessary for rest and soul composure. It is full of greatness and dignity, sacrament and mysteriousness, and saving the things that are the dearest to your heart.
>
> Choosing to leave (sic) outside the city limits, you would get both the relevant level of independence and a possibility to enjoy day-by-day communication with nature, which the normal citizen will lack, and thus will not limit your social activity, for your neighbors are the people of your society.

However, this gated, insulated community designed expressly for consumption of the countryside is well beyond the reach of the average individual. The great majority of the population will continue to be accommodated in the pre-existing apartment block complexes that are now obviously in a sadly deteriorating condition.

Although individual units may be fundamentally sound, quite attractive, and can now be purchased by their occupants, the blocks and their surroundings are currently very inadequately maintained. For example, Valya's apartment in Monastyryshche is well appointed and roomy. It is 49 square metres in area, with two bedrooms, living room, kitchen, bathroom and toilet. In 1993, with privatization, it cost 8,000 rubles and is now worth about $6,000 US. Despite its being centrally located, because of the town's compactness, the apartment looks out over a rural landscape across the valley. However, it is not as pleasant an environment as might be expected. Maintenance levels were once at a high standard, but after Russia cut off gas supplies during the 1991 crisis, this spelled the end of hot water services to the apartment. Although gas supplies are again available, in

the meantime, with no water running through the hot water pipes they have deteriorated to the point where they are now useless. There is no money to replace them, so there is no hot water. Furthermore, since privatization, the Housing Authority has also failed to keep up appropriate standards of care regarding building maintenance, grounds keeping, landscaping and garbage collection. Provision of other essential services can also be erratic. Occupants of the housing block are not wealthy enough, nor are they cohesive enough to mount an effective protest. The Housing Authority claims it does not receive sufficient funds from the occupants to deliver on its responsibilities, while the occupants seem unprepared to pay extra for maintenance of the common areas, so little gets done. Occupants spend money on the interior of their units, while putting up with the depressing exterior surroundings of the urban building complexes. However, the latter is a strong motivation for escaping to their more attractive dachas located in a more rustic or 'suburban' setting.

Conclusion

This paper has demonstrated the widespread popularity of the dacha in parts of Russia and Ukraine and, although the data are not comprehensive, they show that the dacha is an integral component of the housing spectrum. The research for the paper was hampered by time and budgetary constraints and not made any easier by the difficulties of communication in a foreign language. However, direct observation brought many of the issues into clearer focus and provided invaluable insights into the diversity in physical characteristics of dachas, the nature of production and consumption on the properties, and the lifestyles of the 'dachnicki'.

It is clear that there are varied understandings of the dacha concept that incorporate different meanings and priorities for different folks, with different space requirements and different uses associated with the property. It is also clear that the long history of the dacha has contributed to these differences, although the symbiotic relationship between urban and rural life has continued to be a common thread running through the phenomenon. Whereas the earliest dachas were exclusively enjoyed by the nobility for recreational purposes and as sources of revenue, it was not long before they were being enjoyed by a range of middle and even lower class holiday makers as incomes rose and accessibility improved. One can readily draw parallels between events in pre-Soviet Ukraine and Russia and the literature describing peripheral urban expansion and the development of vacation property in Western Europe (Hardy and Ward

1984). During the Soviet era complications arose because of the rapid pace of urbanization, the resultant increased pressure for food supplies and for temporary escape from the stresses of urban living. Again, to a large extent these events paralleled developments in industrializing countries, although the peculiarities of the Communist regime created a variety of schemes designed to manage the system more effectively. War-time emergencies and inefficiencies in food supply and distribution stimulated small-scale agricultural production, giving the dacha another important function and encouraging it to evolve from other forms of rural settlement as well as transforming the purpose-designed vacation properties into places of production. Even here, one can see parallels with the proliferation of allotments and war-time gardens in England and North America during the World Wars (Kains 1942; Buswell 1980; Ward and Crouch 1988). Currently, the development industry in Russia and Ukraine is capitalizing on the growing wealth of the population and the ability of many to acquire a 'dream home' or to return to their roots in a quasi-rural setting.

Some of the immediate concerns about property in general lie in questions of security of tenure and the ability of administrations to deal effectively with the transition from tenancy to private ownership within the framework of new national and local regulations. There are also serious planning issues that must be addressed, especially as the trend to year-round occupation of dachas gains momentum. It is quite evident that the dacha settlements developed at higher densities generally suffer from very rudimentary services and facilities, particularly in the area of sanitation. Dachas occupying lot sizes equivalent to the standard Canadian suburban home certainly have to be considered a health hazard as they proliferate and are used for more extended periods of time.

On the other hand, there is clearly a trend towards incumbent upgrading, the improvement of properties when they change hands, or rebuilding programs. It can be expected that privatization will also encourage these trends to gather momentum. Furthermore, it is evident that there is a growing market for conventional suburban property. Private sector developers are responding to this demand and the authorities are, in their turn, demanding more comprehensive plans from the developers. The interpretation of the word dacha is becoming even more blurred by these trends. Nevertheless, there is still a strong feeling among many dachnicki that their property can be more productive, and not merely a place for escape and relaxation in a quasi-rural environment as a great many of them still gain much enjoyment and economic benefit from harvesting the fruits of their gardening labours.

Although there is an extensive literature on the use of ex-urban lands, sustainable agriculture, recreational land uses and cottage development,

this literature is deficient in comparative studies of these phenomena, especially as they relate to the Russian/Ukrainian experience. Given the revival of allotment gardens, the proliferation of community gardens, the rapidly expanding demand for organically produced foods, and calls for sustainable agriculture, the supporters of these movements might learn from the dachniki of the Ukraine and Russia who have demonstrated that considerable rewards can be obtained from putting even minute parcels of land to productive use on the peripheries of cities. Could it be that Western society is too fervently biased against relatively lax treatment of sewage and that regulations pertaining to land development might deter potential enthusiasts from using their suburban and ex-urban holdings in more diverse and productive ways?

There is no question that, as living standards rise in Ukraine and Russia, those who are able to afford to improve their lifestyle will aspire to obtain property that is more spacious and with higher amenity than the cramped units in the high density apartment complexes reminiscent of Le Corbusier's 'Radiant City' (Behrens 2005) that now dominate the cities of those countries. It is also very likely that elements of the dacha concept will continue to be deeply embedded in the Russian/Ukrainian psyche, or at least to be incorporated into notions of settlement in an essentially urbanized society that, like Canada, can enjoy the privilege (or illusion) of having extensive amounts of land into which to spread. Perhaps the emerging trends towards 'alternative' food systems, the growing interest in community gardens and organic food production, and similar labour intensive aspects of agricultural production, will more effectively blend with recreational activities normally associated with cottage developments on the peripheries so that there can be a better balance between the consumption function and the realisation of the potential for the production of food. A more in-depth examination of the role and functions of the dacha and its incorporation into western geographical literature is needed for there is potentially much we might learn of advantage from the dacha phenomenon. At the very least, the dacha should receive greater recognition in the literature pertaining to exurban land uses, second homes and to peri-urban agriculture.

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Notes

* The web pages of the RED Consulting Company <*http://www.red.Kyiv.ua*> provide a comprehensive listing of accommodations of various kinds in a large number of districts both inside and outside of Ukraine. For additional listings see: Delta Realty <*http://www.deltarealty.ru/en/country*>. Prices listed are not cheap, often quoted in the millions of US dollars!

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The use of spatial and non-spatial analysis for evaluating the need for urban revitalization in Winnipeg

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Abstract: In recent decades, urban research has explored the causes and responses to urban decline in the North American city, exploring methods and potential solutions to manage decline within the urban environment. This research examines how Geographic Information Systems (GIS) can be used as a tool to monitor and manage urban revitalization strategies. Individual factors contributing to a need for renewal were assessed, using multi-criteria evaluation (MCE) as the method of analysis. Maps were created to establish an index scale by which to measure varying levels of socio-economic need, by census tract, within the study area of Winnipeg, Manitoba. A theoretical framework, which detailed the processes of revitalization and decline in Canadian inner city neighbourhoods, and a classification of Winnipeg neighbourhood designations, was then applied to the results of the GIS analysis in order to bring together quantitative and qualitative data for analyzing urban revitalization. This mixed methods approach was used to diagnose urban areas in need of revitalization. The methodology used in this research can be adapted as census data is updated, and could play an important role in present and future urban revitalization strategies and policymaking decisions.

Key Words: urban revitalization, GIS, Winnipeg

Introduction

In recent decades, urban research has explored the causes of and responses to decline in the North American city, exploring management methods and potential solutions to decline within the urban environment. This study identifies census tracts within the City of Winnipeg that demonstrate a need for revitalization, and does so by prioritizing and weighting variables measuring aspects of the built environment that indicate varying levels of social, economic, and physical need. This assessment uses multi-criteria evaluation (MCE) analysis, which is based on a combination of factors, and is used to establish an index scale as a means by which to measure and assess spatial patterns within the study area.

The objectives of this study are twofold: to examine how Geographic Information Systems (GIS) may be used as a tool to monitor and manage urban revitalization strategies in the City of Winnipeg, using a mixed methods approach that examines spatial and non-spatial criteria; and to analyze varying levels of need for urban revitalization according to census tract using MCE. MCE is a technique that allows a number of revitalization factors to be assessed at once by prioritizing and ranking them, then weighting each factor and combining all factors into an index scale, which can be used to interpret need for urban revitalization.

The City of Winnipeg was selected as the study area for this research as it is a medium-sized, slow growth city, and the use of MCE and a mixed methods approach to analyze areas in need of revitalization are unique to this area. Like many other North American cities, Winnipeg has seen a recent concentration of growth in suburban areas while the inner city experienced depopulation and decline (Leo and Brown 2000), yet relevant literature indicates that relatively little attention has been paid to Winnipeg's urban context within Canadian urban studies, as the focus has mainly concentrated on major metropolitan centres. Winnipeg, the capital city of Manitoba, consists of a 462 square kilometre area, with a population of 671,274 people dwelling within 165 census tracts (Statistics Canada Census 2001).

Additionally, a review of pertinent literature indicated that MCE modelling has not yet been performed on medium-sized Canadian cities; rather, urban revitalization and GIS researchers have focused their attention on larger, high growth cities such as Chicago (Dai *et al*. 2001; Thomas 2002; Brown and Perrott 2004). Because urban revitalization is a complex process that involves a broad base of knowledge, methods of evaluation that are unique to an area are of importance when monitoring the resources of a city.

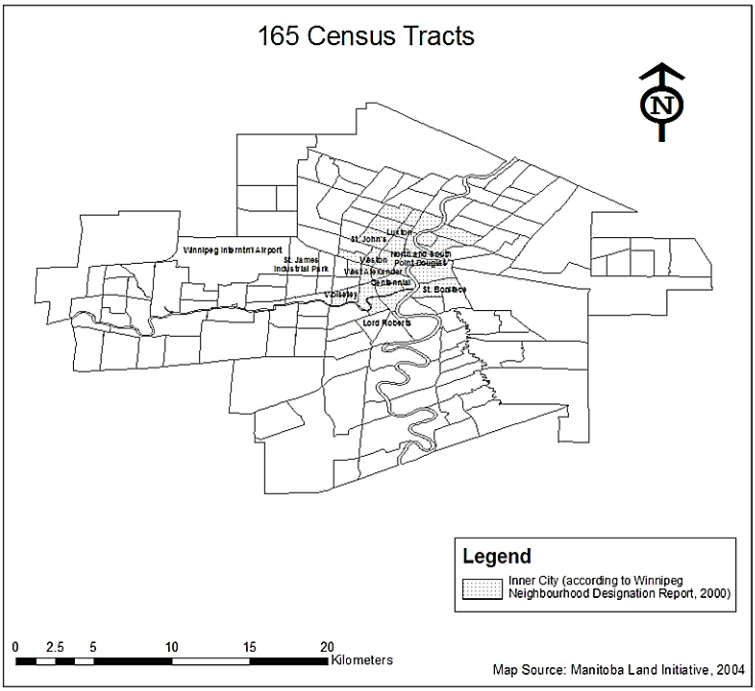

Figure 1: *Study area.*

Stewart (1993) indicated that although a range of valuable perspectives on the development of urban revitalization have been offered, there "does not appear to be one particular model that combines all the elements in just the right formula that can be prescribed for all situations" (153). Based on this thought, this research focuses on the advantages of using GIS modelling as one tool to interpret the urban environment with respect to revitalization efforts, and will introduce a model for urban revitalization in targeted areas, which can contribute to future community policy-making decisions and revitalization strategies.

This paper sets out to define the processes and approaches to urban decline and revitalization, focusing on the typologies of the inner city, and using this as a theoretical framework to bring together qualitative and quantitative classifications. Data collection and analysis is described in terms of factor selection and weighting, MCE modelling and mapping, and the results of these final maps as compared to a previous study that the City of Winnipeg undertook in 2000.

Literature Review

Processes of, and approaches to, urban revitalization:

Urban revitalization has emerged as a way of addressing the social, economic, and physical problems of a city. The processes of revitalization involve strategies consisting of multiple components, all concentrated in a particular geographic area experiencing distress (Zielenbach 2000) and can be separated into identifiable processes of change within the context of the city. A "detailed interaction exists between built forms and human activities" (Longley 2003, 116), and therefore social revitalization and reinvestment must be considered along with physical improvements and upgrades (Longley 2003).

Van Criekingen and Decroly (2003) stated that urban revitalization can be divided into individual processes, comprised of four possible stages: 1) gentrification, 2) marginal gentrification, 3) upgrading, and 4) incumbent upgrading. Although the concept of gentrification "only adequately describes the upward movement of very restricted parts of the inner city [whereas] neighbourhood renewal in general more typically comprises marginal gentrification, upgrading, and incumbent upgrading" (2451) it is of value to discuss all four stages, as each can be recognized as a distinct process within the continuum of urban revitalization.

Gentrification occurs when a "new middle class" emerge and move into lower income areas with potential for restoration, such as notable architecture or proximity to amenities. Sharp transformations will occur in the neighbourhood, and lower income earners that dwell in the area are often displaced due to rising rents in an area that quickly becomes desirable to the wealthier classes. ***Marginal gentrification*****,** often associated with middle income households, is said to be "richer in cultural capital than in economic capital" (2454) because residents of these neighbourhoods are usually highly educated but tenuously employed. Similar to gentrification, marginal gentrifiers will seek out an urban niche in inner city districts. ***Upgrading*** occurs in middle income neighbourhoods, where new homeowners make minor repairs to maintain the area's dwellings, and therefore, this is not directly associated with inner city revitalization. ***Incumbent upgrading***, on the other hand, is a renewal process in which long term residents of an area reinvest in their surroundings in order to maintain or improve their own housing conditions. This type of renewal implies little, if any, population change. The process of incumbent upgrading allows a neighbourhood to take pride in their community, thus as housing standards are maintained or improved, social and economic capital may increase as well.

According to Zielenbach (2000), two types of approaches to urban revitalization exist; place-based and individual approaches that may be used to conceptualize and move towards revitalization. ***Place-based approaches*** view neighbourhood improvement according to geographic location, using methods such as gentrification, incumbent upgrading, and the adaptive redevelopment of existing sites and landuses to describe and define aspects of such renewal, where areas in highest need are targeted for redevelopment. An example of the difficulty with a place-based approach occurs when residents in two different geographic areas are in relatively equal socio-economic need, yet one of these areas may be neglected if it falls outside the designated boundary.

The ***individual-based approach*** concentrates on improving conditions for local residents in terms of social and economic development and well-being. Here, social development focuses on the "improvement of local institutional capacity" (Zielenbach 2000, 24) whereby strengthening these institutions can serve to develop the skills of individuals. Crime rates can be used as an indicator to assess this type of progress. Program-driven economic development is another type of individual-based approach that focuses on the economic growth of a community by increasing job availability, attracting businesses, and enlisting the assistance of government and non-profit organizations. Employment rates can be used as an indicator to monitor the success of such efforts.

The inner city:

It is valuable to have an understanding of the region being investigated, and while "it has been said that all classifications are useful rather than true" (Ley 2000, p. 274), thereby rendering boundaries as somewhat arbitrary, what is termed the inner city must be recognized as an area that has indeed experienced various levels of decline, and has therefore led those concerned with the future of inner cities to look to revitalization efforts. According to Ley (2000), the ring of old neighbourhoods located around the Central Business District (CBD), also known as the inner city, displays considerable diversity, and as the processes of urban decline and revitalization are of interest to this research, a closer examination of the inner city may provide insight in assessing how the urban environment functions as a whole.

Many North American cities have seen a recent concentration of growth in suburban areas, while the inner city experiences decline. In the mid-size city, urban growth is often equated with economic survival, and for this reason, an outward migration has been generated away from the inner city, leaving pockets of the city core lacking in economic capital and

resources (Stewart 1993). Pitkin (2001) contended that urban growth is often considered to be an ideological concept in which investors benefit by promoting the belief that growth provides increased well-being for all residents. Urban sprawl and suburban development draw out those residents and businesses that can afford to do so, leaving the inner city and its surrounding area to decline. For example, newer suburban developments are often accompanied by a plethora of establishments designed to service the consumer needs of an area, including shopping malls, strip development, big box store development, and other retail functions.

Ley (2000) considered inner city areas to be based on "dominant processes of identifiable change" (282) rather than simply on the basis of social characteristics. The inner city is composed of interconnected social, economic, physical, and political elements. By expanding on the work of McLemore, Aass, and Keilhofer (1975), Ley described what causes and forms inner city decline, and this classification facilitated the recognition of similar types of neighbourhoods when examining the GIS-based model created for the study area of Winnipeg, and provided a theoretical framework for analysing the results of the model.

As Table 1 indicates, McLemore *et al*. (1975) created a typology of change within the Canadian inner city neighbourhood and classified four phases: 1) decline, 2) stability, 3) revitalization, and 4) massive redevelopment.

Districts in ***decline***, demonstrating deterioration of the housing stock and in land costs, often display characteristics such as population loss, poverty, and social problems (Ley 2000). Pitkin (2001) supported this thought by noting that as maintenance costs for older housing increase, investment in the stock often decreases, resulting in disinvestment within the community. Ley (2000) noted that neighbourhoods experiencing ***stability*** in population and socio-economic status most often share a sense of community held together by strong social networks. Neighbourhoods experiencing ***revitalization*** begin to see some up-filtering, which is essentially the movement of middle class households into lower class districts. Some renovation of housing stock occurs, and an increase in home ownership is evident. This phase of development can benefit a community by increasing pride and ownership; however, it may also result in the displacement of poorer residents. ***Massive redevelopment*** usually applies to larger, metropolitan cities, and is characterized by high population growth, resulting in changing household composition due to an increase in densities, and in turn often causes the displacement of low income residents, and prompts changes in existing land uses.

Table 1: *Typology of inner city neighbourhoods.*

	Decline	**Stability**	**Revitalization**	**Massive Redevelopment**
Population	Continuing loss of population	No significant losses or gains	Little change	Gain in population
Socio-economic status	Decreasing	Stable	Increasing	Increasing
Family status	Increasing proportion of non-family units & elderly	Maintenance of population mix	Maintenance of population mix	Loss of families, gain of singles
Ethnicity	Varies: can be an influx of deprived ethnic group or breaking down of traditional community	Sometimes strong ethnic community	Sometimes loss of ethnic groups	Seldom important
Community organizations Physical conditions	Poorly organized, unstable Worsening	Varies Stable	Increasingly well organized Improving	Usually unorganized Improved housing, possible environment problems
Housing/land costs Tenure	Increasing much less than metro average Increasing tenancy	Increasing at same rate as metro average Varies, but often high ownership	Increasing more rapidly than metro average Little change	Increasing more rapidly than metro average Tenancy
Non-residential functions	Loss of commercial-industrial functions with no replacement	Maintaining a mix of functions	Maintaining a mix of functions	Losing some commercial functions, but gaining others
Pressure for redevelopment	Low	Low	Strong, but controlled	High

SOURCE: Ley (2000) after McLemore, Aass, and Keilhofer (1975)

Methodology

Geography of analysis:

Cities can be broken down into census tracts, census tracts into neighbourhoods, and neighbourhoods into communities; each will have various agendas. Although investigating the City of Winnipeg at the census tract level may seem broad and generalized when compared to neighbourhood or community areas, generalizations can be made at any level of analysis. As Elwood and Leitner (2003) revealed, even the term community can be problematic, implying uniformity in the identities and

interests of neighbourhood residents, which is often not the case. Therefore, although analysis at the census tract level covers a larger area than the neighbourhood or community level, suggesting a certain degree of generalization when examining the dynamic socio-economic and physical conditions of a city region, it should be noted that even at the community level, which would appear to be a relatively specialized level of intervention, simplifications can still potentially be made.

The definition of a census tract is an area that is small and relatively stable, usually has a population of 2,500-8,000 individuals, and is located in large urban centres that have a core population of 50,000 or more (Statistics Canada 2001). A community is often considered to be a sociological concept that generates a feeling of belonging and a common recognition of shared interests. The term neighbourhood tends to fall somewhere between census tract and community. Neighbourhoods are defined by physical boundaries similar to that of a census tract, but can also share the fuzzy boundaries of a community, as a neighbourhood often generates a positive or negative feeling limited only by perceptual borders (Schneider 2004).

Modelling the urban environment:

According to Longley (2002), Thomas (2002), and Brown and Perrott (2004), the use of MCE and GIS can provide valuable methods for urban revitalization strategies; MCE handles decision situations where the data being analyzed has both qualitative and quantitative characteristics.

Harris and Weiner (1998), Sheppard (1995), and Elwood and Leitner (2003) have described how GIS can be used not only *for* the revitalization of communities, but *by* communities as well. Harris and Weiner (1998) noted that GIS can serve to empower a community, allowing them the ability to obtain and develop alternative information and knowledge in relation to their surroundings. This information can then be used to improve their quality of life by increasing their communicating and negotiating power within the realm of urban politics.

As discussed above, the process of urban revitalization and rehabilitation involves both people and place, and statistical analysis and qualitative insight allow multiple perspectives of dynamic features to be considered. A mixed method approach offers "a strategy of inquiry that allows the researcher to converge qualitative and quantitative methods, with the result being a comprehensive analysis of the research problem" (Creswell 2003, 12). Distasio (2004) highlighted the importance of a mixed method approach to the study of urban development and emphasized that, "authors studying urban phenomena tend to… [make] use of multiple

theories and perspectives to study urban processes such as neighbourhood change, revitalization, gentrification, and population turnaround" (98).

The research of Moodly and Hathout (2000) demonstrated how GIS modelling can incorporate elements of qualitative and quantitative data in an effort to enhance the interpretation of an urban area. Their research used GIS to assess satisfaction and quality of life in an urban environment, where aspects of satisfaction with life were based on the representation of services derived from household survey information, and quality of life was based on the availability of services derived from calculated baseline indicators. An objective index of the quality of life was calculated and the information could then be effectively visualized and analyzed at a district level.

Modelling the urban environment can therefore allow one to generalize or simplify a complex issue in order to bring forward flexible answers and provide potential solutions and problem solving techniques to urban revitalization initiatives. GIS allows its users to engage in descriptive representation of the physical environments in which symbolic interactions take place, thus improving and promoting wider public understanding of generalized spatial systems. By duplicating the urban environment in the form of a GIS model, it is possible to gain new visual information about the human processes and patterns that make up the city (Longley 2004).

Data collection and processing:

GIS and MCE are used as tools to monitor and manage urban revitalization strategies in the City of Winnipeg, and this section outlines the use of a mixed methods approach that examines spatial and non-spatial criteria in order to analyze varying levels of need for urban revitalization according to census tract. Revitalization factors were assessed by prioritization and ranking, then each factor was weighted to generate an index scale which was used to interpret patterns of need for urban revitalization. MCE is an important means of analysis in spatial decision support systems, as it allows weighted values to be assigned to spatial layers, and the sum of these values produces a final map, thereby allowing a research problem to be analyzed and weighted according to component factors (Carter 1991). It should be noted that the results of the MCE analysis are heavily dependent on the specified values.

Seven key factors associated with a need for urban revitalization were derived from 13 variables, as is shown in Table 2**.** The selected data was derived from Statistics Canada's 2001 census (Statistics Canada 2001), and the City of Winnipeg's Neighbourhood Designation Report (City of

Table 2: *Factors indicating need for urban revitalization.*

FACTORS	VARIABLES	SOURCE
1.Income	1- average household income 2- low income as percentage of households	Statistics Canada (2001 Census)
2.Unemployment	3- unemployed population 15 years of age and over	Statistics Canada (2001 Census)
3.Housing (based on total number of private dwellings)	4- rental rate 5- age of dwelling (built before 1946) 6- average value of house 7- condition of dwelling (in terms of need for repairs)	Statistics Canada (2001 Census)
4.Mobility	8- 1 year population mobility 9- 5 year population mobility	Statistics Canada (2001 Census)
5.Education	10- population age 20-85+ with less than grade 9 education 11- population age 20-85+ with university diploma	Statistics Canada (2001 Census)
6.Crime	12- annual crime rate	The City of Winnipeg, Neighbourhood Designation Report (2000)
7.Population Density	13- population per square kilometre	Statistics Canada (2001 Census)

Winnipeg 2001). These variables were selected based on consultation with key informants in the field of urban revitalization and pertinent literature on urban decline and revitalization, namely the theoretical framework provided by Ley (2000) and the work of Brown and Perrott (2004). Factors are derived from one or more variables. For example, housing is an aggregate of 4 related variables; namely, cost, rental rate, condition, and age. Each layer in the GIS analysis evaluated a key factor relating to need for urban revitalization.

It should be noted that in the case of the crime factor, data were only available at the neighbourhood level; therefore, the census tract layer was overlaid with the neighbourhood characterization area (NCA) layer, using the intersect function of ArcGIS, in order to measure the total proportion of neighbourhood area that fell within each of Winnipeg's 165 census tracts. For example, it was found that approximately 30 percent of the total Burrows-Central neighbourhood, 50 percent of the total Dufferin neighbourhood, and 10 percent of the total Weston Shops neighbourhood fell within one given census area.

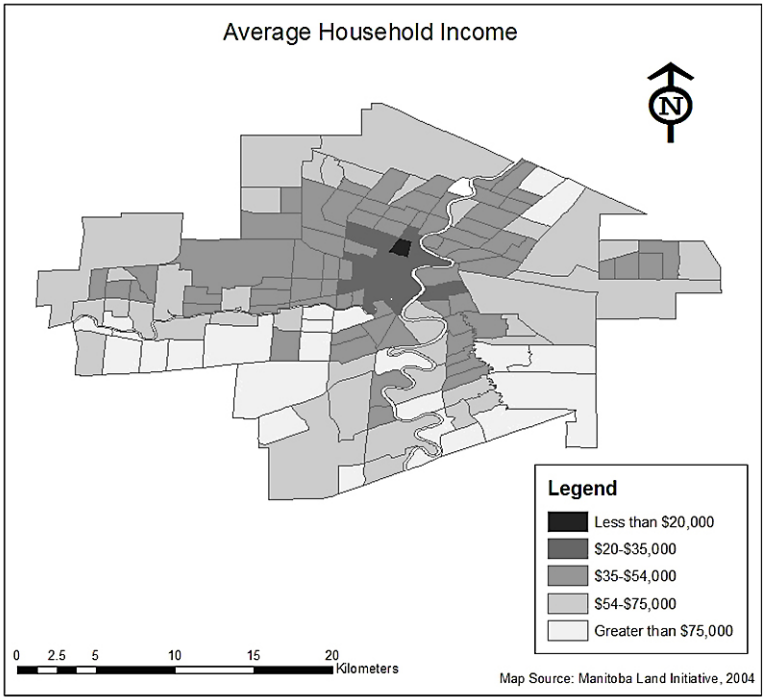

Figure 2: *Reclassified average household income.*

Factor Analysis:

Analysis of each standardized and reclassified socio-economic, housing, mobility, education, crime, and population factor as per census tract was examined, an example of which is illustrated in Figure 2.

Criteria evaluation needed for urban revitalization for the entire city shows variations for each factor between census tracts as follows:

Socio-economic factors. Average household income was represented as per total number of households by census tract. The average annual household income earned in Canada's major metropolitan centres in 2001 was $30,000, with Winnipeg being below this average at $24,000 (Carter *et al*. 2005). Households falling below the average income are noticeably clustered within the core area, with very little exception. Household incomes were assessed at under $35,000, with the result being a significant concentration within the inner city area.

Unemployment was represented by unemployed persons 15 years of age and over, as compared to the total population age 15-64 years of age,

per census tract. Overall, the City of Winnipeg had an average unemployment rate of 4.6 percent in 2001, and once again, above average unemployment rates are found radiating out from the city centre. However, it may be noted that unemployment is a citywide trend, and higher rates may also be found in the northwest and southeast regions of the study area. Although the average maximum unemployment rate was 12.37 percent, and unemployment levels are low within the study area, it should be noted that the availability of low paying jobs may be equated with poverty in certain areas.

Housing factors. Four criteria were considered under this category. Bourne and Lorius (2000) noted that, housing is a significant aspect of urban revitalization strategies and presents "issues of poverty, marginalization, and economic well-being [that] are invariably tied to housing conditions and costs" (40). Physical, social, and economic welfare must also be considered to provide an effective approach to housing. The Neighbourhood Designation Report by the City of Winnipeg (2000) contends that housing revitalization strategies must integrate economic and structural change to improve the quality of life for community residents, while building on neighbourhood stability.

As older housing stock requires a greater degree of regular maintenance, the proportion of houses built prior to 1946 are an important element to consider, and Winnipeg is well above the Canadian metropolitan centre average of 14 percent (Carter *et al*. 2005). It was found that older dwellings are distributed throughout both the poorest (core area east) and the wealthiest (south) areas of the city. However, a high need for repair does not necessarily correspond with an older housing stock. When examining the study area, only the census tracts containing the Chalmers and Elmwood neighbourhoods, on the east side of the Red River (the major river running through the study area), are consistent with a great need for repair and a comparatively moderate percentage (between 20 and 40 percent) of pre-World War II dwellings. Affordable housing can contribute to a greater quality of life, as households have more disposable income available to cover additional living costs. In many census tracts throughout the study area, average household income is relative to average house value, where census tracts with an income ranging between $20-35,000 have homes worth approximately $50,000 in the same area, a cost that falls well below the average Winnipeg house value of $104,331 (Statistics Canada 2001). According to the Canada Mortgage and Housing Corporation (1998), households earning an income between $25-35,000 can afford homes available at a maximum price of $60-96,000. Based on these observations alone, it would seem that affordable housing is available in inner city areas with lower incomes. This being said, many of these

dwellings are in need of major repairs, and therefore may be an expensive investment for low-income families.

High rental rates coupled with population turnover are found concentrated in the inner city area. Greater than 80 percent of the population dwelling in the core area are renters, and 60 to 80 percent of renters are located along the edge of this area.

Mobility factors. Movers over a one-year and a five-year period were analyzed. High mobility areas are often associated with population transience and high rental areas. A concentration of movers can be seen in the inner city over a one-year period, with a maximum of 35 percent of the population relocating. Over a five-year period, higher rates of mobility can be seen more evenly distributed throughout the study area, with the focal point being in the southern sector of the city. It should be noted that over a five-year period these rates double, with a maximum of 72 percent of the population moving over this time period. When this data is reclassified, concentrations of high mobility are emphasized within the core area of the city, as well as in the south-central area. High levels were noted in close proximity to the city's University of Manitoba, where a large proportion of the student population is found.

Education factors. Population over 20 years of age, with less than a Grade 9 education, as well as population with a university diploma, as compared to the total population age 20-85+ years of age, were calculated per census tract. It was found that 15-25 percent of the population that have less than a grade 9 education are located in the northwest side of the city, whereas 35-50 percent of the population with a university education dwell in the south-west side of the city. Maps produced by the GIS model illustrated that the city as a whole has followed this pattern, noting that the entire north side of the city has a low percentage of population with a university education, suggesting a predominantly blue-collar population. According to Brown and Perrott (2004), improving education is a factor that can contribute to urban revitalization, as many areas in the inner city experience a poor quality of education, and lack of education can lead to a lack of job opportunity, perpetuating a cycle of decline.

Crime factors. The conditions leading to crime[1] are important, as it was found that the highest crime rates cut right through the centre of the

[1] Crime rate was based on crimes committed against person and property include homicides, attempted murder, sexual offences and assaults, assaults, abductions, and robbery, and crimes against property included break and enters, theft, possession of stolen goods, motor vehicle theft, fraud, residential arson, and mischief. Commercial buildings, such as shopping malls, were not included in this data (City of Winnipeg Neighbourhood Designation Report 2000).

city. As Bourne (2000) expressed, depopulation and decline in the inner city can create "a polarized society…produc[ing] feelings of alienation and isolation, and often higher levels of antisocial behaviour" (42). A high percentage of misdemeanours can also be found in the sparsely populated industrial areas of the city, such as in the St. James Industrial and St. Boniface Industrial Park areas. Crime rates were determined according to number of crimes per census tract divided by total population per census tract. The City of Winnipeg's Neighbourhood Designation Report (2000) provided total crime rates per neighbourhood, but in order to contrast areas and break crime down into comparable levels, a percentage was calculated to illustrate the number of crimes per person, per census tract.

Population density factors. Population density is a factor that would rather benefit from analysis over time, as it may then highlight growing or declining areas within a city. High population density does not necessarily equate itself with a need for revitalization in slower growth cities such as Winnipeg. Although pockets of high density can be seen in the core area of the city, population distribution is fairly consistent throughout the rest of the urban area, with 800 to 2,500 people per square kilometre on average.

Multi-criteria evaluation:

MCE has benefited this study in that it has allowed key factors to be prioritized, and allowed multiple variables to be assessed in the form of a single map. Thirteen variables grouped as 7 factors were selected according to their significance when considering the need for urban revitalization (City of Winnipeg Neighbourhood Designation Report 2000; Statistics Canada 2001; Brown and Perrott 2004). Each of these variables was then ranked according to hierarchical order, based on assigned numeric values derived from relevant literature and a qualitative assessment made by two experts in the field of urban geography. These results were then synthesized to determine priorities to be assigned to each variable (Dai *et al*. 2001) based on literature relevant to the topic of urban revitalization as well as the subjective judgement of two senior urban researchers at The Institute of Urban Studies, University of Winnipeg. Each researcher was given a survey that listed factors pertinent to the need for renewable urban development (City of Winnipeg Neighbourhood Designation Report 2000; Statistics Canada 2001; Brown and Perrott 2004); the researchers were informed that these factors would be used to create an index scale for urban revitalization in order to quantitatively measure physical and socio-economic variations within the City of Winnipeg. They were then asked to prioritize each variable by ranking it in order of importance, thereby combining qualitative assessment with qualitative values. This assessment was given primary consideration when applying MCE to the study area.

Table 3 shows the final factor ranking according to the level of importance together with their variable components. Each factor was calculated based on a percentage from the total components of variables and was given a percentage rating according to importance, so that when weighting variables for MCE, not all are given equal consideration. For example, when examining the income-based factor, it was determined, based on relevant literature and the interviews with urban experts, that average household income had a more significant influence on distressed urban areas than the percentage of low income households, where average household income is 1.5 times more significant than the percentage of low income households.

Table 3: *Factor rankings.*

FACTOR	RANK
Average household income (60%) Percentage of low income households (40%)	1
Unemployment (100%)	2
Proportion of rented dwellings (20%) Age of dwelling (20%) House condition (i.e. in need of major repairs) (35%) Average house value (25%)	3
5 year population mobility (70%) 1 year population mobility (30%)	4
Less than grade 9 education (pop. > 20 years of age) by highest level of schooling (60%) University degree/diploma (pop. > 20 years of age) by highest level of schooling (40%)	5
Annual crime rate (100%)	6
Population density (100%)	7

SOURCE: Author's survey (2004)

The data for each factor was then reclassified into 5 user defined classes (as shown in Figure 2) based on the average of each factor under consideration, plus and minus two standard deviations from the mean, in order to reveal spatial patterns and groupings within the study area, a method derived from the work of Brown and Perrott (2004).

A pairwise matrix was designed that weighted each factor against another, where pairs of factors were individually compared. As an example, variable one (income) is twice as important as variable 3 (housing), and a value is determined. It is a criteria score that then assigns a relative value between 0.9 and 9 to the intersecting cell, where a value of 9 is the highest given weight, and a value of 0.9 is the lowest given weight. Table 4 indicates

Table 4: *Pairwise comparison matrix.*

Variable	1	2	3	4	5	6	7	Weight
1	1							0.1943
2	.7	1						0.1590
3	.6	.7	1					0.1355
4	.5	.6	.7	1				0.1177
5	.4	.5	.6	.7	1			0.1030
6	.3	.4	.5	.6	.7	1		0.0901
7	.2	.3	.4	.5	.6	.7	1	0.0781

Consistency Ratio: 0.00
SOURCE: Present research (2004)

the pair wise matrix together with the weight for each factor used to create the index for urban revitalization.

Pairwise matrix data was used to calculate the eigenvector of weights for each factor. This procedure generated an acceptable consistency ratio (a value between 0.00 and 1.00), and the weighted values could then be input into a MCE model, using weighted linear combination, which is defined as being composed of the sums and differences of elements in a field of real numbers (Dai *et al*. 2001).

MCE serves as a weighted overlay function that aims "to investigate a number of possibilities in the light of multiple criteria and conflicting objectives" (Voogd 1983, 21). This provides the framework for processing derived weight values, and handles decision situations where the data possess both qualitative and quantitative characteristics (Carter 1991). Therefore, in the case of this project, MCE was selected as the method of measurement.

MCE can take into account all 13 factors in one map, creating an index scale that indicates a need for revitalization (Figure 3); in other words, all factors under consideration can be brought together and weighted by MCE in order to create a map based on ranked variables.

Index scale:

The establishment of an index scale, as described in the previous section, designates census tracts with very high need for urban revitalization ranging to those with very low need in the study area of Winnipeg. The index scale was reclassified into four computer generated, equal class interval categories to reflect census tracts with very low need for revitalization, those with moderate need, and those with an urgent (high or very high) need for urban revitalization.

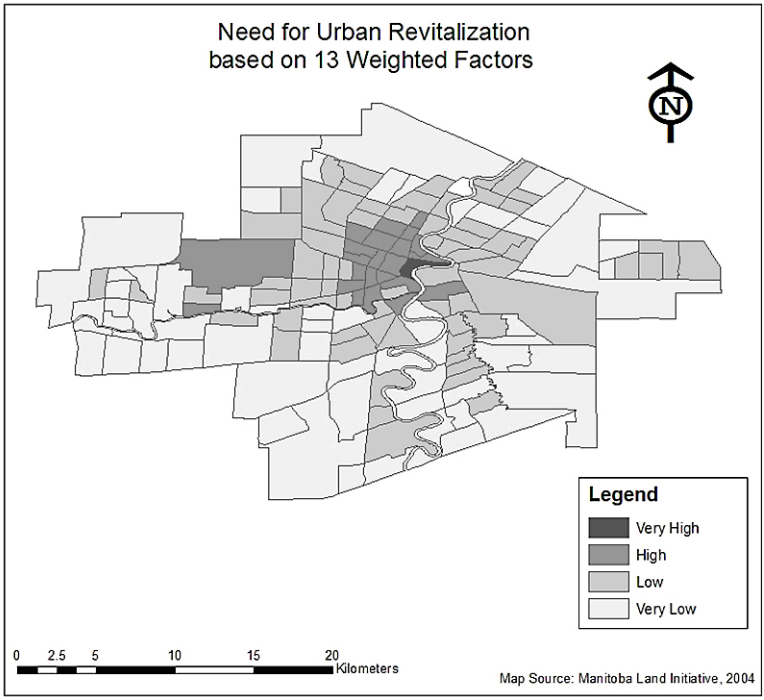

Figure 3: *All 13 variables.*

To further conceptualize the four categories of need for revitalization, based on the MCE index scale, the four indicators were measured against the neighbourhood designation categories derived from the City of Winnipeg's Neighbourhood Designation Report (2000) for comparative levels of need.

MCE areas indexed as high need are fairly consistent with those deemed as Major Improvement areas by the City of Winnipeg. However, the present study's model indicates that the areas of highest need are growing and spilling beyond the boundaries originally determined by the city. As well, rather than showing a homogeneous area, the MCE model reveals a diversity of need in the core area, with certain neighbourhoods demonstrating a more urgent need for revitalization initiatives.

When examining the results of this study, it appears that a high need for housing revitalization exists in pockets throughout the city, as well as in the core area. The maps created using MCE are comparatively consistent with the major improvement and rehabilitation areas; although the model

shows additional high need areas in the central east and west regions of the study area.

Table 5 illustrates the results when comparing the City of Winnipeg's Neighbourhood Designation categories to the urban revitalization index scale generated by the MCE model.

Table 5: *Winnipeg housing policy classifications as compared to index scale rating.*

Neighbourhood Designation	Identifiable Characteristics	Index Scale	Identifiable Characteristics
Major Improvement Area	Older area experiencing significant decline, renewal is required	Very High Need	Older area of inner city, in major decline, and in very high need of social, economic, and housing revitalization
Rehabilitation Area	Decline is beginning to impact overall stability of the area, some intervention is required	High Need	Decline found in inner city area, and spilling into outlying regions; area is in need of renewal intervention, as it is experiencing high levels of factors associated with poverty and decline
Conservation Area	Area that is stable, but requires monitoring as it may be showing initial signs of decline	Moderate Need	Area that is stable; somewhat transient area with moderate income, showing potential decline
Emerging Area	Area where new development is being considered	Low Need	Outer ring of city, little to no need for revitalization; stable socio-economic and physical area

Derived from: Neighbourhood Designation Report (2000) and Present research (2004)

A theoretical framework:

Through the investigation described in Table 5, one finds that the theoretical framework of the subjective characterization of the processes of inner city change, and the results of MCE, act as a bridge to link together the elements of urban revitalization. Ley (2000) stated that a considerable amount of diversity exists between and within inner city neighbourhoods, and although they are often seen as homogeneous, this is a broad generalization. Therefore, by combining elements of a descriptive framework such as provided by Ley (2000) (Table 1) with the results of MCE analysis, the necessary detail can be added to determine whether this diversity is recognizable at the census tract level. Each process of change identified by McLemore *et al*. (1975), and as furthered in the work of Ley (2000), will be reviewed in the context of the results of the MCE analysis, as well as the context of the recognizable processes of inner city change.

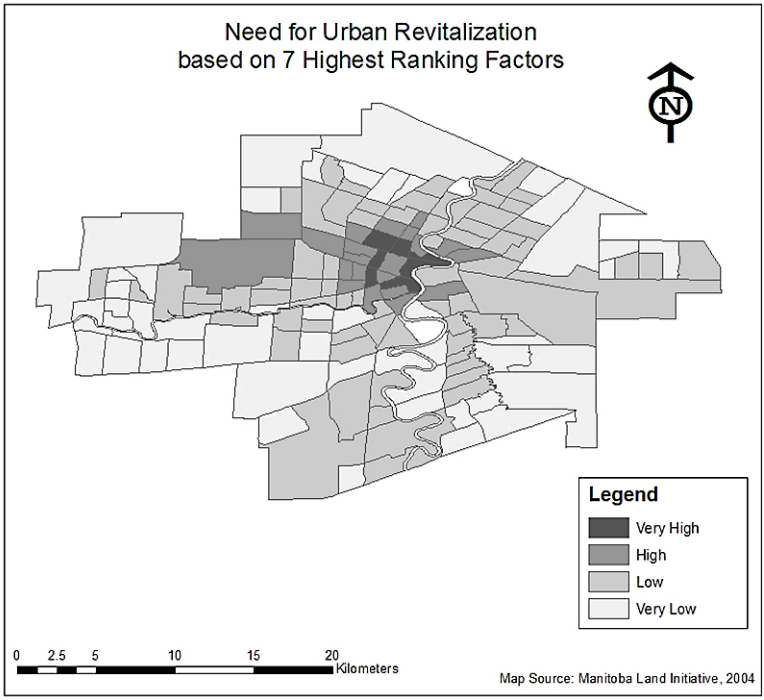

Figure 4: *7 highest ranking criteria/factors.*

The classification of the inner city, as set out by Ley (2000), uses this framework to identify characteristics of the study area, and guides interpretation of the GIS model.

Firstly, it is clear that districts in decline are evident within Winnipeg's inner city. These districts are associated with high tenancy rates, house values below the metropolitan average, and a high population turnover (Ley 2000). When analyzing the 7 most important factors contributing to a need for revitalization in Figure 4, the ring of inner city neighbourhoods radiating out from the downtown area are shown to be in highest need. In general, the figure still shows the inner city area to be in high need, but most specifically the census tract containing the neighbourhood of Point Douglas South, one of Winnipeg's oldest neighbourhoods, is identified as being in highest need. These areas overlap with the Major Improvement Area, as designated by the City of Winnipeg.

Districts experiencing stability demonstrate higher home ownership and better-maintained houses that have a value similar to that of the metropolitan average (Ley 2000). Average house values can be seen in

census tracts to the west of the inner city, as well as in areas that circle the core area and run along the city's rivers, as do the city's Rehabilitation Areas.

Revitalization regions are often located in "proximity to existing elite area[s]" (Ley 2000, 288); as well, they may be located near a university. Populations found in these areas are often better educated, and therefore will generally have somewhat higher than average income levels. Census tracts containing the neighbourhoods of Wolseley and Lord Roberts fall into this category based on the above-mentioned criteria; these neighbourhoods are also considered to be Rehabilitation Areas according to the City of Winnipeg (see Table 5).

As previously discussed, massive re-development areas are most often situated in larger, high growth metropolitan areas. Such development has not yet been observed in Winnipeg; however, the "bull-dozing," slum clearing based initiatives that are typified by this type of development were practiced in Winnipeg during the 1960s and 1970s, where portions of the downtown and core area experienced this process of change (McFayden and Gunn 2004). Today many of these inner city areas are found to be in very high need for revitalization, as this "bull-dozing" approach to urban renewal demolished both housing stock and commercial services that have not since been rebuilt.

Imposing the typology of Ley (2000) after McLemore *et al*. (1975) over the core region of the study area has allowed for an enhanced examination and interpretation. In many cases, "both a statistical and perceptual overview obscure important internal diversity between districts" (Ley 2000, 292), and so continued analysis and involvement is required when investigating the changing geography of the city.

Isolating variables:

As can be seen in Figure 5, factors indicating a need for housing revitalization were isolated. This allowed a more specific type of need for revitalization to be examined, and it was revealed that a very high need for housing restoration exists in several distinct pockets located in the vicinity of the city centre, in neighbourhoods such as Inkster, St. John's, Weston, and Luxton. As well, a high need for housing revitalization can be found scattered throughout the study area. It must be noted that the census tract containing the airport and the St. James Industrial Area, located on the west side of the city, is defined as a very high need district; this may be due to the fact that a very low population of 280 persons dwells here, and there is a high proportion of low cost, rental housing.

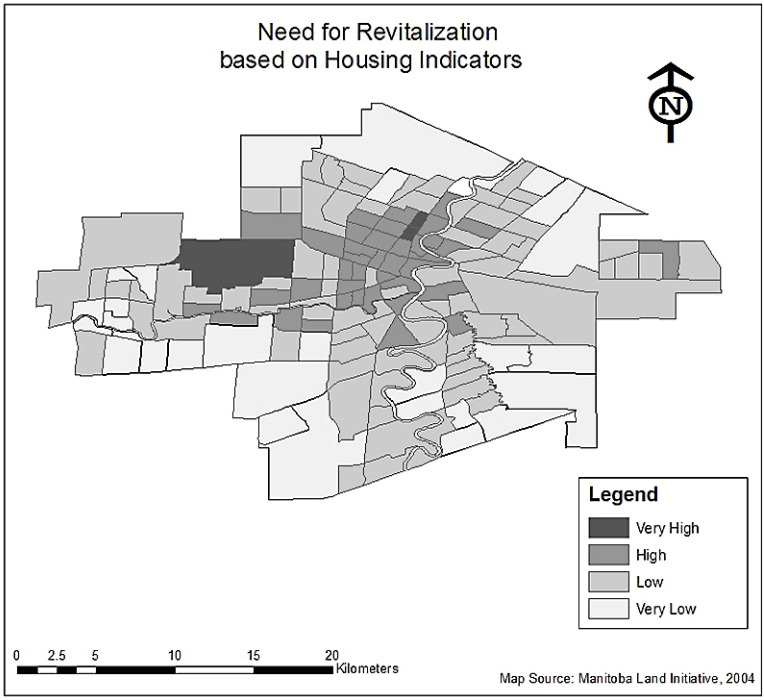

Figure 5: *Isolated housing indicators.*

Socio-economic variables affecting the need for urban revitalization were then segregated by grouping all factors not associated with housing, and in doing so it was found that areas demonstrating both very high and high need for socio-economic improvement are concentrated in the core district of the study area. Several neighbourhoods are shown to be in very high need of urban revitalization initiatives. Neighbourhoods most affected by very high need for socio-economic revitalization include North and South Point Douglas, Centennial, and West Alexander. It is important to note that high need areas do extend beyond these neighbourhoods, and pockets of need can be found in areas of St. Boniface and St. James, for example.

The ranked housing and socio-economic factors were isolated in order to reveal patterns and trends in the study area that might otherwise be overlooked (Figures 5 and 6). By isolating and overlaying selected variables in the form of an MCE model, patterns of need that might not otherwise readily emerge can be established. This model worked well in conjunction with the work of Ley (2000) and the City of Winnipeg's Neighbourhood

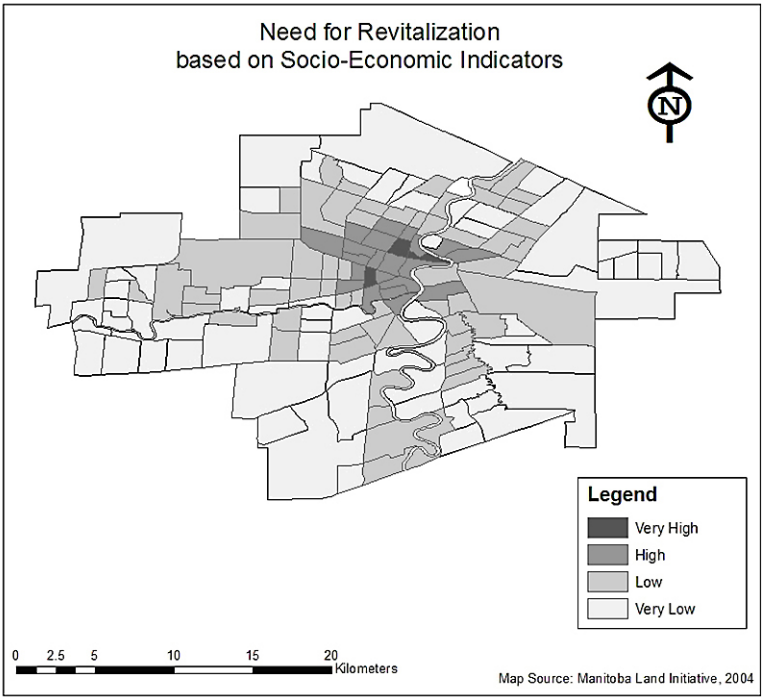

Figure 6: *Isolated socio-economic indicators.*

Designation Report (2000), as it allowed census tract areas to be grouped according to need, thereby corresponding with the four categories of need for revitalization as described in the typology of inner city neighbourhoods and the study area itself.

Discussion and Conclusion

The urban landscape is a dynamic structure, made up of social, economic, physical, and political components, all of which interconnect with one another. In a complex environment such as the urban area, it is vital that research strategies and methods of urban revitalization be part of a continuous, sustainable process; a process that can benefit from the use of various tools for analysis. GIS and MCE were used as tools to monitor urban revitalization strategies in the City of Winnipeg, using a mixed methods approach that examined spatial and non-spatial criteria and analyzed varying levels of need for urban revitalization according to

census tract. Areas displaying common characteristics were highlighted in the form of a single map. MCE is a technique that allowed a number of revitalization factors to be simultaneously assessed by prioritizing and ranking them using a mixed methods approach that joined qualitative and quantitative analysis. These factors were then weighted and combined to create an index scale which was used to interpret varying levels of need for urban revitalization. The use of MCE and a mixed methods approach contributes to the existing literature and research base, as the method described and used to define areas in need of revitalization in this study is unique to medium-sized Canadian cities. GIS and MCE research examining the subject of urban revitalization has predominantly focused its attention on larger, high growth metropolitan areas in this context.

A theoretical framework was established in order to define and diagnose urban areas emerging or increasing in need for revitalization, and was used to illustrate spatial and non-spatial patterns and trends within the study area of Winnipeg when examining the generated series of maps. This approach also allowed the use of both quantitative and qualitative techniques of analysis. A theoretical framework that characterizes the processes of inner city change, joined with GIS and MCE analysis, can be used to effectively assess the need for urban revitalization in a medium-sized Canadian city.

Various factors benefit from more specific consideration when determining revitalization policies, and the MCE model allowed for factors contributing to a need for housing revitalization, as well as those indicating a need for socio-economic revitalization, to be isolated and examined separately, offering a distinct perspective to the study area while supporting existing classifications. This process allowed for clusters of specific high need to be highlighted in areas that may otherwise have been overlooked by creating an index scale that illustrates the existing and emerging divisions of census tracts within the study area that are in highest need for physical and/or socio-economic revitalization.

GIS, in combination with MCE, can benefit community and government policy and decision-making strategies as it offers a holistic view of the city, allowing quantitative statistics to be mapped in conjunction with the qualitative expertise of researchers and planners in the area of urban revitalization. This method of analysis may offer an increased understanding of a slow growth urban environment, and serve to bring together various elements as part of problem solving strategies. This model can adapt to new data, and can be modified as census information changes, making it an important tool for assessing the present and future development of the urban environment.

As a recommendation for further study, it would be useful to consult with a larger, more diverse panel of key experts on the subject of urban revitalization, as the results of MCE rely heavily on the weights assigned by key informants. It would be valuable to survey those that share a vested interest in the successful development of the Winnipeg area, such as researchers, government officials, city planners, and community members. Additional factors that contribute to a need for urban revitalization could be considered in future, such as those associated with education, schooling, and family type.

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