The Québec/Labrador Peninsula and the Evolution of the Eastern Snow Conference

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ABSTRACT

In this paper, we (former Presidents of the Eastern Snow Conference, ESC) compare the ESC as it was more than 50 years ago to its current state today, linking the evolution and success of this organization to the geographic setting of northeastern US and eastern Canada. We illustrate some of our arguments with examples of ESC activity in Québec/Labrador, which has been one fruitful area of the ESC's "territory." We see this article as a contribution to the series of introspective papers on the ESC that occasionally appear in the Proceedings (see Bibliography).

Keywords: evolution and success of ESC, geographical setting, introspective contribution.

THE ESC IN ITS EARLY YEARS

The ESC was founded in 1939 in reaction to the founding of the Western Snow Conference. The two "Conferences" essentially divided North America between them. For its first nine years (with a gap for WWII), the new organization simply held an annual conference. The first Proceedings (1952) were the record of the ninth conference. In the beginning, members were overwhelmingly drawn from northeastern North America and papers presented tended to deal with that region; and the research emphasis was snow, especially snow in connection with hydroelectric projects in New England and eastern Canada. The early corporate sponsors of our organization were hydroelectric generating companies in the US and Canada, and our early executives were drawn largely from people in that line of work. For example, the Proceedings of the first four Proceedings were sponsored by New England Power Company, Ontario Hydro, The Shawinigan Water and Power Company, and Hydro Québec. However, there were already signs of developing interest in the ESC on the part of federal and provincial/state agencies such as the US Geological Survey (USGS), the US Weather Bureau, Environment Canada, and the US Corps of Engineers. All of these early interests were important in laying strong foundations for the ESC as it is today. Some of this early character is apparent from the papers and the authors represented in the first Proceedings (Table 1). When reviewing the Proceedings summary, note the following:

- the focus on snow and hydroelectricity
- the interest in practical instrumentation and methods
- the interest in early river and lake ice work.

Additionally,

- Hydro companies dominated among authors and on the Executive.

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- Most papers dealt with eastern North America.
- Cooperation between Canada and the US was already a feature.
- Interest in other aspects of snow and ice soon becomes apparent in other Proceedings of the 1950s.
- Examples are papers on glaciers and ground frost/permafrost and snow and transportation (on land and water).
- Field research sites outside North America appear.
- University members were a distinct minority in the ESC of those days.

Table 1. Summary of the 1st Proceedings of the ESC, Vol. 1, 9th Annual Meeting, Springfield, MA, February 1952.

The development of the radioactive **snow gage**, R.W. Gerdel, *Snow, Ice and Permafrost Establishment (SIPRE), Wilmette, IL.*
Radioactive **snow gage** with **telemetering** system, John A. Doremus, *Motorola Inc., Chicago, IL.*
Snow-melt as a factor in Quebec **streamflow**, H. M. Finlayson, *The Shawinigan Water and Power Co., Montreal QC.*
Ice and its effect on **hydroelectric operations**, W. C. Fielder, *Niagara Mohawk Power Corp., Syracuse,NY*
The effect of altitude and latitude on **New England snowfall estimates**, Joseph G. Galway, *U.S. Weather Bureau, Jacksonville, Florida.*
President/Vice-President/ Secretary: Leon H. Mann, *Connecticut River Power Co.*/ Ernest C. Johnson, *US Weather Bureau*/ Dean B. Bogart, *USGS*.

THE ESC TODAY

Today, "Eastern Snow Conference" is something of a misnomer. We are no longer so heavily focused on northeastern North America. Since 1980, meetings have been held in Canada and the USA in alternate years; but our members and research topics are drawn from around the world, and occasionally we even hold meetings outside of region. Also, although the annual conference is our main activity, over the years we have engaged in on-going projects, such as cooperative snow surveys and programs to encourage students in diverse disciplines who share our interests. Our focus is no longer just "Snow." Nowadays, the ESC is an academic and professional association devoted to ice in all its forms, on land and water, in the atmosphere and in space. A summary of the Contents of our most recent (2011) Proceedings illustrates some of these points (Table 2).

Table 2. Summary of the 68th Proceedings of the ESC, Vol. 59, 68th Annual Meeting, McGill University, Montréal, QC, June, 2011.

Student Papers

Topics: high latitude **snowmelt and forest fires**; dissolved organic **carbon and nitrate export** during spring snowmelt; **snowmelt patterns** in a conifer forest; a sensor for **snow grain measurement** and snowmelt and **summer baseflow**.

Field sites: the Yukon River (Alaska and Canada); south-central Ontario; the Sequoia National Park and the Sunshine Coast of BC.
Author affiliations: Lehigh U., PA; Trent U., ON; UCLA, CA; U. Colorado; U. Waterloo, ON; Environment Canada, BC; U. British Columbia.

Glaciology

Mass balance loss of Mount Baker, Washington, **glaciers** 1990–2010, M. Pelto and C. Brown, Nicols College, MA & Simon Fraser University., BC.

Hydrochemistry of Snow and Ice

Topics: snowpack **stratigraphy and chemistry** on Kahiltna **Glacier**; snowcover area and **ecosystem exchange during snowmelt**.
Field sites: central Alaska and Darling Lake, NWT.
Author affiliations: U. Maine; Dartmouth College, NH; and U. NH.

River Ice and Hydrology

Topics: precipitation and the **cryological regime of river channels**, **ice jam modeling** for flood forecasting, reconstructing snowmelt runoff using **the SWEHydro Model** and **AMSR-E observations**.
Field sites: southern Québec; St John River, NB; and the Yukon River.
Author affiliations: U. Laval, QC; Environment Canada, ON; Dept. of Environment, NB; and Lehigh U. PA.

Snow and Climate

Topics:Spatial interpolation of sub-daily air temperatures for improving **snow and hydrological forecasts** on Alpine catchments.
Field sites: French Alps
Author affiliations: LTHE/CNRS; Domaine Universitaire; Grenoble, France.

Remote Sensing of Snow and Ice

Topics: MODIS snow cover algorithms, **snow grain size and shape** measurements using optical methods.
Field sites: n/a
Author affiliations: NASA/GSFC, MD; U. de Sherbrooke QC; U. Joseph Fourier, France; and Dartmouth College, NH.

Snowpack Properties and Poster Papers

Topics: **GIS of snow cover** in James Bay; The **Canadian** Meteorological Centre **globa**l **daily snow analysis, 1998–2011**; **merging science and art** to catch public attention of climate change; comparing the **SnowHydro snow sampler** with existing snow tube designs; snow in the life of the **Westviking**.
Field sites: James Bay, Canada; southwestern Alberta; and Greenland.
Author affiliations: U. de Sherbrooke QC; Environment Canada; U. Lethbridge, AB.

President/Vice-President/Secretary-Treasurer, 2011: Mauri Pelto, *Nichols College*; *MA*/Jim Buttle, *Trent U.*; ON / Miles Ecclestone, *Trent U.*; ON / Derrill Cowing *USGS(ret)*, ME.

Compare this list with the papers in the first Proceedings of the ESC (Table 1). Again, note the following:

- The Contents of these Proceedings are sub-divided to differentiate work on different types of ice.
- Work on snow and ice and hydroelectricity does not dominate as it did in the early years of the ESC.
- Authors and field sites are drawn from all over the North America and overseas.
- Universities and government agencies are now well represented among authors and Executive.
- The hydro companies of yesteryear, that gave the ESC its start, are gone.
- A number of these papers were presented by students in response to the ESC's student programs, recognizing the ESC commitment to promoting student research that will lead ultimately to the next generation of snow scientists.

FOUNDATIONS OF SUCCESS OF THE ESC, ILLUSTRATED FROM QUÉBEC/LABRADOR

It seems to us that one of the reasons for the persistence and success of the ESC has been the remarkable fertility of eastern Canada and the northeastern USA as a base for a group interested in ice and snow. Over the years, the ESC Proceedings have included papers with field sites that range from the top of Mount Washington to the sea; from 80ºN to Washington, DC; from the Great Lakes to ponds and streams in New England and Canada. Our "home territory" includes some of the world's great cold weather cities as well as some of the last wilderness regions on earth. All of these characteristics have stimulated ESC members in their snow and ice research interests and are reflected in the Proceedings.

We thought it interesting to illustrate, and perhaps explain, the evolution of our organization through examples drawn from one part of the Canadian portion of "Eastern" in the Eastern Snow Conference, the Québec/Labrador Peninsula. Topographically, the peninsula can be thought of as a high saucer that receives lots of snow and plenty of rain. Rivers break out to the sea through the rims of the plateau, providing the key ingredient to drive hydro plants. Despite the relatively low latitude, this is a region in which all lakes, rivers, and the surrounding seas and ocean develop substantial ice covers. There are tiny glaciers in the Torngats (northern tip of Labrador), but they do not reach the sea. Permafrost is found not far north of the St. Lawrence River, and the latitudinal tree lines swing south to present vegetation types that range from tundra to boreal forest, over a relatively short distance. This corner of North America is one that is remarkably cold for its latitude.

These easily accessible, extremely varied, snow and ice situations soon attracted the attention of ESC members; and it has spawned a remarkable variety of research topics at ESC conferences. This is on top of the ongoing studies of the snowfall and snow cover with respect hydroelectric potential that have been so important over the years; and that is our primary focus here, as illustrated by Figures 1-3.

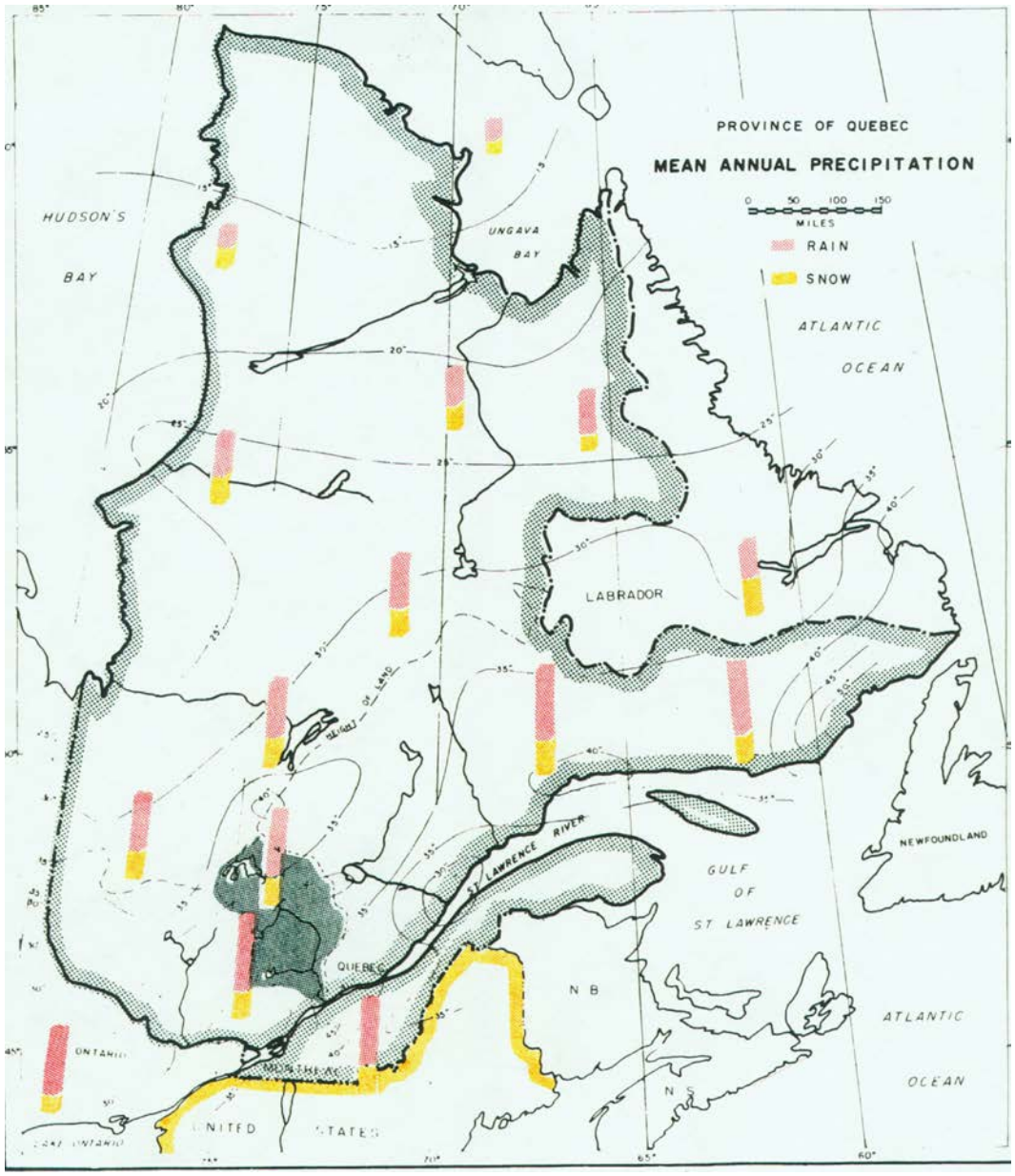

Figure 1. The Québec/Labrador Peninsula from the first Proceedings of the Eastern Snow Conference (Finlayson, 1952). At that time, work was in progress on several hydroelectric projects on rivers flowing south from the Peninsula into the St. Lawrence. These included the St. Maurice basin, shaded here, which had an installed capacity of almost 1700 MW by the 1950s (all derived from plants smaller than 300 MW). Another example further down river was the first (1952) power plant on the Manicouagan River which had an installed capacity of 235 MW. Even further down the estuary, Bersimis-1 (267 MW) and Bersimis-2 (116 MW) were also brought on stream in the 1950s. Such plants were the tiny forerunners of the huge hydroelectric projects based on the Peninsula today. By contrast, the capacity of modern Baie James operations is 50 times this. Projects smaller that 300 MW are not shown in Figure 2. This map illustrates the strong focus on snow (as distinct from other forms of ice) in the early days of the ESC. The precipitation data shown were based on short runs of gauge measurements from a very small number of still-new weather stations. Useful snow cover (as distinct from snow fall) data, one of the emphases of the ESC over the years, came later. This diagram was an example of the early use of color in a scientific publication.

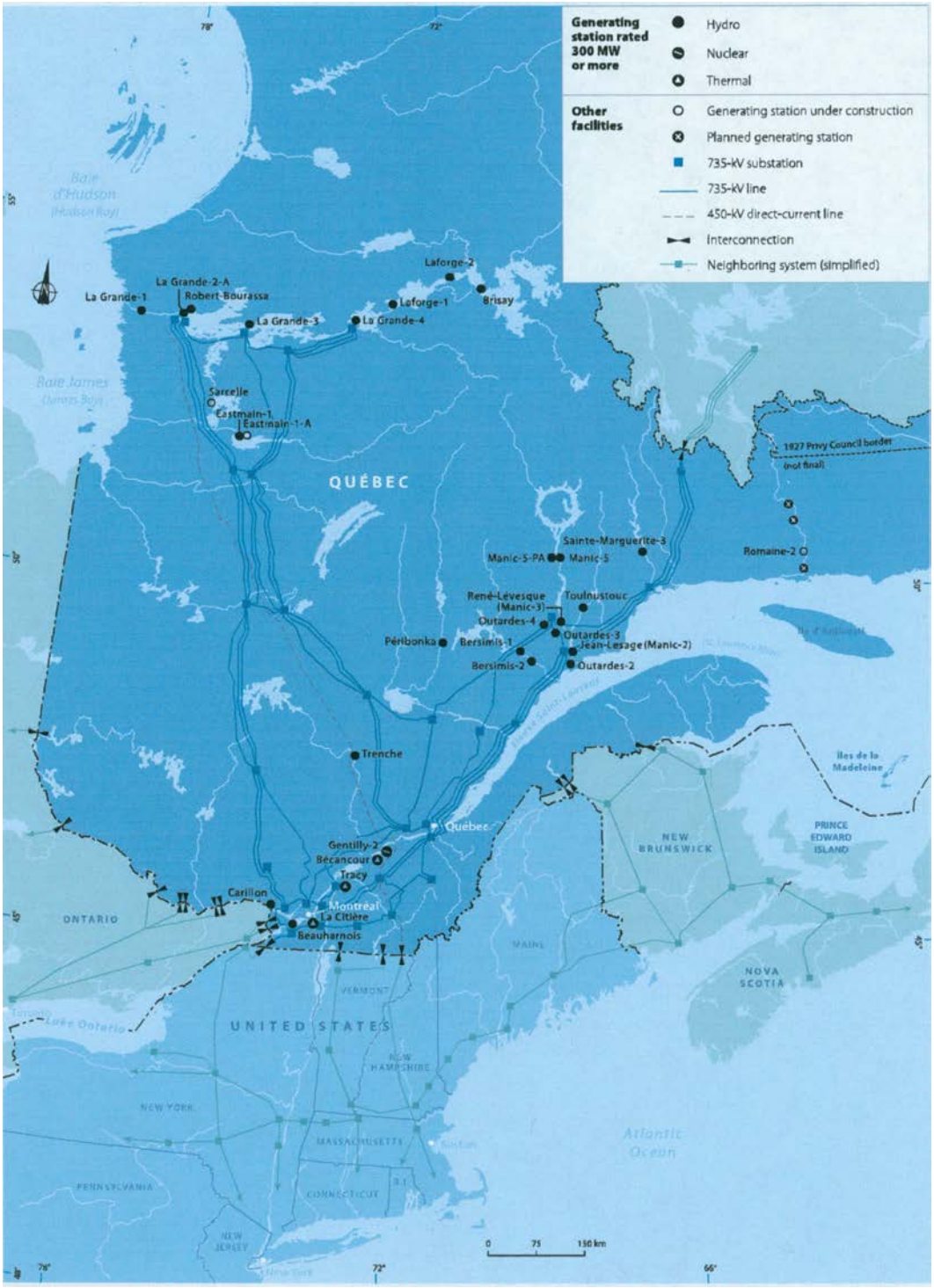

Figure 2. Hydroelectric operations in Québec/Labrador today, one of the great centers of hydroelectricity in the world (Hydro Québec, 2012). There are now numerous projects along the North Shore of the St. Lawrence, building on those mentioned in Figure 1; but the focus has shifted to rivers flowing into James (Hudson) Bay, notably the enormous (installed capacity over 16000 MW) Baie James operation. This map only shows sites with more than 300 MW capacity. The Churchill River power project (5428 MW), in Labrador, is sketched in on this Québec map. The lower Churchill is under development with a projected capacity of over 3000 MW. Projects mentioned with respect to Figure 1 are dwarfed by the modern hydro

operations. The Proceedings of 2011 (Table 2) include our most recent contribution to the study of hydro power in the peninsula (Fortin, 2011). The founders of the ESC, our predecessors, certainly picked a good region for their snow-runoff research!

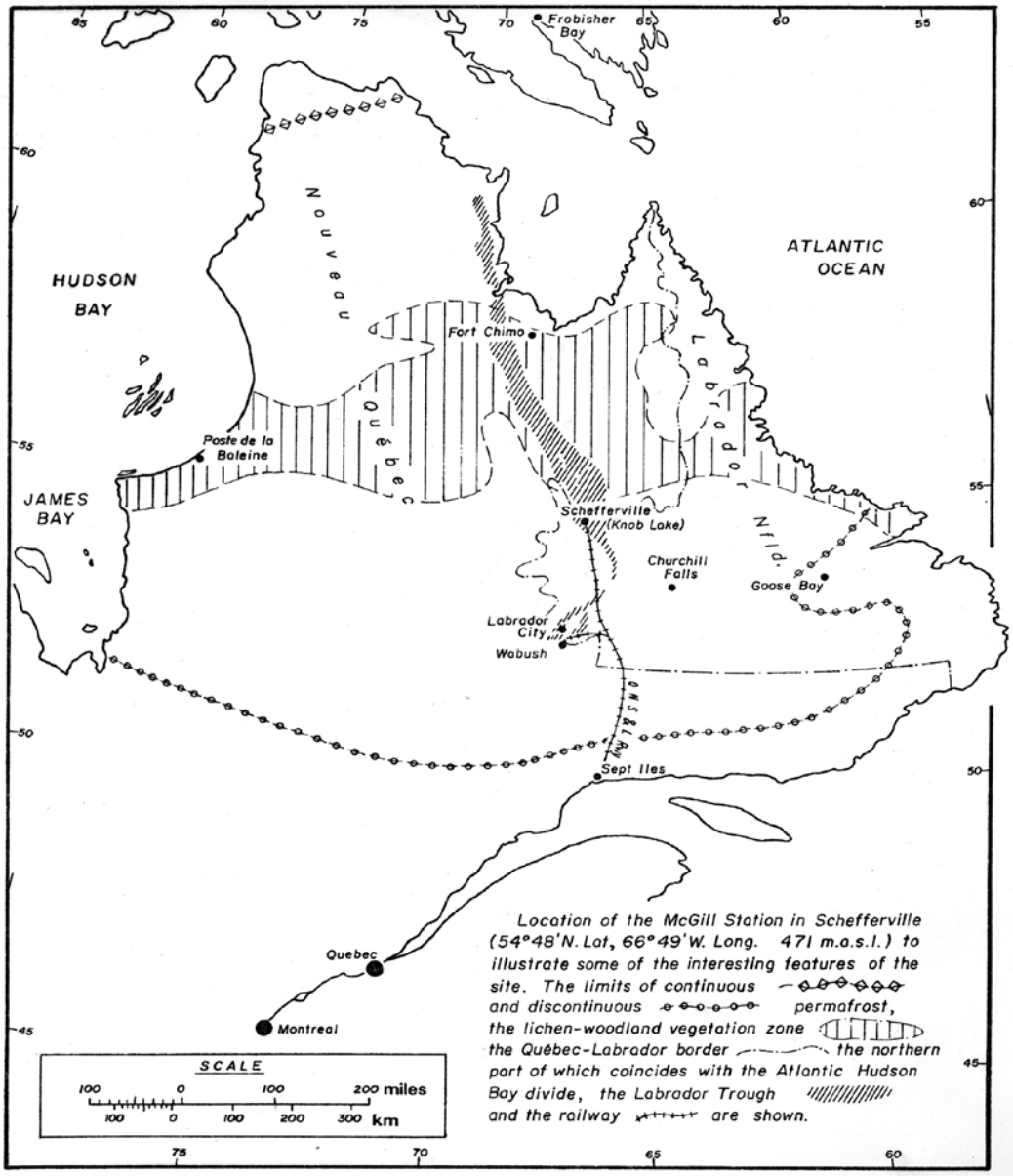

Figure 3. The Québec-Labrador Peninsula has proved to be accessible, fertile ground for varied ice research since the Eastern Snow Conference was founded in 1939. This diagram illustrates some of the reasons for that fertility. This is a very cold region given its latitude. Tree and permafrost lines "dip" well to the south here. The peninsula receives large amounts of snow and rain making it a global centre of hydro electric power (see Figure 2). The surrounding seas and the myriad lakes and rivers (~15% of the land area) develop massive ice and snow covers. Icebergs stream down the Labrador coast often reaching offshore New England. (From The McGill Sub Arctic Research Papers).

CONCLUDING COMMENT

We would argue that eastern North America has proved to be a remarkably productive home base for a professional and academic association such as the Eastern Snow Conference, with its diverse interests in cold weather science. Increasing interest in all aspects of the cryosphere in eastern North America, such as its role in climate change, its ecological significance, and its socioeconomic implications for such activities as hydroelectric power production, will ensure that the region will continue to be the focus of much of the research reported at the Eastern Snow Conference for the foreseeable future.

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REFERENCE AND BIBLIOGRAPHY

Adams WP, McArthur B. 1985. Evolution and roles of the Eastern Snow Conference, with an index and classification of the Proceedings, 1952–1983. In *Proceedings of the Eastern Snow Conference*; **42:** 1–24.

Ecclestone M, Adams P. 2007. The Eastern Snow Conference and the Atlantic Provinces, especially the Province of Newfoundland and Labrador. In *Proceedings of the Eastern Snow Conference*; **64**; 15–23.

Finlayson HM.1952. Snow-melt as factor in Quebec stream-flow. In *Proceedings of the Eastern Snow Conference*; **1**: 25–46.

Fortier R. 2011. GIS of snow cover in James Bay (Canada). In *Proceedings of the Eastern Snow Conference*; **68**: 191–196.

Henderson TJ. 1982. The Western Snow Conference—the first fifty years. In *Proceedings of the Eastern Snow Conference*; **39**: 1–5.

Hydro Québec. 2012. www.hydroquebec.com/generation/hydroelectrique.html.

Lansing L. 1982. Reminiscences of Eastern Snow Conferences. In *Proceedings of the Eastern Snow Conference*; **39**: 6–9.

McGill University Department of Geography. *McGill Subarctic Research Papers*. (A series that extends from the 1950s to the 1990s). McGill University: Montréal.

Nutt DC. 1955. Explorations in Labrador. In *Proceedings of the Eastern Snow Conference*; **3**.