Near-surface water temperatures Mississippi Watershed: Preliminary results of an ON 75th anniversary project

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Executive Summary:

About 80 to 100 volunteers and more than ten associations participated in the Mississippi Valley Field Naturalists (MVFN) outreach project on the August 2006 long weekend. The project was MVFN's contribution to Ontario Nature's 75th anniversary activities and was facilitated and supported by Mississippi Valley Conservation (MVC).

In all, nearly 1400 near surface water temperature readings were collected and submitted by volunteers who ranged from the headwaters to the mouth of Mississippi River over the 3 day sampling period. Most major lakes in the watershed and many smaller ones, as well as the main-stem river itself were included in the sampling program. Raw data, as submitted, are archived with MVC, Lanark Office.

Temperatures which approximated yearly maximum values were remarkably uniform, considering the size of the watershed which is about ½ the size of Algonquin Park. Average surface water temperatures were 26.4 ^{o}C and 69% of these readings were between 26 and 27 ^{o}C . The data provide one basis for considering the implications of future climate changes. Lake and river temperatures are expected to follow current air temperature trends and climate models suggest an increase in mean annual air temperatures of about 3.5 ^{o}C by 2050.

As an outreach activity to engage the public, and to raise awareness of the issue of climate change and the fact that our watershed has not and will not escape impacts from current and future climate changes, the project was an outstanding success.

Both as a result of discussions during the planning of this project and as a logical follow-up to it, two workshops are under discussion (or in planning) for 2007 including:

- **i) a workshop to discuss future water-temperature monitoring in the watershed under the stewardship of MVC and**
- **ii) an experts' workshop to discuss the implications of climate change on the watershed. The latter, it is proposed, would be co-hosted by MVFN and MVC.**

Introduction:

Mississippi Valley Field Naturalists (MVFN) and Mississippi Valley Conservation (MVC) have worked with many partners and associations, to plan and carry out the MVFN Ontario Nature (ON) 75th water sampling outreach program of August 5,6, 7 2006 (see MVFN web site for details). The project, which is focused on Mississippi Watershed, had several diverse goals including:

- engagement of the public to create a broader awareness that lake and river temperatures and overall climate are changing in our watershed
- collection of water temperatures (at the surface and 1m depth) across the watershed over the August long weekend; so as to place individual lake temperature and river temperature observations into a broader watershed context.
- encouragement of individuals, associations or government organizations to monitor water conditions, including water temperature, on an ongoing basis.
- promotion of discussion of climate change, and raising awareness of the need for the development of adaptation strategies and management options in Mississippi Watershed.

Many of us live and play in Mississippi watershed. When at play in the water we humans have a definite thermal comfort zone. Apart from any scientific evidence of changes in water temperatures there is much anecdotal evidence to suggest that lakes and river temperatures are warming : many cottagers and participants in this project reported that in recent years they can comfortably swim in their lake or section of river in July but in the 60's and 70's they could not. Furthermore, anecdotal evidence suggests that the last few years have been exceptionally warm.

Climate is in fact changing in the watershed. Mean annual air temperatures in this area have already changed by about 1.0 ^{o}C and on the basis of climate model outputs may change by at another 1.0 ^{o}C by 2020; 3.5 ^{o}C by 2050; 5.5 ^{o}C by 2080. Lake and river temperatures are expected to follow air temperature change.

Water temperature sampling:

It was assumed that summer water temperatures (measured in early August both at the surface and at 1m depth) would provide a reasonable first approximation of current mid-summer temperature conditions in the most traveled parts of the watershed, their broad geographical variation, and provide an initial basis for considering (not necessarily measuring) future climate changes. Data collection was carried out on a voluntary basis depending largely upon the good will and local interest of various associations and volunteers. However, MVFN members attempted to ensure broad geographic coverage and were, through prior agreement with the Project Co-ordinator (Cliff Bennett), assigned to collect data from across the watershed. There was wide coverage from the headwaters to the mouth of Mississippi River. Nonetheless, there was some bias towards sampling the more developed and accessible parts of it. Thus, the data more correctly reflect conditions in the `most traveled' parts of the watershed: the most traveled parts being defined by the volunteers who chose where to sample temperatures. The sampling protocol can be viewed at the MVFN web-site.

Raw data, sample locations, and maps associated with this project have been deposited with this report and housed and archived by MVC, Lanark Office and are thereby accessible to participating associations.

Volunteers came from a variety of interested organizations and MVFN sincerely thanks the 80 to 100 people and the various associations who participated in this project. By all

counts it was both an educational experience and fun for all, although our sampling gear did draw some strange looks from non-participants (Figure1).

Water temperatures (surface and 1m) in Mississippi watershed.

Lake temperatures, including some 675 paired readings (i.e. at the surface and 1m depth) and an additional 38 spot surface readings were collected over the August 2006 long weekend across the entire watershed. Nearly, 1400 readings were taken in all.

The frequency and range of the paired readings (i.e. for both the surface temperatures and the temperatures collected at 1m depth) are summarized for the entire watershed in histogram format in Figures 2 and 3.

Over the August long weekend the mean surface water temperature for the watershed, based upon 675 surface readings, was 26.4 ^{o}C. Some 69% of the temperatures reported fell between 26 and 27 ^{o}C. Similarly, the mean temperature at 1m depth was 26.3 ^{o}C and 66% of the reported temperatures fell between 26 and 27 ^{o}C. The relative uniformity of the temperature data over such a large watershed (1/2 the size of Algonquin Park) was surprising to many of us.

Typically, surface temperatures recorded as part of this project were quite close to those recorded at a depth of 1m. In 78% of the cases the difference at a site between readings at the surface and 1m was +/- 0.5 ^{o}C or less. In only 4% of the submitted readings did the difference between the surface and 1m readings exceed +/- 1.5 ^{o}C. Such differences could have resulted for a variety of reasons but the most likely cause is related to daily warming and cooling cycles.

Thus, from a watershed wide perspective and in many cases from a lake wide perspective, at this time of year, surface temperatures provide an approximation of temperatures to a 1m depth at least.

Temporal variability:

Did these readings approximate 2006 maximum yearly mean-daily water temperatures? In anticipation of the this question MVFN installed temperature loggers at a depth of 1 m at two lakes for much of summer, 2006: one at Clayton Lake in the eastern part of the Mississippi Watershed and one in Buckshot lake in the western part.

The exact date when yearly maximum daily temperatures are reached at a given depth and location will vary somewhat from year to year, and from place to place in the watershed. However, if the Buckshot and Clayton Lake data (Figures 4 and 5) are representative of the temporal trends in the watershed, then in 2006 the maximum mean daily temperatures at 1m were reached on or about July 17 to 20. It is interesting to note that the mean average temperature, based upon the average daily maximum and minimums, over the entire August long weekend at Buckshot Lake was about 26.3 ^{o}C. The actual maximum mean daily temperature recorded on July 19 was about 26. 7 ^{o}C. The mean values were surprisingly close.

At Clayton Lake the difference between the maximum mean daily temperature reading, reached on July 17, and the mean for the August long weekend was somewhat higher: the

means were 27.7 and 26.6 ^{o}C respectively. However, at Clayton Lake on any given day during the August long weekend the mean daily temperatures varied from about .7 to 1.1 ^{o}C lower than the actual maximum mean daily temperature at 1 m as recorded by the data logger on July 17.

Thus, the data collected by project participants does provide an approximation of maximum near surface water conditions in the watershed. What is also clear from the logger data is that high summer temperatures are maintained for days at least. We consider any differences encountered in the sampling program to be quite reasonable given the broad goals of this outreach project.

Discussion and recommendations:

Data collection took place over several days to encourage broad participation in the project and to allow for wide watershed coverage. Such an approach was desirable: i) to engage the public and to raise awareness of changing water conditions in Mississippi Watershed; ii) to encourage the continuance and further development of an ongoing temperature monitoring program in the watershed and iii) to initiate discussions with people living in the region about the need for adaptation and management options.

MVFN encourages various associations and government agencies to develop and rationalize a basin wide temperature monitoring program. This will require the maintenance and or installation of continuous temperature logging devices to collect long-term data from representative lakes at a variety of depths over the summer months (July and August , at 1m depth) at least. Such data will more precisely document future conditions and changes that occur within the watershed. MVFN suggests that such a program might be developed under the stewardship of MVC, after discussion with interested Lake Associations, Angling Associations and others. An initial workshop, should there be interest in this proposal, is in planning for 2007.

Additionally, MVFN has initiated discussions with MVC about the possibility of holding a workshop in summer 2007 to bring together specialists who have worked on climate change issues in and around Mississippi Watershed. This event would give the public an opportunity to hear what is known about possible current and future changes and to put forward their questions, concerns, and ideas. Public input at this event may be helpful in planning for future information and adaptation initiatives. The workshop would be co-hosted by MVFN and MVC and will be open to the public.

Thanks to all who participated in and supported this project. A special thanks to Cliff Bennett who has acted as project Co-ordinator. Without his efforts and enthusiasm this project would not have been the success that it was.