Characterization of summer water temperatures for 312 selected sites in Nova Scotia

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Characterization of summer water temperatures for 312 selected sites in Nova Scotia

by

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MacMillan, J.L., D. Caissie, J.E. LeBlanc and T.J. Crandlemere. 2005. Characterization of summer water temperatures for 312 selected sites in Nova Scotia. Can. Tech. Rep. Fish. Aquat. Sci. 2582: 43p.

Water temperature plays an important role in the overall health of aquatic ecosystems. It influences most physical, chemical and biological processes of the river environment, including the distribution of fishes and the growth rates of many aquatic organisms. Therefore, a good understanding of the thermal regime of rivers is essential for the management of fish habitat.

In the present study, water temperature sensors were installed in 312 sites across the province of Nova Scotia during the summers of 2000, 2001 and 2002. Water temperature sites were selected in each of the six Recreational Fishing Areas (RFAs) to best represent thermal habitat conditions in each fishing area of the province. Water temperatures were collected at 30 minute intervals and sites were divided into stationary or non-stationary sites. Stationary sites were sampled during the summer period from June 15 to September 5, whereas data were collected for a shorter period of time at non-stationary sites. At non-stationary sites, loggers were systematically moved to different sites to cover as many sites as possible. Thereafter, water temperatures at non-stationary sites were extended for the whole summer period using regression analysis. This method permitted the coverage of a wide range of river sizes as well as different meteorological and thermal conditions within the province. A classification of water temperature was developed and sites were assigned as cool (< 16.5°C), intermediate (16.5-18.9°C) or warm temperature sites (> 18.9°C).

Results showed that both cool and intermediate temperature sites constituted 95 sites (30.5%) for a total of 61% of the sites whereas 122 (39%) sites were classified as warm temperature sites. A good relationship was observed between the mean summer water temperature and the maximum daily summer water temperature. The number of days that the water temperature exceeded 20°C was also highly correlated with the mean summer water temperature for intermediate and warm temperature sites. In most cases, cool water temperature sites did not exceed 20°C. It is estimated that under climate change and with an increase in water temperature of +2°C, the distribution of cool, intermediate and warm temperature sites will change significantly. As such, cool water temperature sites would decrease to 15% (47 sites) followed by 23% (72 sites) intermediate water temperature sites and warm water sites would increase to 62% (193 sites). A discussion is provided on the importance of cool water temperature sites for salmonid habitat as well as the potential impacts of climate change.

RÉSUMÉ

MacMillan, J.L., D. Caissie, J.E. LeBlanc and T.J. Crandlemere. 2005. Characterization of summer water temperatures for 312 selected sites in Nova Scotia. Can. Tech. Rep. Fish. Aquat. Sci. 2582: 43p.

La température de l'eau joue un rôle important au niveau de la santé globale des écosystèmes aquatiques. Par exemple, elle influence la plupart des processus physiques, chimiques et biologiques des cours d'eau ainsi que la distribution des espèces et la croissance de plusieurs organismes aquatiques. Alors, une compréhension des processus thermiques en rivière est essentielle pour une gestion efficace de l'habitat du poisson.

Dans la présente étude, 312 capteurs de température de l'eau ont été installés en Nouvelle-Écosse pendant les périodes estivales 2000, 2001 et 2002. Les sites d'analyse de la température de l'eau ont été choisis afin de bien représenter les conditions thermiques des six régions de pêches récréatives (RPRs) de la province. La température de l'eau a été mesurée à des intervalles de 30 minutes et les sites ont été divisés en sites stationnaires et sites non stationnaires. La température de l'eau a été mesurée aux sites stationnaires durant la période de l'été, c'est-à-dire du 15 juin au 5 septembre, tandis que la température de l'eau a été mesurée pour une plus courte durée aux sites non stationnaires. Pour les sites non stationnaires, les capteurs de températures ont été déplacés systématiquement à différents sites afin d'échantillonner un plus grand nombre de sites possible. Par après, les températures aux sites non stationnaires ont été calculées pour toute le période de l'été en utilisant les températures des sites stationnaires et une analyse de régression. Cette méthode a permis d'effectuer une analyse de la température de l'eau pour un plus grand nombre de sites couvrant plusieurs rivières et conditions météorologiques de la province. Une classification des sites de températures a été effectuée, soit les sites froids (< 16.5°C), sites intermédiaires (16.5-18.9°C) et les sites de températures d'eau chaudes (> 18.9°C).

Les résultats démontrèrent que les sites de températures froides et intermédiaires constituaient chacun 95 sites (30.5%), soit de 61% des sites au total, alors que 122 sites (39%) étaient classifiés comme sites de températures chaudes. Une bonne relation a été observée entre la température moyenne de l'eau et la température maximale durant la période estivale. Également, le nombre de jour avec une température de l'eau supérieure à 20°C démontra une bonne corrélation avec la température moyenne estivale pour les sites intermédiaires et chauds. Il a été estimé que pour des conditions de changement climatique, c'est-à-dire en ajoutant +2 °C à la température de l'eau pour chaque site, le nombre de sites froids, intermédiaires et chauds serait grandement modifié au niveau de la province. Par exemple, le nombre de sites froids pourrait diminuer à 15% (47 sites) suivi de 23% pour les sites intermédiaires (72 sites) tandis que les sites chauds augmenteraient à 62% (193 sites). Une discussion sur l'importance des sites d'eau de température froide pour les salmonidés ainsi que sur l'impact potentiel du changement climatique a été fournie.

1.0 INTRODUCTION

Water temperature is one of the important parameters in stream ecology which determines the overall heath of aquatic ecosystems. It influences the growth rate of aquatic organisms (Elliott and Hurley 1997; Edwards et al. 1979) as well as their distribution within rivers (Ebersole et al. 2003). Water temperatures can also have adverse impacts on aquatic habitat especially when they are outside the optimal thermal range (Coutant 1977). For example, high water temperatures can result in fish mortalities by impacting directly on fish populations and indirectly by limiting fish production in rivers. During high temperature events, fish often seek out thermal refugia near cold water springs or at the mouth of groundwater-fed tributaries (Torgersen et al. 1999). Brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), and Atlantic salmon (*Salmo salar*) are members of the salmonid family that need cool water to survive. For example, brook trout are among the most sensitive salmonids to warm water and usually avoid temperatures greater than 20^{o}C, whereas brown trout and Atlantic salmon are slightly more tolerant of warmer waters (Lee and Rinne 1980; Garside 1973).

Land use practices and development activities have been responsible for increased water temperatures in many rivers throughout North America (Beschta et al. 1987; Mitchell 1999). The removal of streamside vegetation has been shown to significantly increase water temperatures due to increased solar input directly at the water surface. Climate change is also expected to result in warmer air temperature and reduced summer flows which will ultimately result in high stream temperatures. These changes to the thermal regime of rivers due to climate change could potentially impact on the distribution of fish as well as thermal habitat structure as noted in some studies (Minns et al. 1995; Schindler 2001).

The purpose of this study is to better understand how salmonid habitat can be potentially affected by warm water temperatures. Although the thermal regime of rivers plays a key role in fish habitat preference and utilisation, very few studies investigated the spatial variability of river water temperatures on a province-wide basis to characterize cold water vs. warm water temperature sites. Therefore, the objective of the present study is to characterize stream water temperatures for many sites throughout the province of Nova Scotia and to classify these sites into cool, intermediate and warm water temperature sites. Important river thermal indices such as the mean summer water temperature, the maximum daily water temperature and the number of days for which the water temperature exceeded 20°C will also be quantified.

Under a climate change scenario (2 X CO_2), air temperatures in the Maritime Provinces are projected to increase by 4-6°C in the next 80-100 years (Parks Canada 1999). Because air and water temperatures are highly linked (Mohseni and Stefan 1999), it is suspected that climate change will also result in warmer water temperatures throughout the study area. The level of increase can be dependant on many river factors as well as site specific variables; however this study will look at the impact of a hypothetical increase in water temperature of 2°C on the overall thermal habitat conditions. This level of increase is not beyond the range of potential increases given the above air temperature climate change projections and the linear association between air and water temperatures (Pilgram et al. 1998). This information will help our understanding of stream water temperature across river basins and will also improve our knowledge of critical thermal habitats for Nova Scotia's streams.

2.0 MATERIALS AND METHODS

Currently available water temperature recorders (or mini loggers) provide a highly effective method for the characterization of water temperatures over a time series for specific sites within river ecosystems. In addition, some of these water temperature sites can be highly correlated among themselves within a river basin as they are often subject to similar meteorological conditions. Under these conditions, water temperatures from a particular site can be used to supplement data at other water temperatures sites (i.e., using regression analysis) for periods when data are not available. This approach of extrapolating water temperature data from one site to another can be an effective means to increase the spatial representation of water temperature sites using fewer data loggers. This approach was used in this study to capture the summer thermal habitat characteristics for a wide range of sites across the province of Nova Scotia.

A total 312 sites were instrumented with water temperature mini loggers (VEMCO^{TM}) during the summers of 2000, 2001, and 2002. These sites were distributed throughout the province in 30 selected areas (Figure 1), which covered a total of 34 rivers. Water temperature sites were selected in each of the six Recreational Fishing Areas (RFAs) to best represent thermal habitat conditions in each fishing area of the province.

A number of sites were selected to calibrate and validate a water temperature model, which was thereafter used to simulate water temperature at other sites. This model consisted of a simple regression model based on water temperature measurements taken every 30 minutes. The water temperature model was initially calibrated and validated for 19 sites within the following river systems (East and West River of Pictou as well as Canard, Pereaux and Habitant rivers). The model was calibrated using 5-10 days of water temperature data (taken every 30 minutes) during one summer and it was then validated using data from another summer. The validation consisted of using an independent data set to effectively test the predictability of the model (i.e., using data that were not used in the model calibration). The validation data covered a period of approximately 4-83 days of water temperature data depending on the station.

The following equation was used for the water temperature calculation:

[1] $$WT_{Est} = a \; WT_{Obs} + b$$

where WT_{Est} is the water temperature at the estimated site, WT_{Obs} is the water temperature at the observation site, a and b are regression coefficients.

The coefficient of determination, r^2, was calculated for each regression equation, which showed the percentage of variance explained by the model. The mean water temperature was calculated during both the calibration and validation periods and they were compared. The difference between observed and predicted water temperatures (or the mean difference) was also calculated for each period (i.e., calibration and validation) to provide information on the relative bias of the water temperature model. The root-mean-square error (RMSE) is another performance criterion which is often used in water temperature modelling studies (Caissie et al. 2001) and it was also used in the present study. This criterion informs on the average magnitude of the water temperature errors.

The RMSE is given by the following equation:

[2]
$$RMSE = \sqrt{\frac{\sum_{i=1}^{N}(P_i - O_i)^2}{N}}$$

where P_i and O_i are the predicted and observed water temperatures respectively, N represents the number of observations.

After the water temperature model was calibrated and validated, it was then used to extrapolate water temperatures at different sites using water temperatures from specific sites. For instance, within each river system at least one water temperature site was stationary while many other sites were mobile or non-stationary. At the stationary sites, water temperatures were monitored during the whole summer season, i.e., June 15 to September 5 (for most sites). At the non-stationary sites mini loggers were generally installed for a shorter period of time, ranging from 4-33 days, and they were systematically moved to a different location during the summer in order to cover as many sites as possible. Thereafter, water temperatures at the non-stationary sites were extended for the whole summer period using water temperatures from the stationary sites and the above water temperature model. With this approach, it was possible to monitor water temperatures for 312 sites in the Province of Nova Scotia, covering a wide range of river sizes as well as different meteorological and thermal conditions.

From a biological perspective, the number of days for which the water temperature exceeds 20°C can be an important indicator of the level stress experienced by fishes (e.g. trout and other cold water species). As such, the number of days with water temperature exceeding 20°C was calculated for each study sites. In addition, every site was also ranked based on their mean summer water temperature. Each site was also classified into three thermal categories: cool, intermediate and warm temperature sites. Cool water sites had a mean summer water temperature less than 16.5°C. Intermediate sites had a mean summer water temperature between 16.5-18.9°C while warm sites had a mean summer water temperature greater than 18.9°C.

3.0 RESULTS

The Nova Scotia water temperature monitoring project involved the work of many volunteers and community-based organizations (Table 1). Water temperature data were collected in many rivers and covered every county in the province (Figure 1).

Results for the water temperature model are presented in Table 2 (for 19 sites within the East and West River Pictou, Pereaux, Canard and Habitant rivers during 2000-02). This table provides information on both the calibration and the validation periods. The regression equations were provided in this table and *y* represents the estimated water temperature (WT_{Est}) while *x* represents the observed water temperature (WT_{Obs}) during the calibration period (see equation [1]). For example, during the calibration period the coefficient of determination, r^2, varied between 0.43 (Upper Dyke Tributary, 2002) to 0.93 (Sleepy Hollow Brook, 2002), both within the Canard River system. The average coefficient of determination among sites was calculated at 0.74, which means that over 74% of the water temperature variability can be explained using the water temperature regression model.

Mean summer water temperatures (actual or observed mean value) at the different sites varied between 13.2°C (Sanford Brook, 2002) to 20.6°C (Upper Dyke Tributary, 2002), with an average value of 16.7°C (Table 2). It was noted that the predicted water temperatures during the calibration period were very similar to observed values with a mean difference of 0.02°C. In fact, most sites had a mean difference of less than 0.05°C. The mean differences for the East and West rivers were very small during both years. The highest mean difference was observed at the Upper Dyke Tributary in 2001 with a value of 0.25°C.

The associated error for the water temperature modelling was expressed by the RMSE, which ranged between 0.4°C (Eight Mile Brook and Main Branch @ Highway 358, both in 2001) and 1.7°C (Reid Road tributary 2001). The overall RMSE for the study sites was calculated at 0.84°C during the calibration period.

The validation period consisted of using data from a different year than that used for the calibration to test the model's performance. Results of the analysis are presented in Table 2. The water temperature (mean overall) during the validation period was calculated at 16.7°C and identical to the value calculated during the calibration period. A comparison of overall mean water temperatures (observed vs. predicted) at the different sites showed almost identical results as well (16.7°C vs. 16.6°C). The mean difference in water temperatures was slightly higher during the validation period at 0.48°C compared to the calibration period. In addition, the maximum mean difference was observed at 1.3 °C (site on the Main Branch @ Highway 358, 2002), although most sites showed values less than 1°C. The mean RMSE was also higher during the validation period at 1.10°C, with a maximum value of 1.7°C (Six Mile Brook, 2000; Reid Road Tributary, 2001). These results show that the water temperature regression model can be an effective tool to simulate water temperature at different sites with water temperature errors generally less than 1°C. Furthermore, the calculated mean summer water temperature using this particular model will most likely result in a mean water temperature less than 0.5°C of actual measured value.

Using the above water temperature model, many other sites were analyzed throughout the province of Nova Scotia. Water temperature data from stationary sites, usually located within the main river, were used to extend water temperatures at the non-stationary sites (i.e., mostly located on tributaries). The application of the water temperature model will be illustrated using the data from the East River of Pictou (stationary site) and the Thompson Brook (non-stationary site) (Figure 2). For example, the East river of Pictou water temperature time series in 2000 was monitored from June 15 to September 5 (Figure 2a). During that period, 58 days with water temperature exceeding 20°C were observed. The water temperature time series at Thompson Brook relative to the data observed at East River of Pictou are presented in Figure 2b. At Thompson Brook data were collected from June 23-30, 2000. A regression analysis was carried out for a period of 8 days (328 measurements with concurrent data monitoring) and results are provided in Figure 2c. The coefficient of determination was calculated at 0.90. Following the model development, both monitored and predicted water temperatures at Thompson Brook are presented with corresponding water temperatures at East River of Pictou (Figure 2d). With the extended water temperature time series at Thompson Brook, it was possible to calculate the mean summer water temperature (15.7°C for the whole summer) as well as other important thermal characteristics.

The above procedure of extending water temperature data from stationary sites to non-stationary sites for the whole summer was carried out throughout the province of Nova Scotia. Results of this analysis are presented in Table 3 for 312 sites (stationary and non-stationary sites). This table presents the year of analysis as well as the topographic map used to locate the site. Latitude and longitude for each site were provided. For example, the Annapolis River site was located at 4458 6501 (Table 3) which means a latitude of 44° 58’ and a longitude of 65° 01’.

The number of days that the water temperature exceeded 20 °C during the summer period was also calculated (Table 3). Information related to the period of actual water temperature monitoring was provided in terms of duration in days (e.g., 15 June to 05 Sept; Annapolis River) as well as the number of water temperature measurements taken during that period. The regression equation as well as the coefficient of determination was then provided for each site. It should be noted that the regression equation presented in Table 3 was also based on equation [1]. The *y* value in this case represents the water temperature estimate (WT_{Est}) at the non-stationary site while the *x* value represents the water temperature observation (WT_{Obs}) at the stationary site. Based on the regression analysis and water temperature predictions, the mean summer water temperature and the maximum daily water temperature were calculated for each site. With this information, each site was assigned a ranking number from the coldest to the warmest site (based on the mean summer water temperatures). For example, the coldest site was Coldstream (MacDonald Brook) within the Middle River at 10.1°C (site number 1) whereas the warmest site was at Rhyno Lake Outflow (part of the LaHave River) at 24.2°C (site 312; Table 3).

A further analysis of the water temperature sites revealed that there were a similar number of cool, intermediate and warm sites (Figure 3), although that they were not evenly distributed throughout the provinces (Figure 4). In total, cool sites accounted for 95 sites or 30.5% of the sites studied. Very few cool sites had water temperatures less than 11.5°C (5 sites). A total of 35 sites had water temperatures in the range of 11.5-13.9°C while 55 sites were in the range of 14-16.4°C. Most sites were observed in the range of 16.5-18.9°C (95 sites; 30.5% of the sites), which identified the intermediate water temperature conditions. This category was closely followed by the number of sites in the 19.0-21.4°C range (80 sites), while fewer sites were observed for water temperature warmer than 21.5°C (42 sites). In total, 122 sites or 39% of the studied sites were classified as warm temperature sites. As shown on Figure 4, most warm temperature sites were found in the south western part of the province whereas most cool temperature sites were mostly in northern areas, i.e., the mid-section of the province and in Cape Breton. Intermediate temperature sites were found throughout the province.

An analysis was also carried out to study the relationship between the mean summer water temperature as a function of the maximum daily temperature for every site (Figure 5). This regression analysis showed a relatively good relation between these two variables with a coefficient of determination of 0.84. The following equation was calculated: $WT_{max} = 1.13\ WT_{mean} + 1.17$ (N=312). The relationship represents the cool temperature sites better than the warm temperature sites. The warm temperature sites tend to have more scatter around the regression line (especially noticeable at high temperatures, >20°C). Also, the slope of the regression line was calculated at 1.1 and this shows that the difference between the maximum water temperature and the mean summer temperature increases with temperatures. For example, at a mean summer water temperature of 10°C the maximum water temperature is on average 2.5°C warmer (i.e., 12.5 °C) and at 20°C this difference increases to 3.8 °C (Figure 5).

The number of days with water temperatures exceeding 20°C as a function of the mean summer water temperature is illustrated on Figure 6. These results showed that for sites with mean summer water temperature less than 16.5°C, very few days were observed with temperatures exceeding 20°C. Conversely, for sites with water temperatures greater than 17.5°C, it appears that the number of days increased linearly as a function of mean summer temperatures. This relationship was most evident for summer temperature ranging between 18°C and 21°C. At temperatures below and above these values, the relationship was still apparent but with an increased scatter of data points around the fitted line. From this figure, it was estimated that the number of days with water temperatures > 20 °C increased at a rate of approximately 16 days per °C for temperatures above 17.4 °C. It was also apparent from this figure that the number of days with water temperature > 20°C levels off at approximately 80 days for higher water temperature sites. This maximum duration of approximately 80 days is consistent with the period of study, i.e., between June 15 and September 5 or 82 days.

The last analysis consists of studying the impact of an increase in air temperature on water temperatures due to climate change. The projected increase in air temperature using Global Circulation Models (CGMs) results for this region is 4-6°C (Parks Canada 1999), therefore, a hypothetical increase of 2°C for water temperatures at all sites was deemed reasonable to study potential impacts due to climate change. Results showed that an increase of 2°C for each site due to climate change would significantly modify the thermal habitat conditions in Nova Scotia. For example, the number of cool water sites is projected to be the most impacted with a decrease in number by approximately half, i.e., from 95 sites to 47 (Figure 7). The number of intermediate sites is projected to decrease slightly from 95 to 72 sites while the number of warm water temperature sites is projected to increase significantly by over 58%, i.e., from 122 sites (currently) to a potential of 193 sites.

4.0 DISCUSSION

This study focused on the characterization of summer water temperature for numerous sites across the province of Nova Scotia (period of June 15 to September 5). Water temperatures were not available at all sites for the whole summer period; therefore a water temperature model was developed, tested and used to extend the data time series for a number of sites. The model was initially tested using 19 sites within the East and West River Pictou, Pereaux, Canard and Habitant rivers during 2000-02. Results indicated that water temperatures could be predicted with a mean difference of 0.02-0.48°C for mean summer temperatures (Table 2). Also, modelling errors, expressed as the root-mean-square error (RMSE), were generally less than 1-1.5 °C. Water temperature regression models have been used in the past to predict water temperatures (Smith 1981; Mackey and Berrie 1991; Pilgrim et al. 1998) and results were similar to those of the present study. Based on these modelling performances, the regression model was then used to calculate water temperatures at non-stationary sites using data from stationary sites. Summer water temperature was estimated for 312 sites in Nova Scotia.

Results indicated that approximately 61% of the study sites were either cool or intermediate water temperature sites. The remaining sites (warm temperature sites) constituted approximately 39% of the 312 sampled sites. Warm temperature sites are usually located within the main river system while the colder water temperature sites are generally found in small tributaries. For example, cold water tributaries are often observed in small headwater streams, which can constitute important habitat for salmonids. In fact, these smaller headwater streams, also rich in groundwater, have been found to be very important for trout as reported by Benson (1953). For example, he showed that groundwater fed tributaries tended to have less extreme water temperature, i.e., colder in summer and warm in winter, and that cool water sites were very productive in terms of trout spawning habitat. Alternatively, warm water temperature sites are often observed in lower section of rivers, with temperatures that can reach values of 29-31 °C (Huntsman 1946; Caissie 2000). Under such conditions, Huntsman (1946) has shown that different species of fish can experience significant mortalities.

The results pertaining to the spatial variability of summer temperatures indicated that water temperatures from cool sites rarely exceeded 20 °C. Cool water temperature sites are most likely good trout habitat. Intermediate water temperature sites generally exceeded 20°C; however for a period less than 30 days. Warm temperature sites exceeded 20°C for prolonged periods of time in summer (30-80 days), potentially resulting in a restriction of suitable habitat for salmonids. When water warms to stressful levels, studies have shown that many individuals in salmonid populations can migrate and/or aggregate to cooler areas (Kaya et al. 1977; Cunjak et al. 1993; Ebersole et al. 2001). For example, Brook trout have been observed to seek coldwater tributaries during period of high water temperatures (Cunjak et al. 1993). They showed that when water temperatures reached 23-24°C within the main river (i.e., Little Southwest Miramichi River), salmonids moved temporarily into smaller tributaries (e.g., Catamaran Brook). Elson (1942) also reported that brook trout migrated from warm water (21°C) of Lake Ainslie, Nova Scotia, into cool streams (12-15°C). Other studies have shown that salmonids seek cold water patches (e.g., upwelling cold water in pools) within the river when water temperature becomes excessive (Matthews and Berg 1997). Thermal restriction of habitat can result in overcrowding of fish in cool water sites or refugia at high water temperatures (Ebsersole et al. 2001). Their study showed that 10-40% of the fish were observed near cold water patches during midday. In many cases, coldwater patches can be 5 °C cooler than ambient river conditions. Coldwater areas or patches have been characterized by Ebsersole et al. (2003) and they have been classified in cold water tributaries, lateral seeps, deep pools and cold alcoves (or backwater areas). Deep pools (with a cold water source) have been shown to be important thermal refugia for trout even when low dissolved oxygen content is present (Bilby 1984; Matthews et al. 1994). In fact, when faced with a choice, trout seems to prefer low water temperatures despite the fact that it can be associated with low dissolved oxygen (Matthews and Berg 1997). It is suspected that such aggregation of fish during high water temperatures could be more susceptible to predation, parasites, disease transmission, and over fishing (Coutant 1987). In Nova Scotia, approximately 30% of the study sites rarely exceeded 20°C, which makes them very good habitat for cold water species. Intermediate water temperature sites can have suitable thermal habitat for coldwater species provided that these streams have cold water patches during high temperature events. Warm water temperature sites with temperature exceeding 20°C between 30 and 80 days during the summer are probably not suitable for salmonids, unless thermal refugia are present in these river systems.

For the warm water temperature sites, adverse physiological effects on salmonid population can be suspected especially during warm summers. For instance, recent studies have shown that high water temperatures can have an impact on the development of juvenile salmonids (Lund et al. 2002). They showed that high summer water temperatures can cause significant protein damage and induce a heat-shock response as well. Warm temperatures can have adverse physiology effects and influence the survival of Atlantic salmon when angled during high temperature events (Wilkie et al. 1996). Data collected in the present study on the distribution of cool vs. warm temperature sites could be useful in the future to develop maps of suitable thermal habitat. Such maps could be used as guides for future habitat enhancement efforts and regulatory changes to help stressed populations. Beneficial initiatives could also be directed toward those areas that may be of critical importance to the summer survival of cold water fish populations.

Climate change is expected to significantly modify current thermal habitat structure in Canada (Schindler 2001). It could have adverse effect on both water quantity and quality, which will impact aquatic resources. Higher air temperatures will also result in warm river temperatures, which may adversely affect growth of salmonids in this region (Swansburg et al. 2002). To demonstrate the sensitivity of the cool water sites to temperature change and potential climate change, 2°C were added to the summer average water temperature of the 312 sites surveyed. This study showed that a 2°C increase could result in a 50% loss in the number of cool water sites and a 58% increase in the number of warm water sites, while the number of intermediate sites is projected to decrease slightly by approximately 24%. Results indicate that climate warming could potentially have the most profound impact on cold water habitat structure in the future for Nova Scotia streams. Other studies have shown that climate change will most likely modify the thermal habitat distribution in the future. For instance, Keleher and Rahel (1996) demonstrated that trout habitat could be reduced from 16-70% in the Rocky Mountain region depending on the projected increases in air temperatures. They also pointed out that as a result of climate change, coldwater species could be restricted to high elevations within the Rocky Mountains (where water temperatures may not reach lethal values). Eaton and Scheller (1996) showed similar reduction in habitat due to potential climate change. They considered 57 freshwater species and showed a potential reduction of 57% of coldwater habitats. It is therefore important to monitor and model water temperatures in rivers under future climate scenarios to better understand the thermal regime of small and larger rivers alike.

In order to protect existing thermal habitat conditions within the province, it is important that current land use practices be evaluated in relation to current cool water temperature sites to protect buffer zones around these streams. In many situations, these small streams and brooks that remain cool are vital to the survival of trout in summer. Poor land use practices may result in a reduction in the size of buffer (riparian) zones around streams that provide shade, maintain bank stability and ultimately maintain cooler water. Protecting and establishing buffer zones could result in a considerable improvement for salmonid populations that must use small, cool areas in the summer. Angling regulations have been used to protect populations of trout restricted to cool water refugia. These need to be maintained and enhanced where required. For example, Trout Brook, a tributary of Lake Ainslie in Margaree River is a well known cool water refuge for trout in summer and special regulations have been used to protect trout in this area. The present study reported on data pertaining to the classification and distribution of water temperature sites within the province of Nova Scotia. The potential impact of climate warming was also considered in this study with a focus on the distribution of cool, intermediate, and warm temperature sites. Climate change issues will undoubtedly become more important with increasing global temperatures. In general, coldwater habitats remain a key component in the overall heath of our aquatic ecosystems, which we need to protect for future generations.

5.0 ACKNOWLEGEMENTS

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6.0 REFERENCES:

Benson, N.G., 1953. *The importance of ground water to trout populations in the Pigeon River, Michigan*. Transactions of the Eighteenth North American Wildlife Conference, March 9, 10, and 11, 1953, Washington, D.C., pp.269-281.

Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby and T.D. Hofstra. 1987. *Stream temperature and aquatic habitat: fisheries and forestry interactions*. In: E.O. Salo and T.W. Cundy [ed.], Streamside management: Forestry and fishery interactions. University of Washington, Institute of Forest Resources, Contribution No. 57, pp.191-232.

Bilby, R.E. 1984. *Characteristics and frequency of cool-water areas in a western Washington stream*. Journal of Freshwater Ecology 2(6): 593-602.

Caissie, D. 2000. *Hydrological conditions for Atlantic salmon rivers in 1999*. Canadian Stock Assessment Secretariat, Research Document 2000/11, 29p.

Caissie, D., N. El-Jabi and M.G. Satish. 2001. *Modelling of maximum daily water temperatures in a small stream using air temperatures*. Journal of Hydrology 251: 14-28

Coutant. C.C. 1977. *Compilation of temperature preference data*. Journal of the Fisheries Research Board of Canada 34: 739-745.

Coutant, C.C. 1987. *Thermal preference: when does an asset become a liability*? Environ. Biol. Fishes. 18: 161-172.

Cunjak, R.A., D. Caissie, N. El-Jabi, P. Hardie, J.H. Conlon, T.L. Pollock, D.J. Giberson, and S. Komadina-Douthwright. 1993. *The Catamaran Brook (New Brunswick) Habitat Research Project: Biological, Physical and Chemical Conditions (1990-1992)*. Canadian Technical Report of Fisheries and Aquatic Sciences 1914: 81p.

Eaton, J.G. and R.M. Scheller. 1996. *Effects of climate warming on fish thermal habitat in streams of the United States*. Limnology and Oceanography 41: 1109-1115.

Ebersole, J.L., W.J. Liss and C.A. Frissell. 2001. *Relationship between stream temperature, thermal refugia and rainbow trout Oncorhynchus mykiss abundance in arid-land streams in the northwestern United States*. Ecology of Freshwater Fish 10(1): 1-10.

Ebersole. J.L. W.J. Liss and C.A. Frissell. 2003. *Cold water patches in warm streams: physicochemical characteristics and the influence of shading*. Journal of the American Water Resources Association 39(2): 355-367.

Edwards, R.W., J.W. Densem, and P.A. Russell. 1979. *An assessment of the importance of temperature as a factor controlling the growth rate of brown trout in streams*. Journal of Animal Ecology 48: 501-507.

Elliott, J. M., and M. A. Hurley. 1997. *A functional model for maximum growth of Atlantic salmon parr, Salmo salar, from two populations in northwest England*. Functional Ecology 11:592-603.

Elson, P.F. 1942. *Effect of temperature on activity of Salvelinus fontinalis*. J. Fish. Res. Bd. Can. 5: 461-470.

Garside, E.T. 1973. *Ultimate upper lethal temperature of Atlantic salmon (Salmo salar L.)*, Canadian Journal of Zoology 51: 898-900.

Huntsman, A.G. 1946. *Heat stroke in Canadian maritime stream fishes*. Journal of the Fisheries Research Board of Canada 6(7): 476-482.

Kaya, C.M., L.R. Kaeding and D. E. Burkhalter. 1977. *Use of a cold-water refuge by rainbow and brown trout in a geothermally heated stream*. Progressive Fish Culturist 39(1): 37-39.

Keleher, C.J. and F.J. Rahel. 1996. *Thermal limits to salmonid distribution in the Rocky Mountain Region and potential habitat loss due to global warming: A geographic information system (GIS) approach*. Transactions of the American Fisheries Society 125(1): 1-13.

Lee, R.M., and J.N. Rinne. 1980. *Critical Thermal Maximum of Five Trout Species in the Southwestern United States*. Transaction of the American Fisheries Society 109 (6): 632-635.

Lund, S.G., D. Caissie, R.A. Cunjak, M.M. Vijayan and B.L. Tufts. 2002. *The effects of environmental heat stress on heat-shock mRNA and protein expression in Miramichi Atlantic salmon (Salmo salar) parr*. Canadian Journal of Fisheries and Aquatic Sciences 59: 1553-1562.

Mackey, A.P., and A.D. Berrie. 1991. *The prediction of water temperatures in chalk streams from air temperatures*. Hydrobiologia 210: 183-189.

Matthews, K.R., N.H. Berg, D.L. Azuma and T.R. Lambert. 1994. *Cool water formation and trout habitat use in a deep pool in the Sierra Nevada, California*. Transactions of the American Fisheries Society 123: 549-564.

Matthews, K.R. and N.H. Berg. 1997. *Rainbow trout responses to water temperature and dissolved oxygen stress in two southern California stream pools*. Journal of Fish Biology 50: 50-67.

Minns, C.K., R.G. Randall, E.M.P. Chadwick, J.E. Moore, and R. Green. 1995. *Potential impact of climate change on the habitat and production dynamics of juvenile Atlantic salmon (Salmo salar) in eastern Canada*. In: R.J. Beamish [ed.], Climate change and northern fish population, Can. Spec. Publ. Fish. Aquat. Sci. 121: 699-708.

Mitchell, S. 1999. *A simple model for estimating mean monthly stream temperatures after riparian canopy removal*. Environmental Management 24 (1): 77-83.

Mohseni, O., and H.G. Stefan. 1999. *Stream temperature/air temperature relationship: a physical interpretation*. Journal of Hydrology 218: 128-141.

Pilgrim, J.M., X. Fang and H.G. Stefan. 1998. *Stream temperature correlations with air temperature in Minnesota: implications for climatic warming*. Journal of the American Water Resources Association 34 (5): 1109-1121.

Parks Canada. 1999. *Climate change scenario, summer and winter temperatures, 2090*. Air Issues Bulletin no. 100, Air Quality, Climate Change and Canada’s National Parks. Ottawa: Natural Resources Branch, Parks Canada.

Schindler, D.W. 2001. *The cumulative effects of climate warming and other human stresses on Canadian freshwaters in the new millennium*. Canadian Journal of Fisheries and Aquatic Sciences 58: 18-29.

Smith, K. 1981. *The prediction of river water temperatures*, Hydrological Sciences Bulletin 26(1): 19-32.

Swansburg, E., G. Chaput, D. Moore, D. Caissie and N. El-Jabi. 2002. *Size variability of juvenile Atlantic salmon: links to environmental conditions*. Journal of Fish Biology 61: 661-683.

Torgersen, C.E., D.M. Price, H.W. Li and B.A McIntosh. 1999. *Multiscale thermal refugia and stream habitat associations of Chinook salmon in Northeastern Oregon*. Ecological Applications 9 (1): 301-319.

Wilkie, M.P., K. Davidson, M.A. Brobbel, J.D. Kieffer, R.K. Booth, A.T. Bielak and B.L. Tufts. 1996. *Physiology and survival of wild Atlantic salmon following angling in warm summer waters*. Transactions of the American Fisheries Society 125: 572-580.

Table 1. Organizations and volunteers involved in the Nova Scotia water temperature monitoring project, 2000-2002.

Contact	Organization	System	County
Chuck Thompson	Cape Breton Sportfishing Advisory Council	Middle	Victoria
Jack MacKillop & Billy Stevens	Cape Breton Sportfishing Advisory Council	Baddeck	Victoria
Leonard Forsyth	Margaree Salmon Association	Margaree	Inverness
Mary MacNeil	Lake Ainslie and Margaree River Heritage Association	Lake Ainslie	Inverness
John King	Stewards of River Denys Watershed Association	River Denys	Inverness
Charles MacInnis	Department of Fisheries and Oceans	James	Antigonish
Bob MacDonald	Mulgrave and Area Lakes Enhancement Project	St Francis Harbour	Guysborough
Bill Carpin	St. Mary's River Association	St Marys	Guysborough
Bill Cardiff	Pictou County Rivers Association	East & West Pictou	Pictou
Walter Regan	Sackville River Association	Sackville	Halifax
Brooke Cook	Bluenose Atlantic Coastal Action Project	Mushamush	Lunenburg
Carol Randall	LaHave Salmon Association	LaHave	Lunenburg
Garth Trider	Volunteer	Upper LaHave	Lunenburg
Doug Bell	Petite Riviere Association	Petite Riviere	Lunenburg
Dave Dagley	NS Federation of Anglers and Hunters/ Queens Co Fish and Game	Medway	Queens
Paul Smith	NS Federation Anglers and Hunters Shelburne County Fish and Game	Rosewary	Shelburne
Richard Swaine	NS Federation Anglers and Hunters Shelburne County Fish and Game	Clyde	Shelburne
Charles Trask	Tusket River Environmental Protection Association	Tusket	Yarmouth
Roland Smith	Annapolis Fly Fishers	Nictaux	Annapolis
Roland LeBlanc	Salmon River Salmon Association	Salmon & Meteghan	Digby
Stephan Hawbolt	Clean Annapolis River Project	Annapolis	Annapolis
Doug Warner	Volunteer	Canard & Habitant	Kings
Mike Brylinsky	Estuarine Center Acadia University	Habitant	Kings
Peter Bagnall & Derrick Fritz	Friends of Cornwallis River	Cornwallis	Kings
Mack Miles	Black River Environmental Committee	Black	Kings
Darrel Brown	Wildlife Habitat Advocates	Avon & Kennetcook	Hants
Chris van Sylk	Nine Mile River Association	Nine Mile	Halifax
Ivan Polly	Cobequid Salmon Association	Salmon	Colchester
Danny Ripley	Cumberland County River Enhancement Committee	Philip	Cumberland
Ron Allen	Wallace River Trout Management Committee	Wallace	Cumberland

Table 2. Difference in actual and estimated mean water temperature from 19 comparison sites (East and West Rivers of Pictou, and Canard, Pereaux, and Habitant Rivers, Nova Scotia, 2000-2002).

		Calibration year									Validation year						
River	Site	Year	Date	N	Equation	r^2	Actual mean °C	Estimated mean °C	Difference mean °C	RMSE hourly °C	Year	Date	N	Actual mean °C	Estimated mean °C	Difference mean °C	RMSE hourly °C
East	Archibald Brook	2001	30 Jun - 6 Jul	335	y = 0.63x + 3.6	0.89	16.7	16.7	0.00	0.6	2000	14 Jul - 21 Jul	326	17.5	17.3	0.2	0.7
East	Glencoe Brook	2001	25 Aug - 31 Aug	335	y = 0.32x + 7.9	0.48	14.5	14.5	0.00	1.3	2000	1 Aug - 7 Aug	335	16.2	15.1	1.2	1.4
East	MacDonald's Brook	2001	20 Jul - 26 Jul	335	y = 0.79x + 0.9	0.90	18.9	18.9	0.00	1.0	2000	1 Aug - 7 Aug	335	18.0	18.5	0.5	1.0
East	Millstream Brook	2001	16 Jun - 22 Jun	335	y = 0.21x + 14.4	0.44	18.7	18.7	0.00	1.0	2000	21 Jul - 28 Jul	335	20.0	19.0	1.0	1.1
East	Thompson Brook	2001	30 Jun - 6 Jul	335	y = 0.41x + 7.7	0.69	16.2	16.2	0.00	0.8	2000	23 Jun - 30 Jun	328	16.9	17.1	0.2	0.7
West	Eight Mile Brook	2001	25 Aug - 31 Aug	335	y = 0.34x + 8.0	0.84	14.9	14.9	0.00	0.4	2000	15 Jul - 22 Jul	335	15.9	15.2	0.7	0.9
West	Four Mile Brook	2001	10 Aug - 16 Aug	335	y = 0.56x + 4.2	0.78	16.7	16.7	0.00	0.7	2000	7 Jul - 14 Jul	322	13.5	13.9	0.4	0.8
West	Graham's Brook	2001	7 Jul - 13 Jul	335	y = 0.42x + 6.8	0.73	14.7	14.7	0.00	0.5	2000	1 Aug - 7 Aug	335	15.7	15.8	0.0	0.7
West	Six Mile Brook	2001	20 Jul - 26 Jul	335	y = 0.87x - 1.1	0.83	18.0	18.0	0.00	0.9	2000	21 Aug - 27 Aug	335	15.0	15.9	0.9	1.7
West	Sweets Brook	2001	10 Aug - 16 Aug	335	y = 0.61x + 3.9	0.69	16.2	16.2	0.00	0.8	2000	30 Jul - 7 Jul	324	16.4	16.0	0.4	0.9
East	Archibald Brook	2000	14 Jul - 21 Jul	326	y = 0.66x + 3.3	0.90	17.5	17.5	0.00	0.6	2001	30 Jun - 15 Jul	737	16.5	16.6	0.1	0.6
East	Glencoe Brook	2000	1 Aug - 7 Aug	335	y = 0.36x + 8.3	0.65	16.2	16.2	0.00	0.8	2001	4 Aug - 6 Sep	1583	16.1	16.2	0.1	1.3
East	MacDonald's Brook	2000	1 Aug - 7 Aug	335	y = 0.67x + 3.1	0.87	18.0	18.0	0.00	0.8	2001	17 Jul - 2 Aug	815	17.3	17.3	0.1	1.1
East	Millstream Brook	2000	21 Jul - 28 Jul	335	y = 0.26x + 14.4	0.80	20.0	20.0	0.00	0.5	2001	16 Jun - 28 Jun	623	19.1	19.7	0.6	1.1
East	Thompson Brook	2000	23 Jun - 30 Jun	328	y = 0.46x + 6.1	0.90	16.9	16.9	0.00	0.6	2001	15 Jun - 6 Sep	3983	16.4	16.0	0.4	1.2
West	Eight Mile Brook	2000	15 Jul - 22 Jul	335	y = 0.50x + 5.5	0.82	15.9	15.9	0.00	0.5	2001	25 Aug - 5 Sep	574	14.8	15.2	0.5	0.7
West	Four Mile Brook	2000	7 Jul - 14 Jul	322	y = 0.45x + 5.6	0.73	13.5	13.5	0.00	0.7	2001	4 Aug - 23 Aug	959	16.7	15.8	0.9	1.1
West	Graham's Brook	2000	1 Aug - 7 Aug	335	y = 0.45x + 6.1	0.69	15.7	15.7	0.00	0.7	2001	1 Jul - 16 Jul	629	14.6	14.7	0.1	0.7
West	Six Mile Brook	2000	21 Aug - 27 Aug	335	y = 0.29x + 9.4	0.70	15.0	15.0	0.00	0.4	2001	15 Jun - 3 Aug	2353	16.1	15.1	0.9	1.6
West	Sweets Brook	2000	30 Jun - 7 Jul	324	y = 0.61x + 4.2	0.81	16.4	16.4	0.00	0.9	2001	4 Aug - 23 Aug	688	16.0	16.5	0.5	1.1
Pereaux	Sanford Brook	2002	27 Aug - 4 Sept	368	y = 0.94x - 1.3	0.82	13.2	13.2	0.00	0.7	2001	29 Aug - 3 Sept	168	14.4	14.2	0.2	1.0
Pereaux	Main Branch @ Highway 358	2002	20 Aug - 27 Aug	335	y = 0.58x + 1.4	0.65	11.2	11.3	0.10	1.5	2001	22 Aug - 27 Aug	240	11.2	11.4	0.2	0.5
Canard	Grand Dyke Tributary	2002	5 Aug - 12 Aug	320	y = 1.11x - 2.5	0.61	16.7	16.7	0.00	1.3	2001	31 Jul - 5 Aug	250	17.5	17.6	0.1	0.9
Canard	Jackson Brook	2002	30 Jul - 5 Aug	306	y = 0.57x + 7.7	0.73	18.4	18.3	0.08	0.6	2001	6 Aug - 13 Aug	336	17.7	18.7	1.1	1.3
Canard	Reid Road Tributary	2002	21 Jul - 29 Jul	384	y = 1.03x - 0.1	0.70	18.0	18.0	0.00	1.3	2001	23 Jul - 30 Jul	378	19.0	18.7	0.4	1.7
Canard	Main Branch @ Highway 358	2002	13 Jul - 21 Jul	384	y = 0.56x + 9.6	0.63	19.6	19.6	0.00	0.8	2001	16 Jul - 22 Jul	288	20.5	19.3	1.2	1.5
Canard	Middle Dyke Tributary	2002	5 Jul - 13 Jul	365	y = 0.87x + 3.5	0.81	18.9	19.0	0.00	0.8	2001	9 Jul - 15 Jul	288	18.4	17.9	0.5	0.8
Canard	Upper Dyke Tributary	2002	27 Jun - 5 Jul	356	y = 0.50x + 11.1	0.43	20.6	20.6	0.02	1.3	2001	28 Jun - 8 Jul	484	19.9	20.2	0.2	1.4
Habitant	Sleepy Hollow Brook	2002	19 Jun - 26 Jun	318	y = 1.10x - 4.8	0.93	13.5	13.5	0.00	0.7	2001	21 Jun - 28 Jun	326	16.0	15.8	0.1	1.0
Pereaux	Sanford Brook	2001	29 Aug - 3 Sept	168	y = 1.21x -5.6	0.84	14.4	14.2	0.18	0.9	2002	27 Aug - 4 Sept	368	13.2	12.9	0.2	0.9
Pereaux	Main Branch @ Highway 358	2001	22 Aug - 27 Aug	240	y = 0.64x +0.2	0.91	11.2	11.2	0.01	0.4	2002	20 Aug - 27 Aug	335	11.2	11.0	0.2	1.5
Canard	Grand Dyke Tributary	2001	31 Jul - 5 Aug	250	y = 1.22x -4.6	0.87	17.5	17.4	0.09	0.9	2002	5 Aug - 12 Aug	320	16.7	16.4	0.3	1.3
Canard	Jackson Brook	2001	6 Aug - 13 Aug	336	y = 0.33x +11.3	0.48	17.7	17.6	0.04	0.6	2002	30 Jul - 5 Aug	306	18.4	17.4	1.0	1.2
Canard	Reid Road Tributary	2001	22 Jul - 30 Jul	378	y = 1.05x - 0.1	0.66	19.0	19.1	0.03	1.7	2002	21 Jul - 29 Jul	384	18.0	18.4	0.4	1.4
Canard	Main Branch @ Highway 358	2001	16 Jul - 22 Jul	288	y = 0.70x +8.5	0.63	20.5	20.5	0.04	0.8	2002	13 Jul - 21 Jul	384	19.6	20.9	1.3	1.6
Canard	Middle Dyke Tributary	2001	9 Jul - 15 Jul	288	y = 1.05x + 1.0	0.89	18.4	18.5	0.06	0.5	2002	5 Jul - 13 Jul	365	18.9	19.8	0.8	1.2
Canard	Upper Dyke Tributary	2001	28 Jun - 8 Jul	484	y = 0.74x +6.8	0.55	19.9	20.2	0.25	1.4	2002	27 Jun - 5 Jul	356	20.6	20.8	0.2	1.4
Habitant	Sleepy Hollow Brook	2001	21 Jun - 28 Jun	326	y = 1.18x - 6.1	0.82	16.0	16.0	0.01	1.0	2002	19 Jun - 26 Jun	318	13.5	13.5	0.0	0.7
Mean						**0.74**	**16.7**	**16.7**	**0.02**	**0.84**				**16.7**	**16.6**	**0.48**	**1.10**

N = number
RMSE = root mean square error

Table 3. Water temperature characteristics for 312 sites across Nova Scotia from 15 June to 5 Sepember, 2000-2002.

Logger site (stationary site in bold)	Year	Topo map	Latitude Longitude	Dates for regression	Records N	Mobile regression equation	r^2	Summer 15 Jun - 5 Sep average	Warmest daily average	Number days > 20°C daily mean	Site number	Rank
Annapolis River	2001	21A/14	4458 6501	15 Jun - 5 Sep	3984			20.9	25.0	51	257	warm
Sherman Brook	2001	21H/02	4501 6453	17 Jul - 24 Jul	329	y = 0.67x - 0.8	0.74	13.1	15.9	0	21	cool
McGee Brook	2001	21H/02	4501 6451	10 Jul - 17 Jul	325	y = 0.32x + 7.6	0.31	14.2	15.5	0	44	cool
Eel Weir Brook	2000	21A/14	4453 6510	26 Jul - 2 Aug	328	y = 0.94x - 3.5	0.66	14.6	19.3	0	50	cool
Patterson Brook	2001	21H/02	4502 6449	25 Jul - 2 Aug	378	y = 0.86x - 2.1	0.96	15.8	19.3	0	82	cool
Hollow (Fraser) Brook	2000	21A/14	4447 6527	30 Aug - 6 Sep	330	y = 0.96x - 2.0	0.87	16.5	21.2	2	97	inter
East Branch Brook	2000	21A/14	4451 6501	8 Sep - 15 Sep	365	y = 0.97x - 1.9	0.64	16.7	21.5	2	104	inter
Leonard Brook	2000	21A/14	4451 6512	2 Aug - 9 Aug	326	y = 1.10x - 4.6	0.72	16.7	22.2	0	106	inter
Millers Brook	2000	21A/14	4452 6508	25 Aug - 1 Sep	334	y = 1.17x - 5.7	0.54	17.0	22.8	6	122	inter
Wiswall Brook	2000	21A/15	4458 6500	4 Jul - 11 Jul	322	y = 0.81x + 2.01	0.88	17.5	21.5	2	145	inter
Morton Brook	2000	21A/14	4457 6502	27 Jul - 3 Aug	337	y = 1.48x - 10.8	0.71	17.7	25.0	7	152	inter
Skinner Brook	2001	21H/02	4501 6448	25 Jun - 3 Jul	374	y = 1.44x - 12.1	0.82	17.9	23.8	19	166	inter
Black River	2000	21A/15	4454 6458	26 Jun - 3 Jul	337	y = 1.52x - 11	0.80	18.3	25.9	12	175	inter
Paradise Brook	2000	21A/14	4452 6512	9 Aug - 16 Aug	326	y = 1.21x - 4.97	0.90	18.4	24.5	12	180	inter
Evans Brook	2000	21A/14	4457 6502	25 Jun - 3 Jul	336	y = 1.32x - 6.9	0.94	18.4	25.0	12	181	inter
Graves Brook	2001	21H/02	4501 6450	3 Jul - 10 Jul	325	y = 1.35x - 9.5	0.81	18.8	24.3	26	189	inter
South Annapolis	2000	21A/15	4458 6448	11 Jul - 18 Jul	333	y = 0.47x + 10.2	0.12	19.1	21.5	5	196	warm
McEwan Brook	2000	21A/14	4455 6508	19 Aug - 26 Aug	325	y = 1.25x - 4.8	0.97	19.3	25.5	27	202	warm
Bloody Creek Brook	2000	21A14	4449 6518	24 Aug - 30 Aug	264	y = 1.63x - 11.9	0.64	19.6	27.7	30	210	warm
Bath Brook	2001	21A/14	4450 6520	20 Aug - 30 Aug	457	y = 0.66x + 4.7	0.53	19.8	24.7	36	218	warm
Dalanceys Brook	2000	21A/14	4454 6505	12 Aug - 19 Aug	328	y = 1.55x - 10.1	0.84	19.8	27.6	34	219	warm
Round Hill River	2000	21A/14	4446 6524	16 Aug - 24 Aug	388	y = 1.52x - 9.31	0.70	19.9	27.5	34	223	warm
Slokum Brook	2000	21A/14	4455 6505	6 Aug - 12 Aug	297	y = 0.85x + 3.7	0.69	20.1	24.3	41	229	warm
Fash Brook	2001	21A/14	4450 6518	2 Aug - 13 Aug	513	y = 1.49x - 10.9	0.77	20.3	26.5	39	234	warm
Annis River Gardners Mills	2000	21A/04	4402 6558	15 Jun - 6 Sep	3984			22.2	24.3	79	293	warm
Pleasant Valley	2000	20P/13	4459 6558	20 Jul - 27 Jul	294	y = 0.97x - 0.5	0.81	21.0	23.1	69	261	warm
Big Brazil Lake Outflow	2000	21B/01	4401 6600	6 Jul - 13 Jul	334	y = 0.58x + 8.5	0.67	21.4	22.6	79	270	warm
Moods Mill Road 1	2000	20P/13	4358 6600	4 Aug - 11 Aug	326	y = 1.28x - 6.8	0.72	21.6	24.4	73	280	warm
Saunders Road	2000	20P/13	4356 6600	27 Jul - 4 Aug	374	y = 1.18x - 4.1	0.70	22.1	24.7	77	291	warm
Norwood Fire Station	2000	21A/04	4404 6601	14 Jul - 20 Jul	294	y = 0.89x + 2.4	0.71	22.1	24.0	79	292	warm
Avon River Salt Meadow	2000	21A/16	4457 6416	15 Jun - 6 Sep	3984			20.6	24.8	56	245	warm
Mill Brook	2000	21A/16	4449 6416	17 Jul - 24 Jul	320	y = 0.76x + 2.1	0.11	17.7	20.9	2	155	inter
North Branch Avon	2000	21A/16	4455 6418	26 Jun - 3 Jul	324	y = 0.93x + 0.8	0.78	19.9	23.7	43	222	warm
Allen Brook	2000	21A/16	4458 6410	19 Jun - 26 Jun	336	y = 0.79x + 3.6	0.95	19.9	23.2	43	224	warm
South Branch Avon	2000	21A/16	4452 6413	10 Jul - 7 Jul	338	y = 0.29x + 14.7	0.09	20.6	21.8	78	244	warm
LeBreau Creek	2000	21A/16	4458 6409	3 Jul - 10 Jul	339	y = 1.13x - 1.7	0.42	21.6	26.3	58	278	warm

Table 3. Water temperature characteristics for 312 sites across Nova Scotia from 15 June to 5 Sepember, 2000-2002 (continue).

Logger site (stationary site in bold)	Year	Topo map	Latitude Longitude	Dates for regression	Records N	Mobile regression equation	r^2	Summer 15 Jun - 5 Sep average	Warmest daily average	Number days > 20°C daily mean	Site number	Rank
Baddeck River	2000	11K/02	4611 6646	20 Jun - 6 Sep	3744			18.1	21.1	13	172	inter
MacRae Brook	2001	11K/02	4610 6047	11 Aug - 17 Aug	284	y = 0.39x + 3.8	0.96	10.5	12.3	0	3	cool
Farguhars Brook	2001	11K/02	4607 6048	21 Jul - 28 Jul	339	y = 0.92x - 4.6	0.93	11.9	15.6	0	8	cool
Usige Bahn Park	2002	11K/02	4612 6046	14 Jun - 21 Jun	330	y = 0.60x + 2.7	0.85	13.1	16.5	0	20	cool
Mill Brook	2002	11K/02	4612 6044	29 Jun - 6 Jul	375	y = 0.63x + 2.6	0.84	13.4	16.9	0	27	cool
New Glen Brook	2002	11K/02	4612 6046	21 Jun - 29 Jun	378	y = 0.73x + 0.9	0.87	13.5	17.6	0	36	cool
Adelaide Brook	2001	11K/02	4607 6048	28 Jul - 4 Aug	318	y = 0.66x + 2.8	0.94	14.1	17.3	0	43	cool
Harris Brook	2001	11K/02	4606 6050	8 Jul - 14 Jul	324	y = 0.49x + 5.8	0.66	14.6	16.5	0	49	cool
Allans Brook	2001	11K/02	4606 6049	14 Jul - 21 Jul	326	y = 0.41x + 9.5	0.7	16.5	18.4	0	96	inter
Manse Bridge	2001	11K/02	4610 6046	18 Aug - 22 Aug	186	y=1.02x-0.9	0.94	17.6	21.7	8	147	inter
Forks Baddeck	2002	11K/02	4610 6046	6 Jul - 17 Jul	526	y = 1.54x - 8.1	0.86	18.5	27.1	23	182	inter
Morgans Brook	2001	11K/02	4608 6046	4 Aug - 11 Aug	321	y = 0.70x + 7.5	0.78	19.6	23.0	46	214	warm
Black River	2000	21H/01	4501 6423	22 Jun - 6 Sep	3648			16.6	19.1	0	102	inter
Clyde River	2001	20P/11	4339 6529	15 Jun - 5 Sep	3984			21.6	24.5	77	274	warm
Roseway R Turtle Creek	2002	20P/14	4357 6522	21 Jul - 28 Jul	326	y = 0.86x - 1.0	0.35	16.8	21.7	12	115	inter
Roseway R Marks Brook	2002	20P/14	4351 6521	24 Jun - 1 Jul	324	y = 0.51x + 6.4	0.71	17.0	19.9	0	124	inter
Sabeans Lake Brook	2001	21A/04	4404 6532	16 Jul - 22 Jul	278	y = 0.82x + 0.1	0.76	17.7	20.1	1	154	inter
Upper Clyde Brook	2001	21A/04	4404 6532	9 Jul - 16 Jul	323	y = 0.37x + 9.7	0.22	17.7	18.9	0	158	inter
Dirty Creek	2001	20P/11	4342 6528	15 Jun - 21 Jun	309	y = 0.90x - 0.3	0.25	19.2	21.8	16	198	warm
Roseway R Quinland Creek	2002	20P/14	4403 6527	14 Jul - 21 Jul	323	y = 0.95x - 0.5	0.51	19.3	24.6	37	201	warm
Roseway R Scotland Creek	2002	20P/14	4403 6526	7 Jul - 14 Jul	329	y = 1.37x - 8.9	0.72	19.4	27.2	40	205	warm
East Barclay Brook	2001	21A/04	4401 6532	1 Jul - 7 Jul	281	y = 1.0x - 2.3	0.77	19.5	22.5	24	209	warm
Roseway R Beaver Creek	2002	20P/14	4403 6527	1 Jul - 7 Jul	278	y = 1.33x - 7.3	0.64	20.2	27.7	47	232	warm
Lyles Hill Brook	2001	20P/12	4342 6532	13 Aug - 20 Aug	319	y = 1.55x - 13	0.66	20.4	25.0	49	240	warm
Bloody Creek	2001	20P/12	4343 6532	20 Aug - 26 Aug	291	y = 0.59x + 7.9	0.74	20.7	22.4	74	246	warm
Barclay Brook	2001	21A/04	4401 6533	23 Jun - 30 Jun	310	y = 1.1x - 2.8	0.70	20.8	24.0	62	249	warm
Hemlock Creek	2001	20P/14	4354 6528	29 Jun - 6 Jul	366	y = 0.58x + 8.3	0.84	20.8	22.5	75	250	warm
Barrington River	2001	20P/12	4338 6534	27 Aug - 3 Sep	323	y = 0.51x + 10.4	0.71	21.3	22.8	83	264	warm
Roseway R Mahaney Creek	2002	20P/14	4355 6521	28 Jul - 5 Aug	371	y = 1.43x - 8.2	0.71	21.3	29.4	52	267	warm
Roseway River	2001	20P/14	4348 6521	5 Aug - 12 Aug	336	y = 1.14x - 2.1	0.78	21.6	24.5	56	275	warm
Beaver Creek	2001	21A/04	4405 6531	22 Jul - 29 Jul	327	y = 1.48x - 8.9	0.92	22.9	27.3	78	307	warm
Cornwallis River	2001	21H/02	4505 6439	15 Jun - 5 Sep	3984			17.2	20.4	1	136	inter
Sharpe Brook	2001	21H/02	4503 6438	7 Jul - 12 Jul	214	y = 0.56x + 3.6	0.72	13.2	15.0	0	24	cool
Spidle Brook	2001	21H/02	4503 6435	3 Aug - 10 Aug	327	y = 0.76x + 0.33	0.90	13.5	15.9	0	32	cool
Fisher Brook	2001	21H/02	4504 6444	10 Aug - 18 Aug	373	y = 0.9x - 1.9	0.97	13.5	16.4	0	35	cool
Rochford Brook	2001	21H/02	4503 6440	18 Aug - 27 Aug	411	y = 0.95x - 2.5	0.93	13.8	16.8	0	39	cool
Lawrence Brook	2001	21H/02	4505 6436	21 Jun - 29 Jun	364	y = 0.91x + 0.9	0.95	16.7	19.6	0	107	inter
Coleman Brook 2	2001	21H/02	4504 6434	27 Jul - 3 Aug	326	y = 1.10x - 1.9	0.52	17.0	20.5	1	125	inter
Coleman Brook	2001	21H/02	4505 6438	15 Jun - 21 Jun	313	y = 1.02x - 0.4	0.98	17.1	20.4	1	129	inter
Cornwallis River	2001	21H/02	4503 6435	13 Jul - 20 Jul	316	y = 1.08x - 1.3	0.94	17.2	20.6	1	132	inter
Tupper Brook	2001	21H/02	4503 6434	20 Jul - 27 Jul	328	y = 1.41x - 6.94	0.98	17.2	21.7	5	140	inter
Brandywine Brook	2001	21H/02	4505 6435	29 Jun - 7 Jul	381	' = 1.0281x - 0.17	0.96	17.5	20.8	3	144	inter
Cornwallis River 2	2001	21H/02	4503 6444	27 Aug - 31 Aug	176	y = 0.94x + 1.6	0.80	17.8	20.9	4	165	inter

Table 3. Water temperature characteristics for 312 sites across Nova Scotia from 15 June to 5 Sepember, 2000-2002 (continue).

Logger site (stationary site in bold)	Year	Topo map	Latitude Longitude	Dates for regression	Records N	Mobile regression equation	r^2	Summer 15 Jun - 5 Sep average	Warmest daily average	Number days > 20°C daily mean	Site number	Rank
Habitant River	2001	21H/01	4508 6428	15 Jun - 5 Sep	3984			17.8	21.1	5	160	inter
Main Branch Upper Habitant	2002	21H/01	4509 6430	15 Jun - 22 Jun	343	y = 0.69x+0.8	0.85	13.0	15.6	0	19	cool
Sleepy Hollow Brook	2001	21H/01	4508 6428	21 Jun - 28 Jun	323	y = 1.18x - 6.07	0.82	14.8	18.7	0	52	cool
North Brook	2001	21H/01	4508 6428	15 Jun - 21 Jun	319	y = 0.52x + 8.6	0.51	17.7	19.5	0	156	inter
Canard River	2001	21H/01	4506 6426	15 Jul - 22 Jul	330	y = 0.70x + 8.5	0.63	21.0	23.4	71	260	warm
Canard R Reid Road Tributary	2001	21H/01	4508 6428	22 Jul - 30 Jul	367	y = 1.05x - 0.1	0.66	18.6	22.1	16	184	inter
Canard R Grand Dyke	2001	21H/01	4506 6427	30 Jul - 6 Aug	334	y = 1.22x - 4.6	0.87	17.0	21.1	3	128	inter
Canard R Jackson Brook	2001	21H/02	4506 6431	6 Aug -14 Aug	380	y = 0.33x + 11.3	0.48	17.1	18.2	0	130	inter
Canard R Middle Dyke	2001	21H/01	4506 6428	8 Jul - 15 Jul	327	y = 1.05x + 1.0	0.89	19.6	23.1	34	213	warm
Canard R Upper Dyke	2001	21H/01	4506 6428	28 Jun - 8 Jul	460	y = 0.74x + 6.8	0.55	19.9	22.3	35	221	warm
Pereaux River	2001	21H/01	4511 6424	21 Aug - 28 Aug	308	y = 0.64x + 0.18	0.91	11.6	13.8	0	7	cool
Pereaux R Highway 358 Tributary	2001	21H/01	4507 6426	14 Aug - 21 Aug	345	y = 0.82x - 1.0	0.22	13.6	16.3	0	37	cool
Pereaux R Sanford Brook	2001	21H/01	4511 6424	28 Aug - 4 Sep	331	y = 1.21x - 5.6	0.84	15.9	19.9	0	84	cool
Pereaux R Doyle Brook	2001	21H/01	4511 6424	4 Sep - 12 Sep	360	y = 0.91x + 0.9	0.96	17.0	20.0	1	123	inter
James River Reservoir	2000	11E/09	4536 6208	30 Jun - 6 Sep	3264			15.4	17.6	0	69	cool
Kennetcook River	2001	11E/04	4505 6352	15 Jun - 5 Sep	3984			22.5	26.9	75	302	warm
Nolan's Brook	2001	11E/04	4512 6337	6 Aug - 12 Aug	260	y = 0.74x + 0.6	0.83	17.2	20.4	2	135	inter
Hanna Brook	2001	11E/04	4511 6339	28 Jul - 6 Aug	434	y = 0.94x - 3.65	0.85	17.5	21.6	8	143	inter
Birch Brook	2001	11E/04	4506 6349	23 Jun - 1 Jul	367	y = 0.50x + 6.45	0.58	17.8	20.0	0	161	inter
Rines Brook	2001	11E/04	4508 6345	8 Jul - 15 Jul	336	y = 0.89x + 0.12	0.96	20.2	24.1	46	233	warm
Upper Kennetcook/Turples Bk	2001	11E/04	4513 6337	15 Jun - 5 Sep	3984			16.6	20.4	1	101	inter
O'Toole Brook	2001	11E/04	4510 6342	12 Aug - 19 Aug	325	y = 0.65x + 4.8	0.71	15.6	18.1	0	74	cool
Bartlett's Brook	2001	11E/04	4507 6347	1 Jul - 8 Jul	323	y = 0.75x + 5.1	0.70	17.6	20.5	1	148	inter
Burns Brook	2001	11E/04	4511 6341	15 Jul - 21 Jun	276	y = 0.76x + 6.1	0.76	18.7	21.7	10	188	inter
Tomcod River	2001	11E/04	4505 6355	16 Jun - 23 Jun	338	y = 1.11x + 0.7	0.92	19.1	23.3	21	195	warm
Clark's Brook	2001	11E/04	4512 6339	21 Jul - 28 Jul	314	y = 1.01x + 2.5	0.93	19.2	23.0	21	197	warm
LaHave River (Cooks Brook)	2002	21A/07	4425 6433	15 Jun - 6 Sep	3984			17.8	22.7	11	163	inter
Ash Brook	2002	21A/07	4427 6447	25 Jul - 29 Jul	178	y=1.41x-7.9	0.70	16.7	22.6	8	111	inter
Varner Brook	2002	21A/10	4433 6445	18 Aug - 22 Aug	185	y=0.49x+7.1	0.83	17.6	20.4	6	150	inter
West Branch LaHave	2000	21A/08	4419 6426	11 Sep - 15 Sep	206	y = 1.13x - 0.4	0.81	19.4	23.7	21	204	warm
Fish Weir Brook	2000	21A/07	4427 6447	21 Aug - 28 Aug	383	y = 0.83x + 5.1	0.77	19.7	22.9	27	215	warm
Smith Brook	2000	21A/07	4429 6446	31 Jul - 6 Aug	336	y = 1.32x - 2.8	0.78	20.4	25.6	55	241	warm
Demone's Run	2000	21A/07	4428 6445	3 Jul - 10 Jul	383	y = 1.21x + 1.8	0.76	23.0	27.7	82	308	warm
Rhyno Lake Outflow	2000	21A/07	4425 6444	25 Jun - 2 Jul	350	y = 0.18x + 20.6	0.42	24.2	28.8	82	312	warm

Table 3. Water temperature characteristics for 312 sites across Nova Scotia from 15 June to 5 Sepember, 2000-2002 (continue).

Logger site (stationary site in bold)	Year	Topo map	Latitude Longitude	Dates for regression	Records N	Mobile regression equation	r^2	Summer 15 Jun - 5 Sep average	Warmest daily average	Number days > 20°C daily mean	Site number	Rank
Lake Ainslie	2001	11K/03	4606 6107	15 Jun - 5 Sep	3984			21.3	24.5	66	263	warm
Lake Ainslie (Trout Brook)	2001	11K/03	4605 6107	15 Jun - 5 Sep	3984			14.9	18.6	0	53	cool
Johnson Brook	2001	11K/03	4606 6108	31 Aug - 5 Sep	248	y = 0.64x + 3.16	0.91	12.7	15.2	0	14	cool
Dunbar Brook	2001	11K/03	4610 6111	17 Aug - 24 Aug	317	y = 0.42x + 6.6	0.79	12.8	14.4	0	17	cool
McKay Brook	2001	11K/03	4602 6106	15 Jun - 22 Jun	331	y = 1.05x - 1.9	0.94	13.8	17.7	0	38	cool
MacSweens Brook	2001	11K/03	4602 6106	22 Jun - 29 Jun	327	y = 0.87x + 1.04	0.96	14.0	17.3	0	41	cool
MacMillan Brook	2001	11K/03	4602 6107	29 Jun - 6 Jul	349	y = 0.68x + 5	0.75	15.0	17.6	0	60	cool
Ronalds (Glenmore) Brook	2001	11K/03	4608 6108	24 Aug - 31 Aug	333	y = 0.88x + 2.6	0.96	15.7	19.0	0	77	cool
MacEacherns Brook	2001	11K/03	4606 6112	13 Jul - 20 Jul	322	y = 0.98x + 1.4	0.94	15.9	19.6	0	85	cool
Hays River	2001	11K/03	4606 6115	26 Jul - 3 Aug	395	y = 1.52x - 6.6	0.84	16.0	21.7	4	86	cool
Camerons Brook	2001	11K/03	4604 6108	6 Jul - 13 Jul	325	y = 0.95x + 2.7	0.92	16.6	20.1	1	103	inter
Dan MacDonalds Brook	2001	11K/03	4606 6113	20 Jul - 26 Jul	301	y = 1.13x + 0.72	0.91	17.5	21.8	6	146	inter
Jack MacQuarries Brook	2001	11K/03	4611 6115	10 Aug - 17 Aug	330	y = 1.04x + 2.9	0.94	18.4	22.2	11	177	inter
Saddlers Brook	2001	11K/03	4608 6117	3 Aug - 10 Aug	322	y = 0.64x + 9.20	0.44	18.7	21.1	6	187	inter
Magaree - Timmons Brook	2001	11K/06	4619 6104	15 Jun - 5 Sep	1992			17.1	21.1	7	131	inter
Margaree - MacFarlane's Brook	2000	11K/03	4612 6108	15 Jun - 6 Sep	1992			20.3	22.5	50	235	warm
Margaree River Bailey Bridge	2000	11K/06	4613 6108	15 Jun - 6 Sep	1992			17.2	19.6	0	138	inter
Margaree River Doyles Bridge	2000	11K/06	4619 6104	15 Jun - 6 Sep	1992			17.2	19.6	0	137	inter
Ingram Brook	2000	11K/07	4622 6057	14 Jul - 21 Jul	168	y = 0.75x + 0.59	0.81	13.4	15.2	0	28	cool
Nile Brook	2000	11K/07	4621 6058	28 Jun - 5 Jul	168	y = 0.74x + 0.75	0.67	13.5	15.3	0	31	cool
Margaree Forks Brook	2000	11K/06	4620 6105	25 Aug - 1 Sep	168	y = 1.03x - 3.79	0.95	13.9	16.4	0	40	cool
Salt Brook	2000	11K/06	4619 6102	28 Jul - 4 Aug	168	y = 1.0x - 1.38	0.84	15.7	18.2	0	79	cool
Margaree River SW Margaree	2000	11K/03	4612 6108	15 Jun - 6 Sep	1992			14.4	17.1	0	47	cool
Margaree SW Stationary	2000	11K/03	4611 6115	15 Jun - 6 Sep	1992			20.2	22.3	56	231	warm
Margaree-Upper MacKenzie Pool	2001	11K/07	4626 6055	15 Jun - 5 Sep	3984			14.9	18.6	0	56	cool
Stewarts Brook	2001	11K/07	4627 6055	1 Aug - 8 Aug	321	y = 0.44x + 5.4	0.87	12.0	13.6	0	9	cool
MacKenzies Brook	2001	11K/07	4626 6055	18 Jul - 1 Aug	669	y = 0.97x - 2.2	0.97	12.3	15.8	0	10	cool
Timmons Brook	2001	11K/06	4619 6103	26 Jun - 4 Jul	405	y = 0.55x + 4.5	0.76	12.7	14.8	0	15	cool
William Donalds Brook	2001	11K/06	4619 6106	28 Aug - 5 Sep	432	y = 0.76x + 2.0	0.79	13.4	16.2	0	29	cool
Big Brook	2001	11K/06	4618 6102	12 Jul - 17 Jul	231	y = 0.21x + 11.2	0.52	14.3	15.0	0	45	cool
Mill Brook	2001	11K/06	4619 6105	4 Jul - 12 Jul	375	y = 0.98x - 0.04	0.87	14.5	18.1	0	48	cool
Marsh Brook	2001	11K/06	4622 6100	8 Aug - 15 Aug	333	y = 0.71x + 4.6	0.89	15.2	17.8	0	62	cool
Gallant brook	2001	11K/06	4623 6102	15 Aug - 27 Aug	562	y = 1.02x + 0.43	0.89	15.6	19.3	0	75	cool
Lake O'Law	2001	11K/06	4619 6100	15 Jun - 25 Jun	473	y = 1.16x - 1.3	0.93	16.1	20.4	2	88	cool
Medway River Shaddy Side	2000	21A/02	4414 6447	15 Jun - 6 Sep	3984			21.8	24.6	70	284	warm
Medway RiverSunny Side	2000	21A/02	4414 6447	15 Jun - 6 Sep	3984			20.0	24.4	44	228	warm
Meteghan River	2000	21B/01	4413 6607	15 Jun - 6 Sep	3984			18.8	20.8	11	190	inter

Table 3. Water temperature characteristics for 312 sites across Nova Scotia from 15 June to 5 Sepember, 2000-2002 (continue).

Logger site (stationary site in bold)	Year	Topo map	Latitude Longitude	Dates for regression	Records N	Mobile regression equation	r^2	Summer 15 Jun - 5 Sep average	Warmest daily average	Number days > 20°C daily mean	Site number	Rank
Middle River (Indian Brook)	2000	11K/02	4608 6056	15 Jun - 6 Sep	3984			17.9	21.0	6	167	inter
Coldstream (MacDonald Brook)	2000	11K/02	4611 6055	23 Jun - 30 Jun	336	y = 0.46x + 1.9	0.91	10.1	11.5	0	1	cool
Indian Brook (West side Middle River Rd.)	2002	11K/02	4607 6056	13 Aug - 23 Jul	200	y = 0.28x + 6.4	0.88	11.3	12.9	0	5	cool
Indian Brook (McMillan Mtn Rd.)	2002	11K/02	4609 6057	17 Jul - 24 Jul	327	y = 0.32x + 5.8	0.88	11.5	13.3	0	6	cool
Morrison Brook	2000	11K/02	4614 6056	30 Aug - 6 Sep	336	y = 0.35x + 6.6	0.93	12.8	13.9	0	18	cool
MacRae Brook	2000	11K/02	4611 6057	14 Jul - 21 Jul	383	y = 0.50x + 4.4	0.93	13.3	14.8	0	25	cool
Leonard MacLeod Brook	2000	11K/02	4609 6055	11 Sep - 15 Sep	320	y = 0.22x + 9.6	0.77	13.5	14.2	0	33	cool
MacKenzie Brook	2000	11K/02	4609 6058	14 Aug - 21 Aug	335	y = 0.46x + 5.2	0.77	13.5	14.9	0	34	cool
Upper Indian Brook	2000	11K/02	4609 6057	7 Aug - 13 Aug	335	y = 0.53x + 4.9	0.74	14.3	16.0	0	46	cool
Gold Brook	2002	11K/02	4612 6056	24 Jul - 31 Jul	318	y = 0.95x - 1.00	0.86	15.5	20.8	4	70	cool
Mushamush River	2000	21A/08	4428 6423	15 Jun - 6 Sep	3984			20.8	24.8	80	247	warm
Caribou Lake outflow	2000	21A/10	4416 6402	15 Aug - 21 Aug	278	y = 0.57x + 6.44	0.96	18.3	20.6	2	176	inter
Big Mush outflow	2000	21A/07	4430 6432	16 Jun - 21 Jun	234	y = 0.53x + 8.14	0.51	19.1	21.2	13	193	warm
Blockhouse Mill Brook 1	2000	21A/08	4428 6425	9 Aug - 16 Aug	336	y = 0.78x + 2.99	0.91	19.2	22.3	21	199	warm
Naas Brook	2000	21A/08	4426 6428	13 Jul - 19 Jul	284	y = 0.87x + 1.56	0.93	19.6	23.1	34	211	warm
Mush River 103 Hwy	2000	21A/08	4429 6424	19 Jul - 26 Jul	336	y = 1.0x + 0.07	0.99	20.8	24.8	62	248	warm
Little Mush inflow	2000	21A/10	4430 6432	21 Jun - 28 Jun	332	y = 0.67x + 6.9	0.65	20.9	23.6	67	256	warm
Highway 324 Tributary	2000	21A/08	4428 6427	4 Aug - 9 Aug	336	y = 0.67x + 7.5	0.80	21.6	24.2	75	277	warm
Big North Brook	2000	21A/10	4417 6400	5 Jul - 13 Jul	361	y = 1.36x - 5.48	0.93	22.7	28.1	70	304	warm
Nictaux Fish Ladder	2001	21A/14	4556 6502	15 Jun - 5 Sep	3984			20.9	25.0	75	255	warm
Black Brook	2001	21A/14	4456 6500	29 Jun - 6 Jul	316	y = 0.97x - 2.5	0.87	16.6	22.0	12	100	inter
Hatchery Brook	2001	21A/14	4456 6502	26 Jul - 26 Jul	318	y = 0.97x - 1.7	0.97	18.5	22.5	19	183	inter
Walkers Brook	2001	21A/15	4459 6457	12 Jul - 19 Jul	321	y = 1.38x - 9.6	0.80	19.3	25.0	35	203	warm
Mumford Brook	2001	21A/15	4456 6453	26 Jul - 2 Aug	318	y = 1.27x - 6.0	0.86	20.5	25.7	45	242	warm
South River	2001	21A/15	4458 6448	26 Jul - 2 Aug	322	y = 1.95x - 18.6	0.82	21.9	29.6	52	285	warm
Lily Lake	2001	21A/14	4458 6506	2 Aug - 11 Aug	418	y = 0.71x + 9.1	0.70	23.9	26.9	83	310	warm
Nictaux River	2001	21A/14	4449 6502	15 Jun - 5 Sep	3984			21.7	25.7	68	283	warm
Barteaux Brook	2001	21A/14	4452 6509	15 Jun - 22 Jun	324	y = 1.18x - 9.2	0.70	16.4	21.2	2	95	cool
Soloman Chute Brook	2001	21A/14	4450 6517	22 Jun - 29 Jun	323	y = 1.4x - 10.4	0.43	17.2	24.9	22	139	inter
Berry Brook	2001	21A/15	4459 6457	6 Jul - 2 Jul	273	y = 0.84x - 0.7	0.87	17.6	21.0	2	149	inter
Watton Brook	2001	21A/14	4457 6501	22 Jun - 29 Jun	323	y = 1.22x - 8.8	0.57	17.7	22.7	11	157	inter
Fales River	2001	21A/15	4457 6456	12 Jul - 19 Jul	320	y = 1.45x - 11.2	0.75	20.1	26.0	45	230	warm
Zeke Brook	2001	21A/15	4458 6454	19 Jul - 26 Jul	320	y = 0.78x + 4.0	0.90	20.8	24.0	64	253	warm
Hasses's Hole	2001	21A/14	4455 6502	17 Aug - 25 Aug	385	y = 0.83x + 3.7	0.74	21.6	25.0	66	281	warm
Lightfoot Spring	2001	21A/14	4459 6503	2 Aug - 11 Aug	419	y = 0.73x + 8.3	0.84	24.1	27.0	83	311	warm

Table 3. Water temperature characteristics for 312 sites across Nova Scotia from 15 June to 5 Sepember, 2000-2002 (continue).

Logger site (stationary site in bold)	Year	Topo map	Latitude Longitude	Dates for regression	Records N	Mobile regression equation	r^2	Summer 15 Jun - 5 Sep average	Warmest daily average	Number days > 20°C daily mean	Site number	Rank
Nine Mile River	2002	11D/13	4458 6330	15 Jun - 5 Sep	3984			22.0	28.2	68	288	warm
Whittier Brook	2002	11E/04	4504 6341	8 Jul - 14 Jul	275	y = 0.79x - 1.7	0.80	10.9	14.8	0	4	cool
Captain MacPhee Brook	2002	11E/04	4504 6340	30 Jun - 8 Jul	389	y = 0.57x + 3.3	0.77	12.4	15.2	0	11	cool
Tributary of Little Nine Mile River	2002	11E/04	4505 6336	23 Jun - 30 Jun	329	y = 0.49x + 4.8	0.58	12.5	14.9	0	12	cool
Rawdon Brook	2002	11E/04	4504 6342	14 Jul - 28 Jul	667	y = 0.47x + 5.1	0.70	12.6	14.9	0	13	cool
Carrigan Brook	2002	11E/04	4502 6341	28 Jul - 3 Aug	288	y = 0.43x + 6.5	0.56	13.4	15.4	0	26	cool
Little Nine Mile River (Sandy Desert Road)	2002	11E/04	4502 6334	16 Jun - 23 Jun	310	y = 0.72x + 2.5	0.90	14.0	17.5	0	42	cool
Petite River	2001	21A/08	4415 6428	15 Jun - 5 Sep	3984			21.9	25.7	73	287	warm
Wamback Mill	2001	21A/01	4414 6426	3 Jul - 10 Jul	325	y = 0.99x - 3.4	0.79	18.2	21.9	12	174	inter
Browns Branch Brook	2001	21A/01	4414 6428	19 Jun - 26 Jun	334	y = 1.06x - 1.9	0.85	21.3	25.3	63	266	warm
Pictou East River	2000	11E/10	4530 6241	15 Jun - 6 Sep	3984			20.9	25.8	58	258	warm
Drug Brook	2000	11E/07	4523 6241	30 Jun - 7 Jul	330	y = 0.40x + 6.6	0.88	15.0	17.0	0	58	cool
Sam Cameron Brook	2000	11E/07	4525 6234	21 Jul - 28 Jul	334	y = 0.41x + 6.9	0.89	15.4	17.4	0	68	cool
West Branch East River	2002	11E/07	4522 6240	17 Sep - 24 Sep	383	y = 1.88x - 18.1	0.90	15.6	19.3	0	73	cool
Thompson Brook	2000	11E/08	4524 6227	23 Jun - 30 Jun	328	y = 0.46x + 6.1	0.90	15.7	18.7	0	76	cool
Little River	2002	11E/08	4524 6222	16 Jun - 23 Jun	326	y = 0.52x + 4.9	0.87	15.8	19.0	0	81	cool
Caledonia Rd	2000	11E/08	4524 6229	30 Jun - 7 Jul	328	y = 0.45x + 6.4	0.85	15.9	18.1	0	83	cool
Archibald Brook	2000	11E/07	4525 6236	14 Jul - 21 Jul	326	y = 0.66x + 3.3	0.90	17.0	21.2	7	126	inter
Westray Brook	2000	11E/10	4533 6239	16 Jun - 23 Jun	324	y = 0.51x + 6.6	0.95	17.2	19.7	0	134	inter
Cameron Brook	2000	11E/07	4527 6242	14 Jul - 21 Jul	326	y = 0.64x + 4.3	0.92	17.6	21.7	10	151	inter
Black Lake Brook	2000	11E/07	4523 6240	7 Jul - 14 Jul	324	y = 0.42x + 9.1	0.67	17.8	19.8	0	162	inter
Mill Pond Brook	2000	11E/07	4525 6242	23 Jun - 30 Jun	326	y = 0.43x + 9.8	0.79	18.7	20.8	6	186	inter
Pictou East River Main	2001	11E/10	4531 6240	15 Jun - 5 Sep	3984			21.3	25.9	59	265	warm
MacDonald's Brook	2001	11E/07	4524 6233	16 Jul - 3 Aug	860	y = 0.79x + 0.7	0.89	17.5	21.1	8	142	inter
Middle River	2001	11E/07	4529 6246	16 Jul - 3 Aug	861	y= 1.04x - 2.5	0.97	19.8	24.6	36	216	warm
Pictou East River Thompson	2001	11E/08	4524 6227	15 Jun - 5 Sep	3984			16.4	19.9	0	94	cool
Graham's Brook	2001	11E/10	4532 6252	29 Jun - 16 Jul	801	y = 0.73x + 3.1	0.82	15.0	17.6	0	57	cool
Glencoe Brook	2001	11E/07	4525 6232	3 Aug - 5 Sep	1598	y = 0.73x + 3.7	0.78	15.7	18.4	0	80	cool
Pictou West River 6 Mile	2001	11E/10	4535 6255	15 Jun - 5 Sep	3984			16.8	21.4	3	114	inter
Four Mile Brook	2001	11E/10	4536 6252	3 Aug - 24 Aug	1012	y = 0.84x +0.8	0.91	14.9	18.9	0	55	cool
Eight Mile Brook	2001	11E/10	4533 6255	24 Aug - 5 Sep	608	y = 0.53x + 6.5	0.94	15.3	17.8	0	64	cool
Sweets Brook	2001	11E/10	4532 6250	15 Jun - 29 Jun	665	y = 0.89x + 1.7	0.86	16.7	20.9	1	110	inter
Millstream Brook	2001	11E/07	4526 6238	15 Jun - 29 Jun	664	y = 0.65x + 8.8	0.83	19.6	22.6	32	212	warm
Pictou West River Main	2001	11E/10	4535 6250	15 Jun - 5 Sep	3984			20.6	24.4	47	243	warm
Benbie Brook	2000	11E/10	4532 6253	23 Jun - 30 Jun	324	y = 0.47x + 4.2	0.74	13.5	15.2	0	30	cool
Watervale Brook	2000	11E/07	4530 6254	23 Jun - 30 Jun	324	y = 0.73x + 0.3	0.86	14.9	17.6	0	54	cool
Quaker Brook	2000	11E/10	4531 6254	30 Jun - 7 Jul	324	y = 0.37x + 7.7	0.78	15.0	16.4	0	59	cool
Six Mile Brook	2000	11E/10	4535 6254	21 Aug - 27 Aug	335	y = 0.28x + 9.4	0.70	15.1	16.2	0	61	cool
West River Main	2000	11E/07	4527 6254	1 Aug - 7 Aug	335	y = 0.79x - 0.3	0.90	15.4	18.3	0	67	cool

Table 3. Water temperature characteristics for 312 sites across Nova Scotia from 15 June to 5 Sepember, 2000-2002 (continue).

Logger site (stationary site in bold)	Year	Topo map	Latitude Longitude	Dates for regression	Records N	Mobile regression equation	r^2	Summer 15 Jun - 5 Sep average	Warmest daily average	Number days > 20°C daily mean	Site number	Rank
River Denys	2001	11F/14	4550 6110	15 Jun - 5 Sep	3984			19.9	24.8	34	225	warm
MacLean Brook	2002	11F/14	4551 6105	31 Jul - 6 Aug	300	y = 0.30x + 5.1	0.73	10.3	12.0	0	2	cool
Alder Brook	2002	11F/14	4553 6114	27 Jul - 3 Aug	325	y = 0.56x + 2.8	0.87	13.2	17.0	0	23	cool
Glen Brook	2002	11F/14	4552 6115	20 Jul - 27 Jul	323	y = 0.74x + 1.6	0.97	15.4	20.4	2	66	cool
Kennedys Brook	2001	11F/14	4549 6109	15 Jun - 22 Jun	339	y = 0.95x - 3.3	0.82	15.6	20.3	2	71	cool
McIntyre Brook	2002	11F/14	4549 6110	22 Jun - 29 Jun	325	y = 0.90x + 0.1	0.89	16.9	23.0	10	118	inter
MacLellan Brook	2002	11F/14	4551 6113	13 Jul - 20 Jul	326	y = 1.45x - 9.1	0.90	17.8	27.7	22	164	inter
Big Brook	2002	11F/14	4549 6111	29 Jun - 6 Jul	315	y = 0.8x + 3.2	0.67	18.0	23.5	16	170	inter
Big Marsh Brook	2001	11F/14	4552 6112	3 Aug - 9 Aug	306	y = 0.54x + 7.4	0.82	18.1	20.7	5	171	inter
Morley's Brook	2001	11F/14	4550 6112	26 Jul - 13 Jul	315	y = 1.37x - 8.3	0.93	19.0	25.8	27	191	warm
River Deny's River	2001	11F/14	4553 6112	14 Aug - 20 Aug	249	y = 0.21x + 15.4	0.35	19.5	20.5	9	207	warm
River Phillip Lower	2001	11E/12	4540 6353	15 Jun - 5 Sep	3984			19.2	23.6	30	200	warm
Davidson Brook	2001	11E/12	4537 6355	25 Jun - 16 Jul	991	y = 0.63x + 2.5	0.89	14.6	17.3	0	51	cool
Collingwood corner	2000	11E/12	4536 6355	1 Aug - 7 Aug	383	y = 1.19x - 6.2	0.92	16.2	18.9	0	90	cool
Polley Brook	2001	11E/12	4539 6354	16 Jul - 23 Jul	327	y = 0.86x + 0.1	0.91	16.7	20.4	1	113	inter
River Phillip Main	2001	11E/12	4536 6352	15 Jun - 5 Sep	3984			17.0	21.3	6	127	inter
Bulmer Brook	2001	11E/12	4536 6352	6 Aug - 5 Sep	1462	y = 0.76x + 2.9	0.89	16.1	19.4	0	89	cool
Tillets Brook	2001	11E/12	4540 6347	23 Jul - 6 Aug	659	y = 1.27x - 0.1	0.97	21.6	27.0	58	276	warm
Sackville R Heflars fishway	2000	11D/13	4445 6343	15 Jun - 6 Sep	3984			22.5	25.4	79	303	warm
Little Sackville R	2000	11D/13	4445 6340	19 Jun - 26 Jun	332	y = 1.91x - 23.4	0.81	19.5	25.0	35	208	warm
Lewis Lake Bridge	2000	11D/13	4453 6348	27 Jun - 4 Jul	383	y = 1.55x - 14.1	0.88	20.8	25.2	58	251	warm
S Uniacke Rd	2000	11D/13	4452 6347	17 Jul - 24 Jul	328	y = 1.35x - 9.5	0.63	20.8	24.7	60	254	warm
DND Property	2000	11D/13	4445 6341	1 Aug - 8 Aug	326	y = 1.12x - 4.2	0.88	21.0	24.2	64	259	warm
Pentz Lake Bridge	2000	11D/13	4454 6348	10 Jul - 17 Jul	334	y = 1.36x - 9.2	0.82	21.5	25.4	68	272	warm
Thompson's Run	2000	11D/13	4446 6346	15 Jun - 19 Jun	210	y = 1.17x - 2.9	0.95	23.4	26.7	80	309	warm
Sackville River	2001	11D/13	4444 6339	26 Jun - 5 Sep	3455			22.0	25.9	58	289	warm
South Uniacke Rd Bridge	2001	11D/13	4451 6347	20 Aug - 28 Aug	368	y = 0.51x + 7.1	0.32	18.4	20.4	4	179	inter
Payzants	2001	11D/13	4445 6340	29 Aug - 5 Sep	356	y = 0.68x + 4.9	0.74	19.8	22.4	35	217	warm
Station Court	2001	11D/13	4445 6343	18 Jul - 27 Jul	411	y = 1.02x - 2.6	0.88	19.9	23.9	38	226	warm
Peverils Brook	2001	11D/13	4445 6340	12 Aug - 20 Aug	368	y = 0.87x + 1.2	0.85	20.4	23.7	52	239	warm
102 Overpass	2001	11D/12	4444 6339	3 Aug - 12 Aug	422	y = 0.86x + 2.5	0.80	21.3	24.6	52	268	warm
Feely Lake	2001	11D/13	4447 6341	27 Jul - 3 Aug	319	y = 0.87x + 3.3	0.94	22.4	25.8	70	299	warm

Table 3. Water temperature characteristics for 312 sites across Nova Scotia from 15 June to 5 Sepember, 2000-2002 (continue).

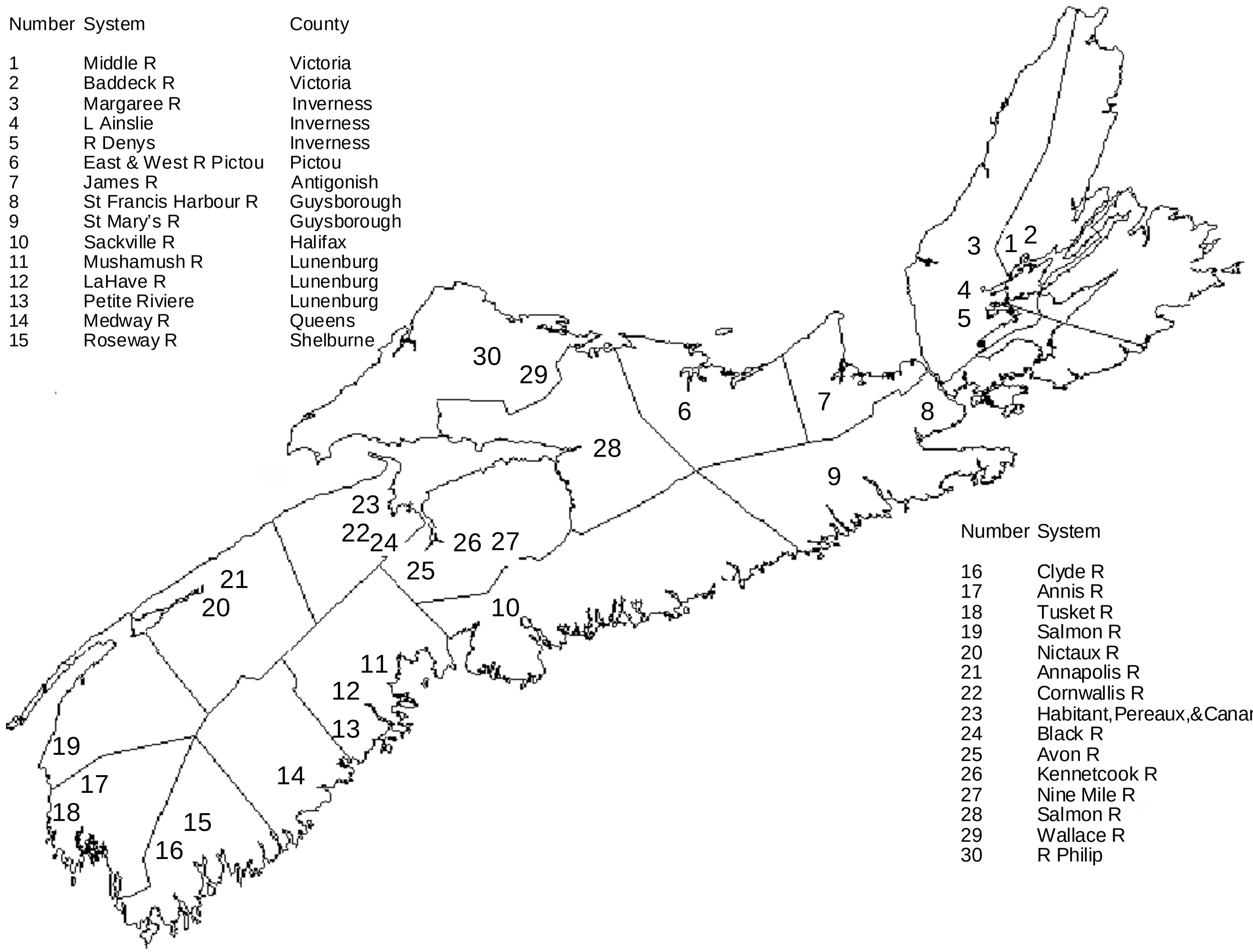
Logger site (stationary site in bold)	Year	Topo map	Latitude Longitude	Dates for regression	Records N	Mobile regression equation	r^2	Summer 15 Jun - 5 Sep average	Warmest daily average	Number days > 20°C daily mean	Site number	Rank
Salmon River Colchester County	2000	11E/06	4523 6307	15 Jun - 6 Sep	3984			19.9	24.0	50	227	warm
Kemptown 2	2000	11E/06	4528 6304	28 Aug - 6 Sep	334	y = 0.37x + 5.3	0.78	12.8	14.0	0	16	cool
Blair Brook	2000	11E/06	4525 6315	6 Sep - 12 Sep	297	y = 0.66x + 2.9	0.76	13.2	15.3	0	22	cool
Brayinon Brook	2000	11E/06	4523 6305	15 Aug - 21 Aug	280	y = 0.95x + 0.6	0.92	15.3	18.3	0	63	cool
North River	2000	11E/06	4523 6318	6 Sep - 13 Sep	288	y = 0.57x + 3.8	0.92	15.3	17.3	0	65	cool
Greenfield Brook	2000	11E/06	4524 6307	15 Aug - 21 Aug	283	y = 1.04x - 0.7	0.97	15.6	18.5	0	72	cool
Valley Crossroads	2000	11E/06	4524 6312	8 Aug - 15 Aug	351	y = 0.56x + 5.2	0.84	16.3	18.5	0	91	cool
Farmham Brook	2000	11E/06	4523 6317	8 Aug - 15 Aug	334	y = 0.49x + 6.9	0.61	16.8	18.5	0	116	inter
Salmon River Clifford Brook	2001	11E/06	4525 6309	15 Jun - 5 Sep	3984			16.0	22.0	6	87	cool
Salmon River Digby County	2000	21B/01	4403 6609	15 Jun - 6 Sep	3984			21.2	23.6	72	262	warm
St Mary's Lower	2001	11E/08	4516 6217	15 Jun - 5 Sep	3984			21.5	26.3	66	271	warm
Indian Man Brook	2001	11E/08	4516 6213	21 Jul - 28 Jul	325	y = 0.92x - 3.4	0.93	16.4	20.7	2	93	cool
Sutherland Brook	2001	11E/08	4516 6215	7 Jul - 16 Jul	405	y = 0.49x + 6.1	0.46	16.7	19.0	0	105	inter
MacDonald Brook	2001	11E/08	4516 6214	16 Jul - 21 Jul	241	y = 0.67x + 2.8	0.79	17.3	20.5	2	141	inter
Glencross Brook	2001	11E/08	4516 6210	4 Aug - 11 Aug	321	y = 0.65x + 3.9	0.91	18.0	21.1	7	168	inter
Barren Brook	2001	11E/08	4516 6217	29 Jun - 6 Jul	335	y = 0.64x + 4.7	0.90	18.4	21.4	9	178	inter
St Mary's Upper (Nelson Brook)	2001	11E/07	4518 6240	15 Jun - 5 Sep	3984			20.4	25.4	46	236	warm
Clark Brook	2001	11E/08	4515 6212	28 Jul - 4 Aug	321	y = 0.59x + 3.7	0.89	15.7	18.7	0	78	cool
Chisholm Brook	2002	11E/08	4516 6225	31 Jul - 7 Aug	328	y = 0.31x + 10.3	0.59	16.3	18.1	0	92	cool
Mitchell Brook	2002	11E/08	4516 6221	7 Aug - 14 Aug	328	y = 0.42x + 8.3	0.91	16.5	19.0	0	99	inter
Kelly Brook	2001	11E/08	4516 6219	11 Aug - 19 Aug	373	y = 0.17x + 13.3	0.39	16.7	17.5	0	108	inter
Beaver Brook	2002	11E/08	4518 6229	28 Aug - 4 Sep	328	y = 0.71x + 3.0	0.90	16.7	20.8	5	109	inter
Archibald Mill Brook	2002	11E/08	4516 6205	9 Jul - 16 Jul	335	y = 0.64x + 5.0	0.82	16.7	20.8	7	112	inter
MacDonald Mill Brook	2002	11E/08	4515 6216	24 Jul - 31 Jul	330	y = 0.41x + 9.0	0.61	16.9	19.2	0	117	inter
Cross Brook	2002	11E/08	4517 6224	14 Aug - 21 Aug	327	y = 1.07x - 3.8	0.92	16.9	23.1	14	119	inter
Long John Brook	2002	11E/07	4518 6231	21 Aug - 28 Aug	327	y = 0.58x + 5.7	0.91	17.0	20.3	1	121	inter
McLeod Lake Brook	2002	11E/08	4516 6208	16 Jul - 24 Jul	364	y = 0.54x + 10.0	0.60	20.4	23.5	43	238	warm
St. Francis Harbour River	2000	11F/06	4527 6118	1 Jul - 6 Sep	3216			19.1	22.4	27	194	warm
East branch	2000	11F/11	4531 6125	3 Jul - 10 Jul	383	y = 0.56x + 6.2	0.79	17.0	18.8	0	120	inter
West Branch	2000	11F/06	4529 6126	23 Jul - 30 Jul	383	y = 0.38x + 10.5	0.61	17.7	19.0	0	159	inter

Table 3. Water temperature characteristics for 312 sites across Nova Scotia from 15 June to 5 Sepember, 2000-2002 (continue).

Logger site (stationary site in bold)	Year	Topo map	Latitude Longitude	Dates for regression	Records N	Mobile regression equation	r^2	Summer 15 Jun - 5 Sep average	Warmest daily average	Number days > 20°C daily mean	Site number	Rank
Tusket River	2001	20P/13	4352 6544	15 Jun - 5 Sep	3984			22.4	25.2	77	297	warm
Annis R Carleton Road	2001	20P/13	4359 6558	18 Aug - 25 Aug	331	y = 1.34x - 9.1	0.74	20.8	24.6	58	252	warm
Annis Lake Outflow	2001	21B/01	4404 6601	11 Aug - 18 Aug	354	y = 0.63x + 7.2	0.47	21.3	23.1	77	269	warm
Big Brazil Brook	2001	21B/01	4400 6600	4 Aug - 11 Aug	325	y = 1.09x - 2.9	0.41	21.6	24.7	74	279	warm
Annis R Woods Mill Road	2001	20O/16	4352 6600	1 Sep - 8 Sep	322	y = 0.91x + 1.3	0.69	21.9	24.5	77	286	warm
Raynaton Bridge	2001	20P/13	4356 6555	21 Jul - 28 Jul	333	y = 0.66x + 7.3	0.39	22.0	23.8	82	290	warm
Annis R Woods Mill Road 2	2001	20O/16	4351 6601	8 Sep - 15 Sep	324	y = 1.04x - 0.9	0.38	22.3	25.2	77	294	warm
Eli Doucette Road	2001	20P/13	4355 6549	22 Jun - 30 Jun	370	y = 0.8x + 4.5	0.75	22.4	24.6	81	295	warm
Coinubia Road	2001	20P/13	4354 6555	14 Jul - 21Jul	283	y = 0.76x + 5.4	0.44	22.4	24.5	82	296	warm
Wilson Road	2001	20P/13	4355 6551	7 Jul - 14 Jul	325	y = 0.70x + 6.8	0.80	22.4	24.4	82	298	warm
Carleton Bridge	2001	20A/04	4400 6555	28 Jul - 4 Aug	324	y = 0.82x + 4.0	0.48	22.5	24.8	82	300	warm
Cold Stream	2001	20P/13	4358 6548	15 Jun - 22 Jun	357	y = 0.39x + 13.7	0.09	22.5	23.6	83	301	warm
Quinan River Joins	2001	20P/13	4355 6549	30 Jun - 7 Jul	320	y = 1.02x - 0.1	0.82	22.7	25.6	79	305	warm
Annis R Sanders Rd	2001	20P/13	4358 6559	25 Aug - 1 Sep	309	y = 2.23x - 27	0.45	22.8	29.1	72	306	warm
Wallace River	2001	11E/12	4542 6334	15 Jun - 5 Sep	3984			21.7	26.0	68	282	warm
Wentworth Park	2001	11E/12	4537 6333	4 Aug - 11 Aug	313	y = 0.49x + 5.8	0.85	16.5	18.7	0	98	inter
Treen Brook	2001	11E/12	4540 6339	4 Sep - 10 Sep	278	y = 0.46x + 7.2	0.86	17.2	19.2	0	133	inter
Wentworth Park Area Main	2001	11E/12	4537 6333	11 Aug - 20 Aug	413	y = 0.41x + 8.9	0.75	17.7	19.4	0	153	inter
Henderson Brook	2001	11E/12	4540 6336	6 Jul - 13 Jul	324	y = 0.63x + 4.3	0.89	18.0	20.8	4	169	inter
West Branch	2001	11E/12	4538 6340	27 Aug - 4 Sep	363	y = 0.73x + 2.2	0.96	18.2	21.4	9	173	inter
East branch	2001	11E/12	4537 6331	20 Aug - 27 Aug	335	y = 0.58x + 6.1	0.88	18.6	21.1	9	185	inter
Crowley Brook	2001	11E/12	4542 6334	29 Jun - 6 Jul	322	y = 0.86x + 0.3	0.92	19.0	22.8	28	192	warm
Flemming Brook	2001	11E/12	4542 6333	15 Jun - 22 Jun	323	y = 0.94x - 0.9	0.92	19.4	23.6	29	206	warm
Drennan Brook	2001	11E/12	4542 6334	22 Jun - 29 Jun	334	y = 0.86x + 1.3	0.89	19.9	23.7	38	220	warm
Tidd Pool	2001	11E/12	4541 6333	20 Jul - 4 Aug	719	y = 0.94x - 0.1	0.93	20.4	24.5	44	237	warm
Gough Brook	2001	11E/12	4540 6332	13 Jul - 20 Jul	325	y = 0.78x + 4.7	0.85	21.5	24.9	71	273	warm
Mean							0.77	18	21	23		

Legend

Number	System	County
1	Middle R	Victoria
2	Baddeck R	Victoria
3	Margaree R	Inverness
4	L Ainslie	Inverness
5	R Denys	Inverness
6	East & West R Pictou	Pictou
7	James R	Antigonish
8	St Francis Harbour R	Guysborough
9	St Mary's R	Guysborough
10	Sackville R	Halifax
11	Mushamush R	Lunenburg
12	LaHave R	Lunenburg
13	Petite Riviere	Lunenburg
14	Medway R	Queens
15	Roseway R	Shelburne



Number	System	County
16	Clyde R	Shelburne
17	Annis R	Yarmouth
18	Tusket R	Yarmouth
19	Salmon R	Digby
20	Nictaux R	Annapolis
21	Annapolis R	Annapolis
22	Cornwallis R	Kings
23	Habitant,Pereaux,&Canard R	Kings
24	Black R	Kings
25	Avon R	Hants
26	Kennetcook R	Hants
27	Nine Mile R	Hants
28	Salmon R	Colchester
29	Wallace R	Cumberland
30	R Philip	Cumberland

Figure 1. Location of river system in the Nova Scotia water temperature monitoring project, 2000-2002.

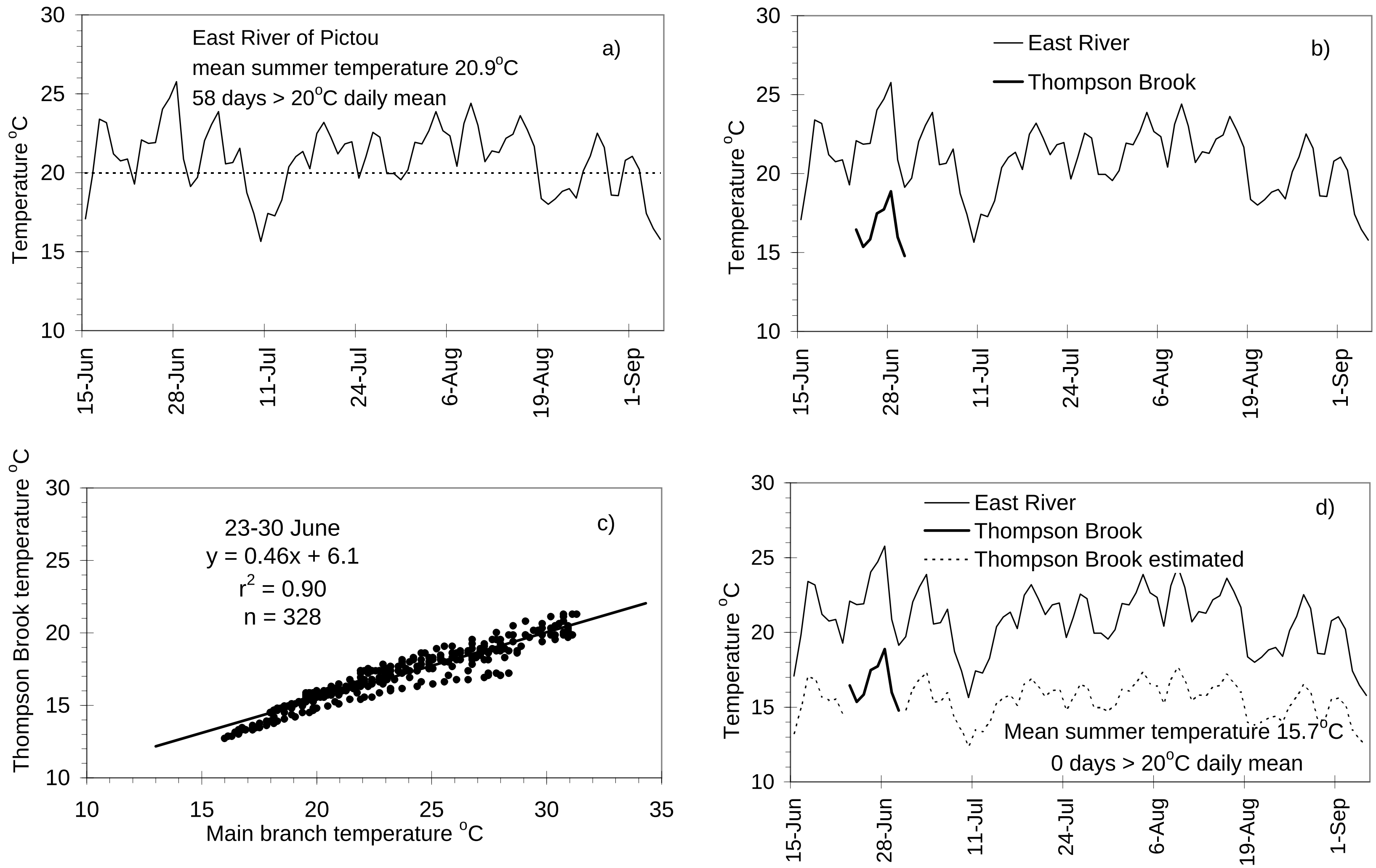


Figure 2. Daily mean water temperature of the main branch of East River of Pictou and the method used to estimate the temperature of Thompson Brook from a week long temperature data set: a) main branch stationary logger, b) one week water temperatures from Thompson Brook, c) regression of Thompson Brook and main branch temperature, and d) estimated water temperatures for Thompson Brook with associated thermal characteristics.

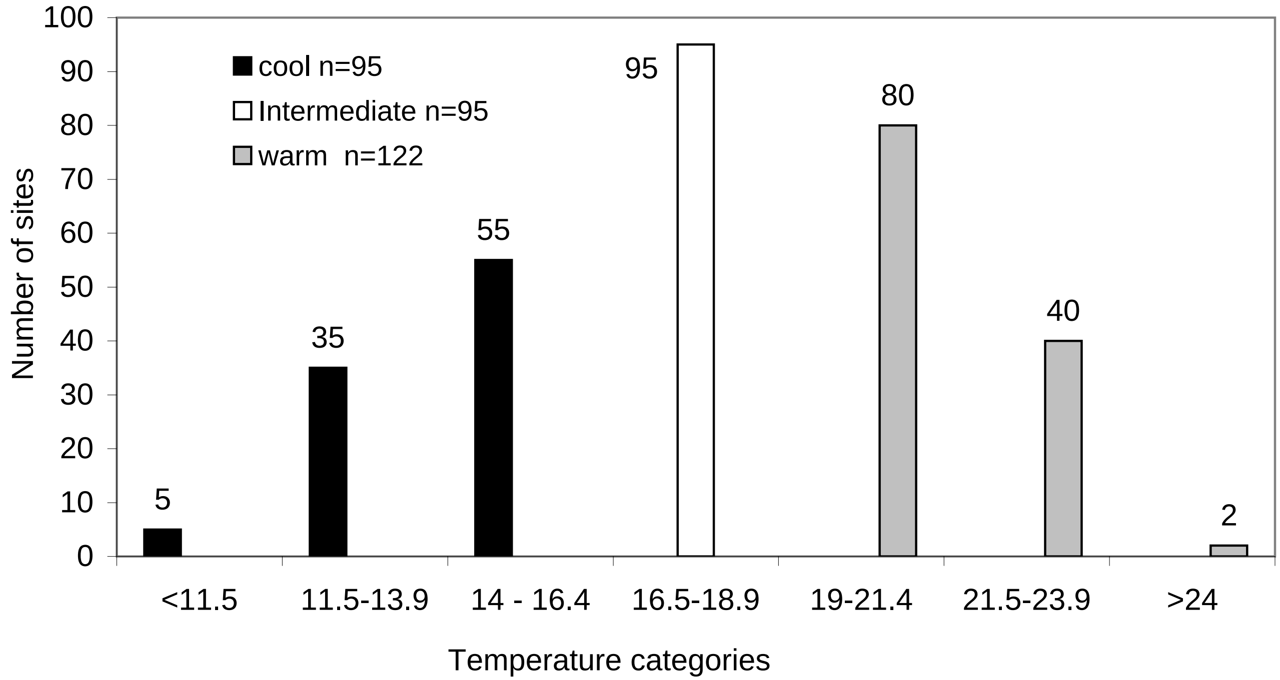


Figure 3. The number of sites in each summer mean water temperature category, Nova Scotia, 2000-2002.

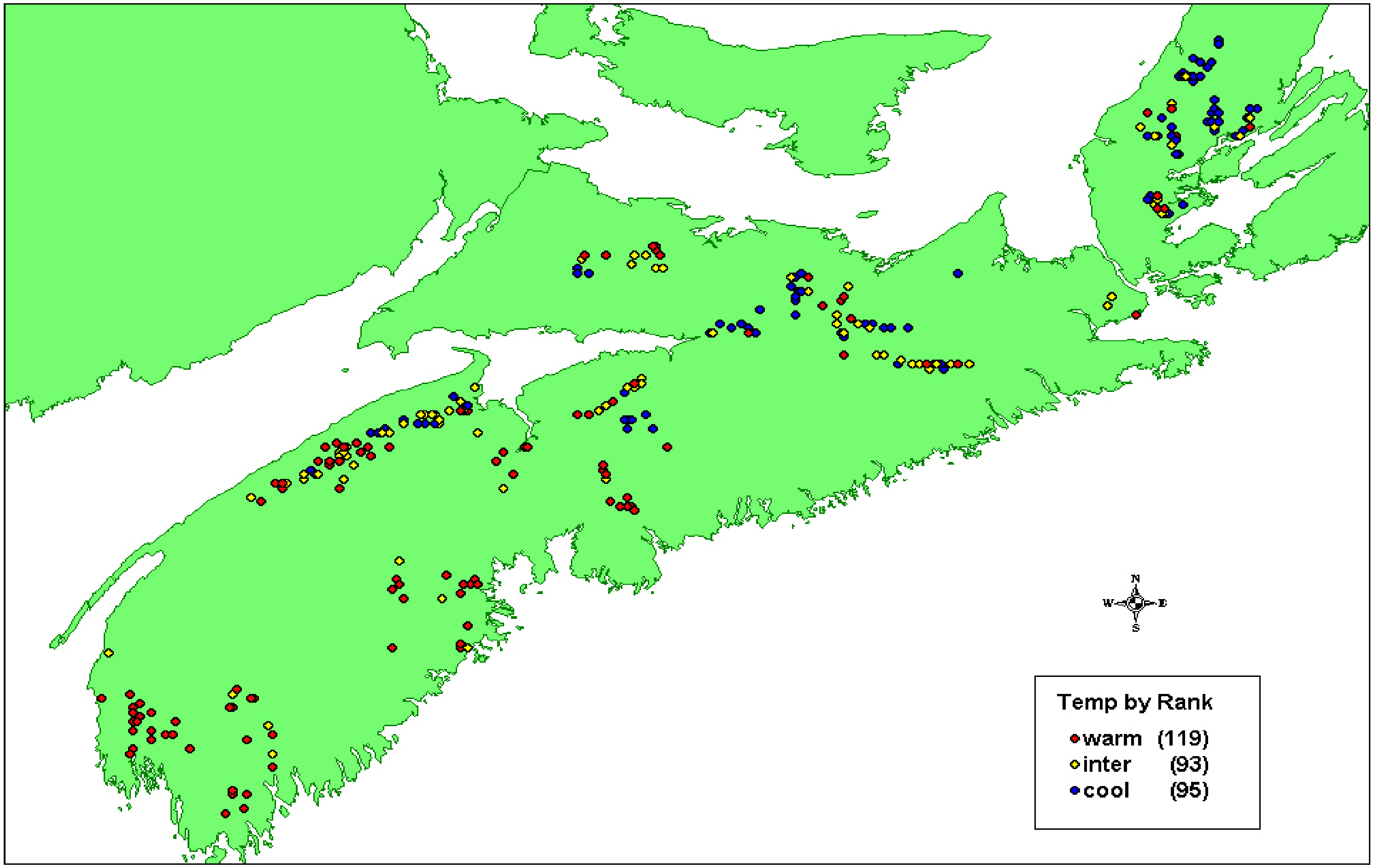


Figure 4. Map showing the water temperature sites (cool, intermediate and warm) across the province of Nova Scotia.

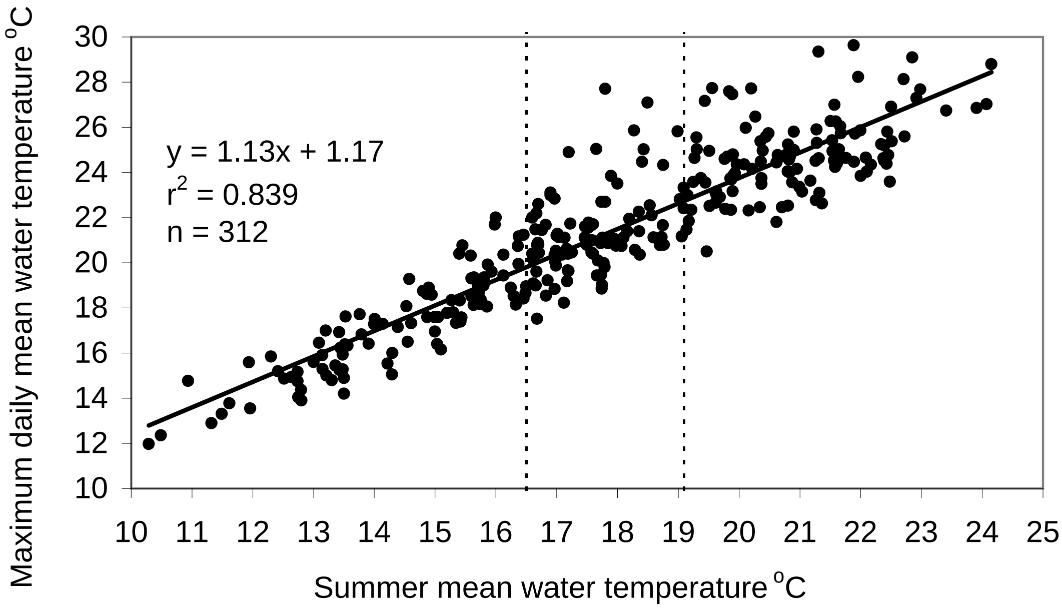


Figure 5. Summer mean water temperature and the warmest daily mean water temperature for the period between 15 June to 5 September, 2000-2002.

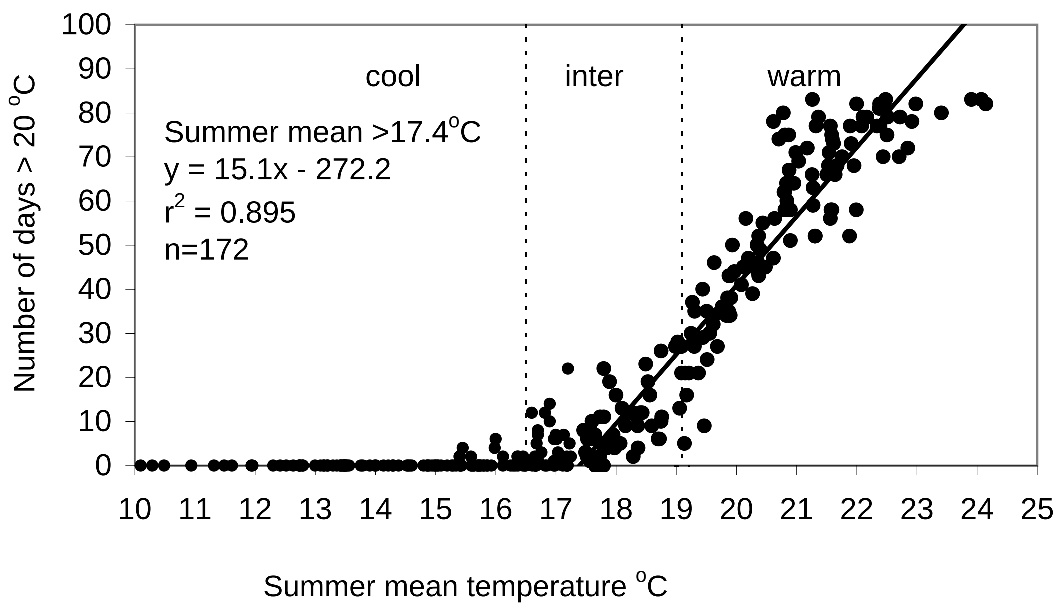


Figure 6. The number of days when the daily water temperature exceeded 20°C for the period between 15 June to 5 September in 312 sites, Nova Scotia, 2000-2002.

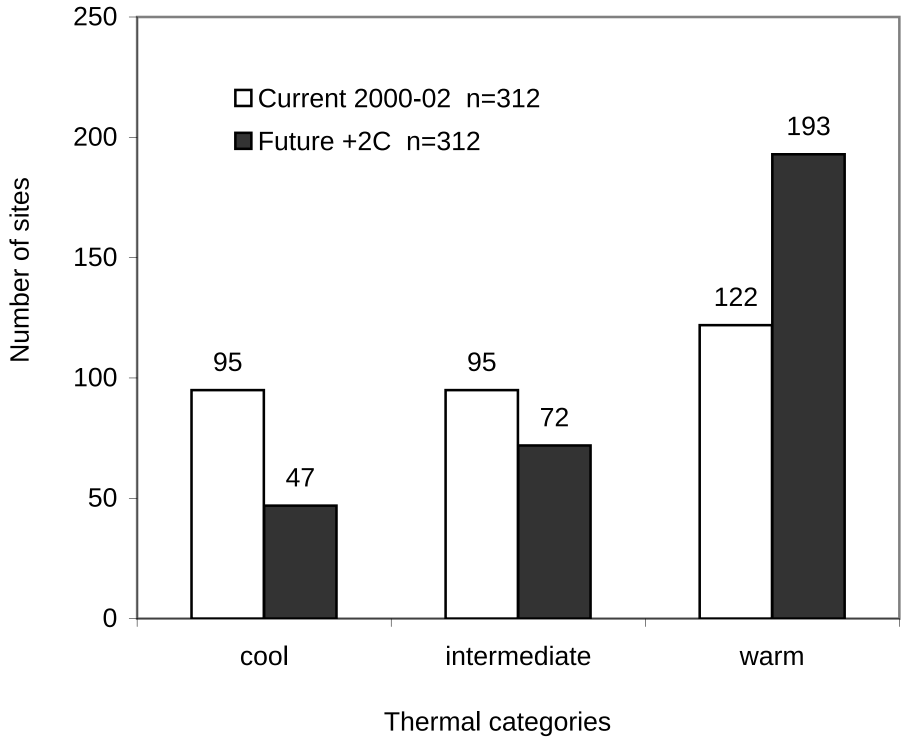


Figure 7. Estimated change in the number of sites in each thermal category after a 2°C increase in mean summer water temperature between 15 June - 5 September, Nova Scotia, 2000-2002.