

Water temperature summaries for the Mainstream, North Branch, and South Branch of the Au Sable River – 1990-2009

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Purpose: To archive water temperature data collected from the three major branches of the Upper Au Sable River system over a 20 year period. A very brief analysis and description of data is also provided.

Thermometer deployment sites:

Mainstream Au Sable River: Thendara Road and Stephan Bridge
North Branch Au Sable River: Twin Bridges and Dam 4
South Branch Au Sable River: Chase Bridge and Smith Bridge

Background:

Water temperature is one of the most important factors affecting the suitability of river and stream habitats for trout. Water temperature affects their survival, growth, reproductive success and their food supply. Accordingly, Michigan fisheries and research biologists have collected water temperature data from streams to assess their suitability for trout for at least the past 75 years. In the past it was very labor intensive to collect detailed data on water temperature variation (daily or seasonal). However, by the late 1980s new electronic technologies made collection of massive amounts of temperature data more affordable. In 1989, Dr. Richard D. Clark Jr., at the Michigan DNR's Institute for Fisheries Research purchased several electronic thermometers from Ryan Instruments and deployed them in the Au Sable River. The price per unit at that time was about \$1,000. These units were capable of collecting water temperature data at specified intervals and the data could be quickly and easily downloaded into a PC. Within less than 10 years electronic thermometers became much cheaper, which enabled Fisheries Division to purchase and deploy hundreds of them throughout the state. Summaries of the year-round water temperature data collected electronically in the Upper Au Sable River System over the past 20 years are provided in this report.

Data quality and accuracy:

New electronic thermometers of the types used to collect the Au Sable River system temperatures are certified to be accurate to within roughly 0.5 °F. However, thermometers do occasionally malfunction and lose calibration. Serious malfunctions are easily detected but small changes in accuracy ($\pm 1-2$ °F) are difficult to detect. Beginning in 2003, we began deploying two thermometers at most sites so that readings could be compared between thermometers at the end of each deployment. In addition, we began checking the calibration of thermometers by deploying them in an artesian spring for several weeks about once every 1.5 years. Thermometers that were inaccurate were discarded or repaired. I also checked correlations between temperatures at multiple stations (e.g. Thendara Road and Stephan Bridge) to help detect anomalies. In this instance, I knew that mid-summer water temperatures at Stephan Bridge should be colder than at Thendara, so if this relation changed it was an indication of thermometer malfunction. Data of questionable accuracy were discarded. This report focuses on monthly summary statistics. I did not present monthly summary statistics unless valid data were available for at least 25 days of the month. The graphics in this report are based on July water temperatures. All July data presented are complete (data for all 31 days of the month).

Rationale for focusing on July water temperatures

In the upper Au Sable River average July water temperatures are almost always the highest of the year. Average July water temperatures were computed as the average of all temperature

readings taken in the month. In most years temperature readings were taken once each hour so the July averages are derived from 744 measurements (31 days x 24 readings/day).

Common terms used in this report:

- Mean monthly water temperature – Average of all temperatures readings taken during the month.
- Average of daily maximum water temperatures for a month
 - Note that this is NOT the same as the highest temperature in a month. For example, the highest temperature recorded at Twin Bridges in July 1990 was 80.4 °F but the average of the 31 highest daily temperatures was only 70.4 °F.
- Average of daily minimum water temperatures for a month – See bullet above
- Highest water temperature recorded during the month – Highest of 744 readings
- Average daily range of July water temperatures
 - Average daily maximum temperature minus average daily minimum temperature

Data Summary:

The same temporal pattern of warmer or colder mean July water temperatures was evident at all sites on all three branches of the Au Sable. The coldest July water temperatures at all six stations were recorded in 1992 and 2009 (See Figures 1 through 6). Years with July temperatures that were warmer than average included 1999, 2002, 2005 and 2006.

The average range of July water temperatures *at each thermometer site* were similar between warm and cold years (Figure 7). In the Mainstream and South Branch the average range of July water temperatures was low, about 6 F in both 2006 when it was hot, and in 2009, which was cool. However, in the North Branch, the average range in July water temperatures was about 10°F (Figure 7). The higher variation in July water temperatures in the North Branch is presumably due its wide and shallow channel morphology. Long term (1990-2009) mean July water temperatures were approximately 64 °F at all sites except Stephan Bridge, where July temperatures averaged 62 °F (Figure 8).

Both the highest summer temperatures and the lowest winter temperatures are found in the North Branch. These temperature extremes are believed to contribute to the higher mortality rates exhibited by trout in the North Branch, as compared to the South Branch or Mainstream.

Monthly temperature statistics for all six stations for the past 20 years are contained in Tables 1-24.

The highest mean July air temperatures since the turn of the century occurred in 2002, 2005, and 2006 whereas the coolest July was 2009 (Figure 9). Mean July water temperature is highly correlated with mean July air temperature at all Au Sable River stations evaluated, as shown in Figure 10.

Figures 9 and 10 illustrate that one-time (year) measurements of summer water temperature should be evaluated in the context of how hot air temperatures were compared to long-term averages. They indicate that air temperature should be considered and accounted for in evaluations of effects of management actions such as beaver dam removals on water temperatures. False conclusions on the effectiveness (or ineffectiveness) of management actions based on a simple before-and-after dam removal comparison of summer water temperatures could easily be made if air temperature differences between years are not considered.

Mainstream Au Sable River at Thendara Road 1990-2009

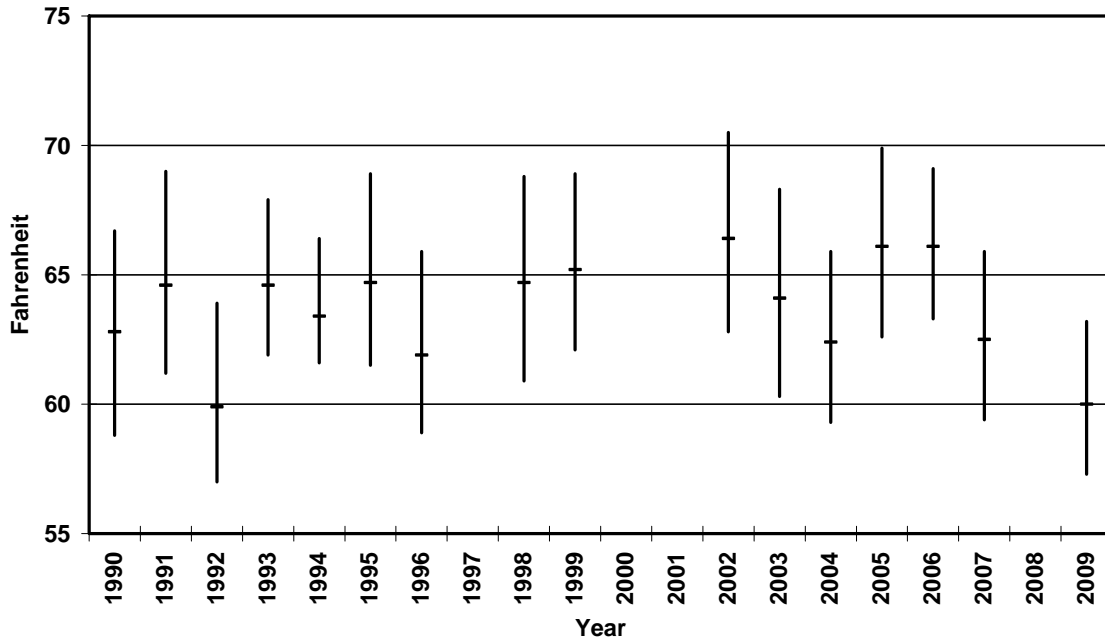


Figure 1.—Mean July water temperature ($^{\circ}$ F) and average daily range of July water temperatures at Thendara Road. The horizontal tick marks depict the July mean temperature. The top of the vertical bars are the average of 31 daily maximum water temperatures and the bottom of the vertical bars are the average of 31 daily minimum water temperatures.

Mainstream Au Sable River at Stephan Bridge 1991-2009

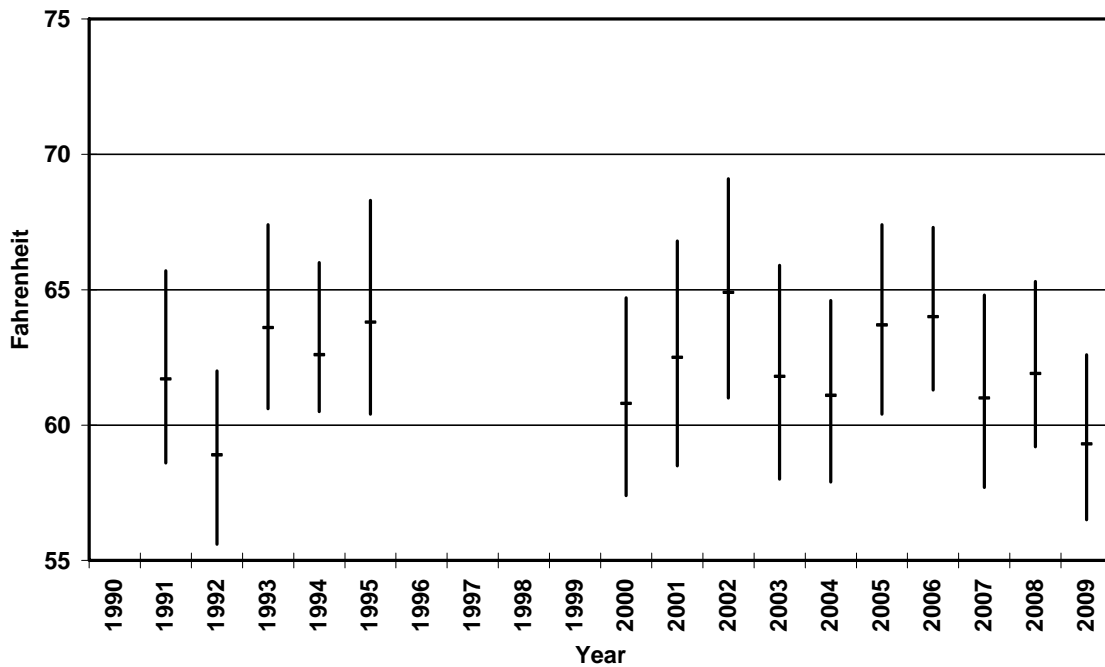


Figure 2.—Mean July water temperature ($^{\circ}$ F) and average daily range of July water temperatures at Stephan Bridge.

North Branch Au Sable River at Twin Bridges 1990-2009

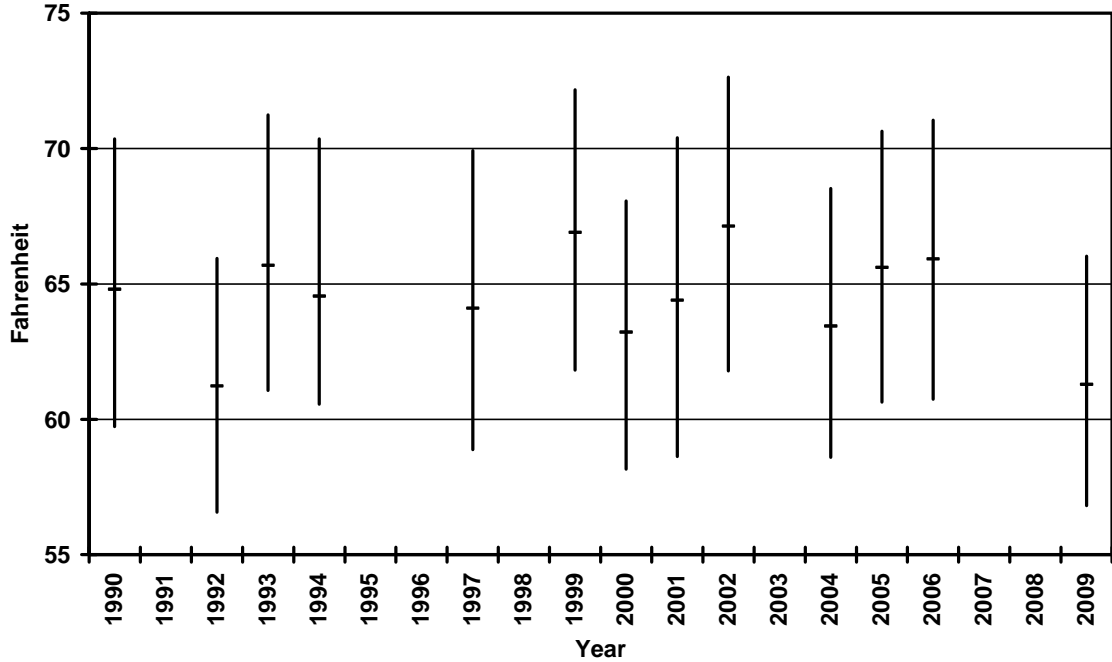


Figure 3.—Mean July water temperature (°F) and average daily range of July water temperatures at Twin Bridges. The horizontal tick marks depict the July mean temperature. The top of the vertical bars are the average of 31 daily maximum water temperatures and the bottom of the vertical bars are the average of 31 daily minimum water temperature measurements.

North Branch Au Sable River at Dam 4: 1990-2009

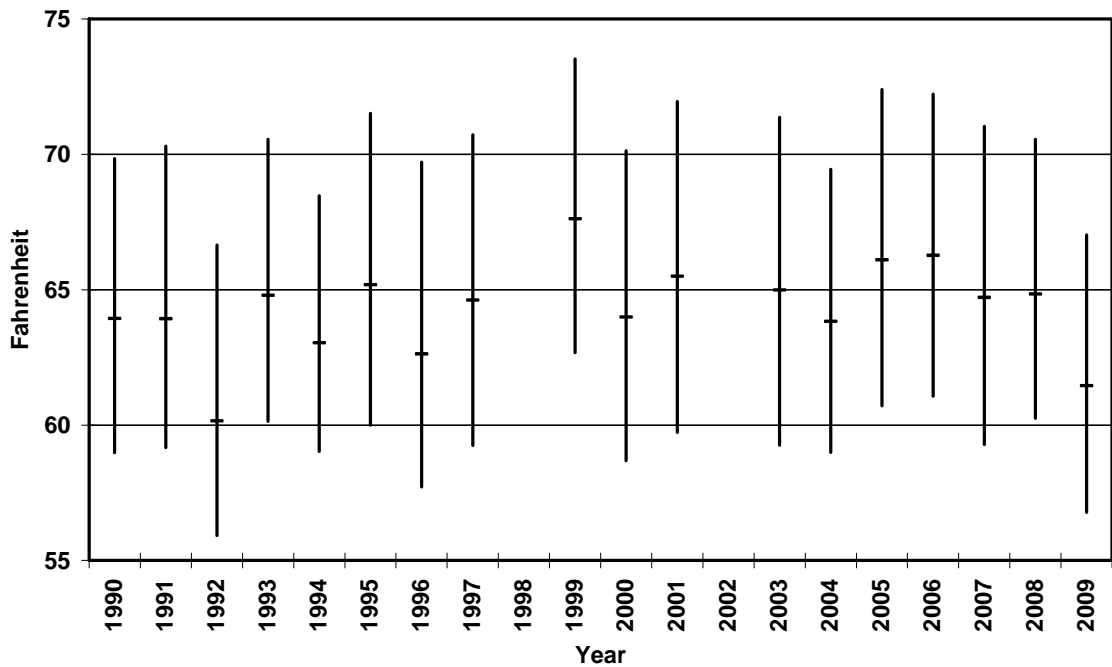


Figure 4.—Mean July water temperature (°F) and average daily range of July water temperatures at Dam 4.

South Branch Au Sable River at Chase Bridge 1990-2009

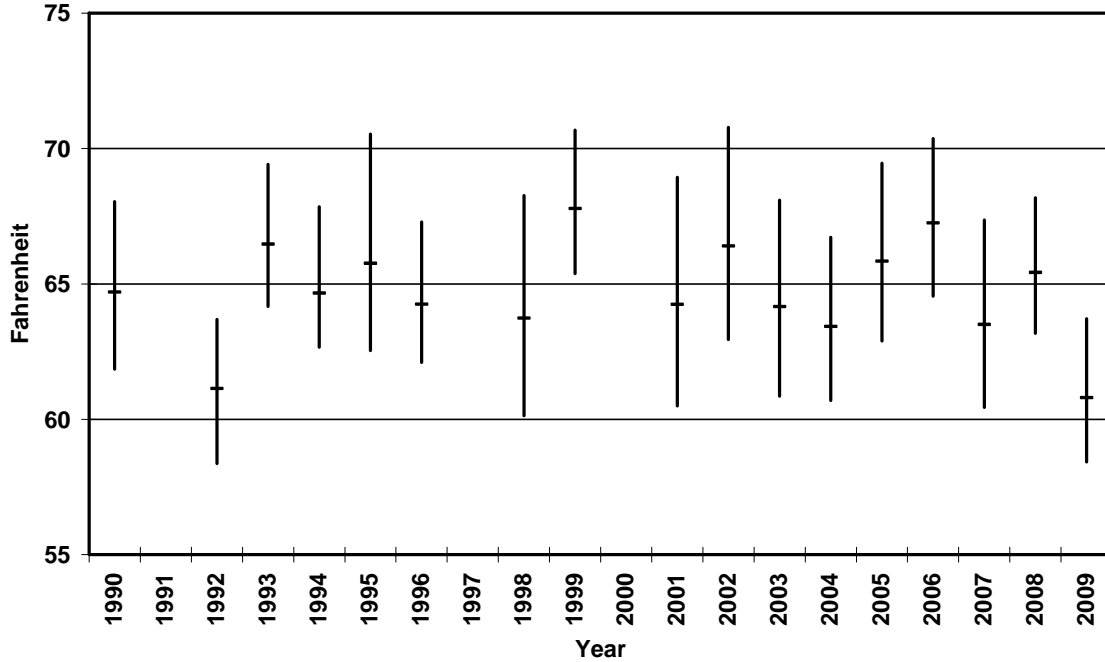


Figure 5.—Mean July water temperature (°F) and average daily range of July water temperatures at Chase Bridge. The horizontal tick marks depict the July mean temperature. The top of the vertical bars are the average of 31 daily maximum water temperatures and the bottom of the vertical bars are the average of 31 daily minimum water temperature measurements.

South Branch Au Sable River at Smith Bridge 1991-2009

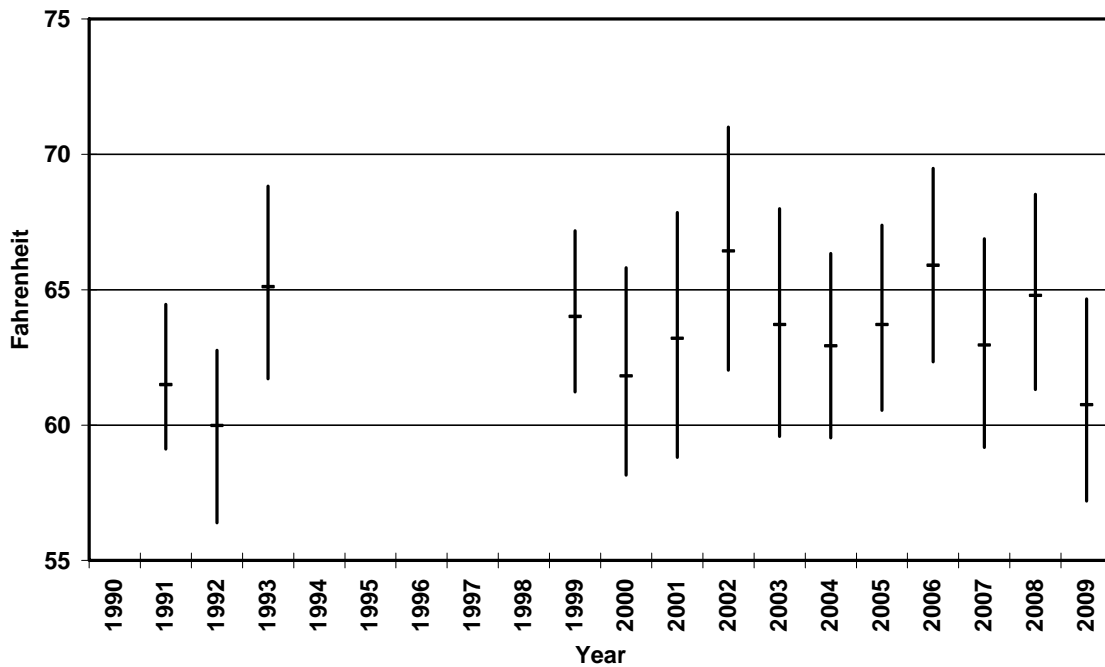


Figure 6.—Mean July water temperature (°F) and average daily range of July water temperatures at Smith Bridge.

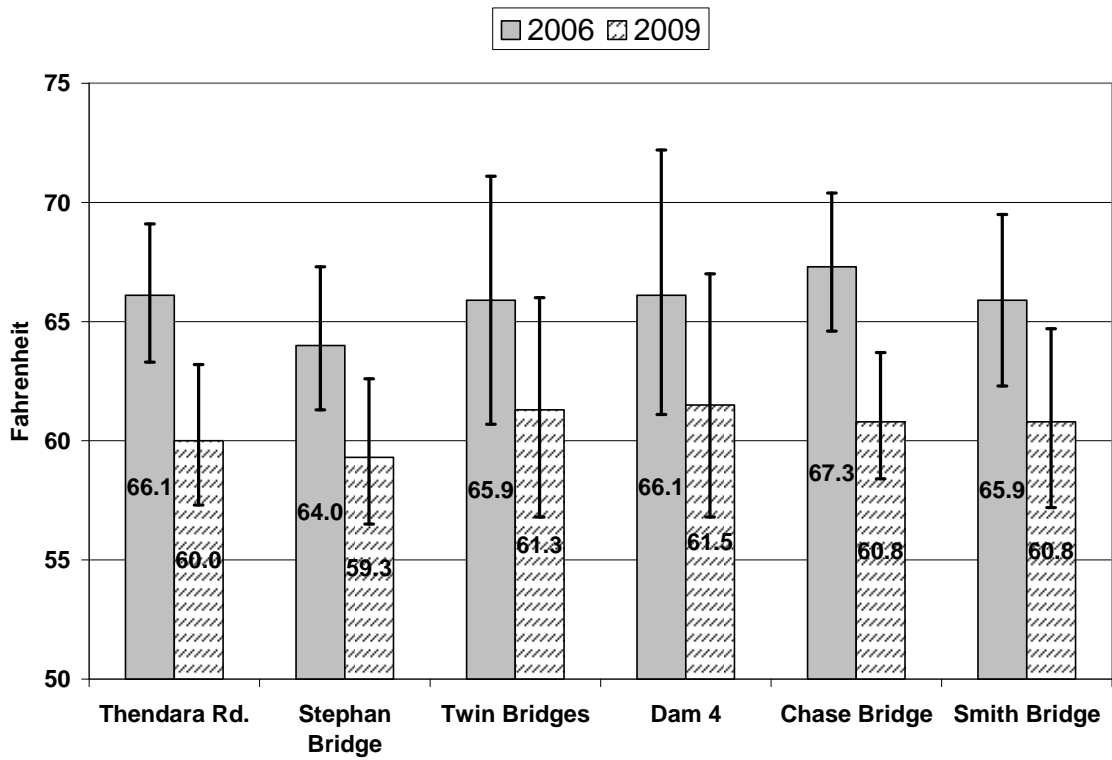


Figure 7.—Comparisons of mean July water temperature ($^{\circ}$ F) and average range of water temperatures at six sites on the Upper Au Sable River system during a warm July (2006) and a cold July (2009).

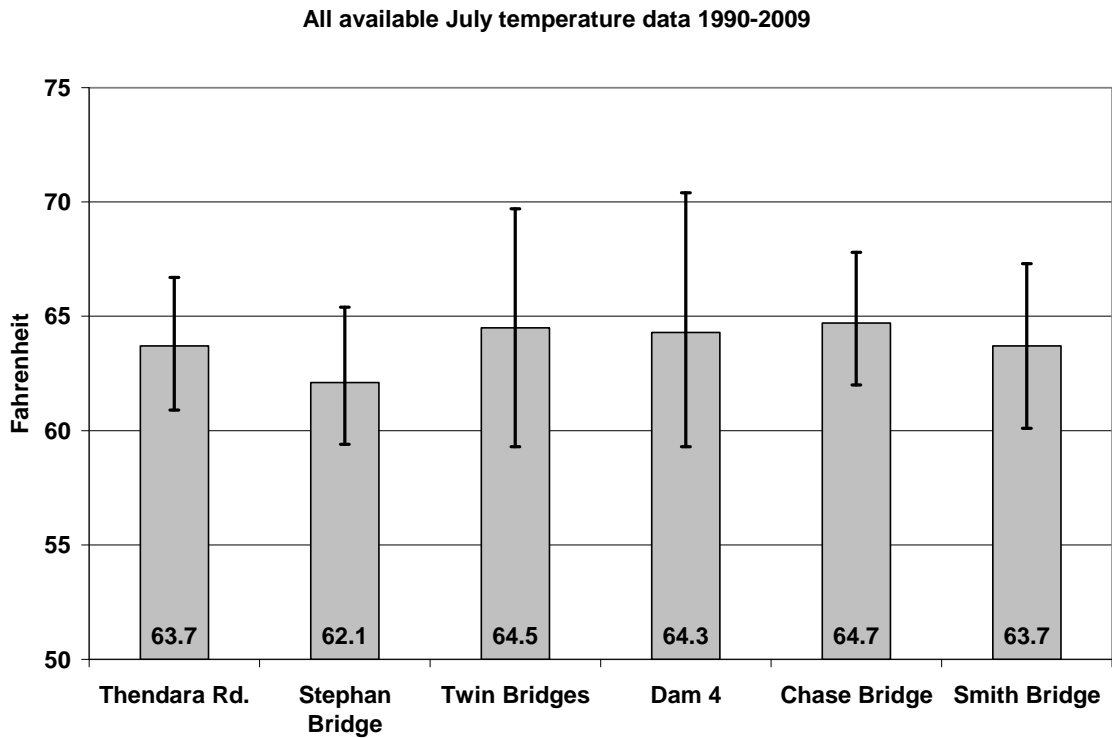


Figure 8.—Comparisons of mean July water temperature ($^{\circ}$ F) and average range of water temperatures at six sites on the Upper Au Sable River system based on all years from 1990-2009 that had complete temperature records (See Tables 1-24 to determine which years are included in the computation of the averages and ranges).

Mean June-August Air Temperature (F) at Hunt Creek Research Station
The heavy horizontal line at 67.1 F is mean July air temperature 2001-2009

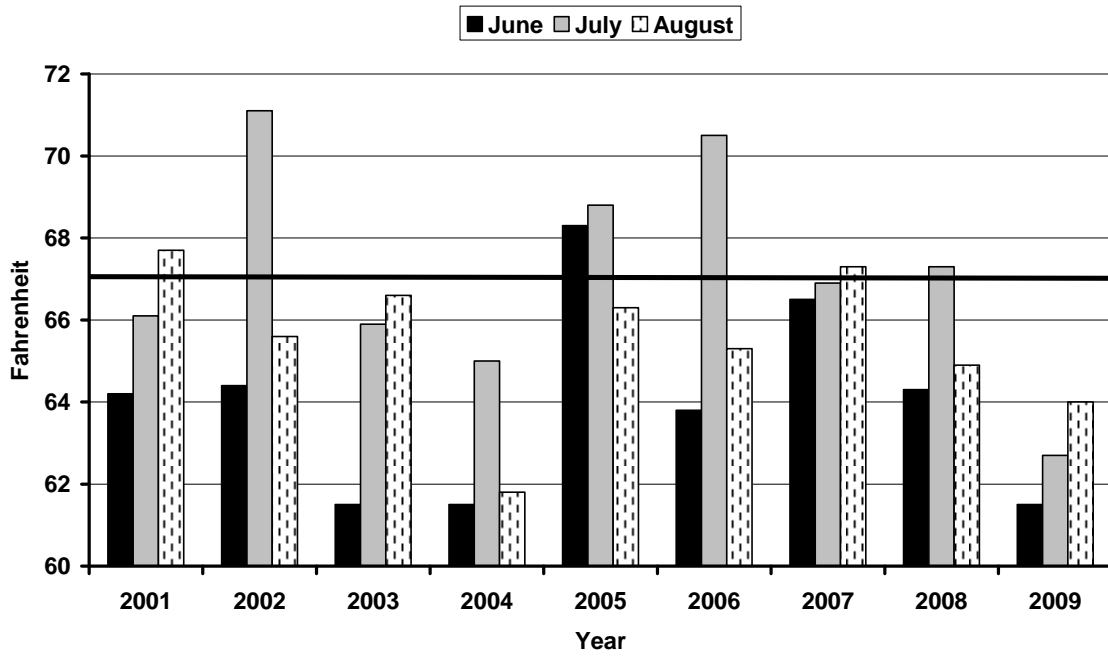


Figure 9-

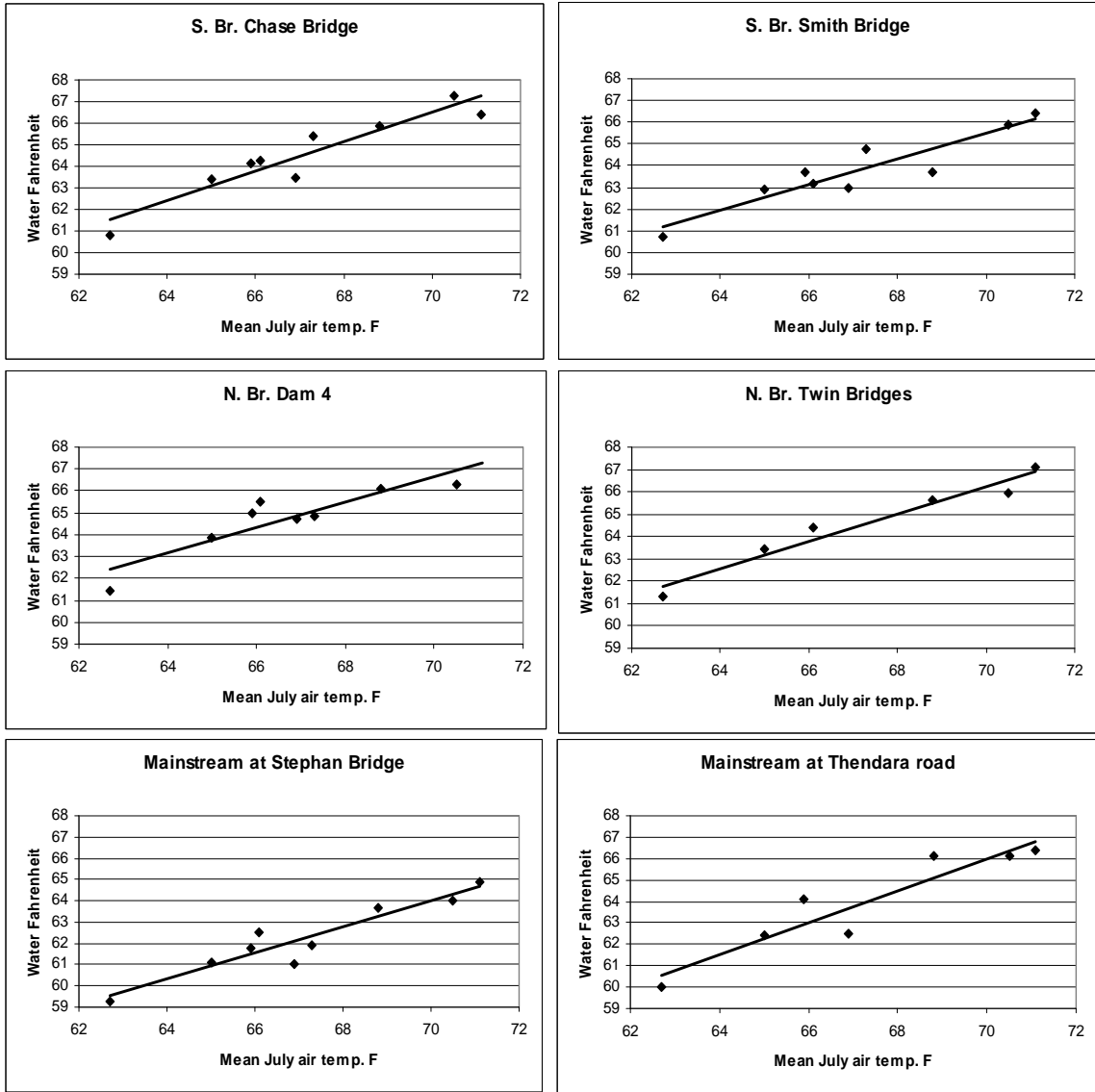


Figure 10.—Relation between mean July water temperature at Au Sable River sites (⁰F) and mean July air temperatures collected at the Hunt Creek Fisheries Research Station from 2001 through 2009.

Table 1.—Mainstream Au Sable River at Stephan Bridge. Mean monthly water temperature (⁰F) by year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990										46.1	40.9	35.7
1991	33.9	35.8	39.6	47.8	58.4	63.4	61.7	61.5	54.5			
1992							58.9	57.7	54.3			
1993						58.7	63.6	61.8	53.1	46.3	39.4	36.4
1994	33.2	33.8	38.7	44.8	54.5	61.1	62.6	59.6	56.3	48.8	41.4	37.7
1995	35.4	34.6	40.3	45.0	53.3	62.7	63.8	63.6	53.9	49.2	37.5	34.4
1996	33.9	35.1	37.9								38.5	36.1
1997	33.9	35.5									39.3	36.9
1998	35.1	38.2	38.8	46.9	57.7	59.9					41.9	38.0
1999	34.4	36.6	39.9	48.2	56.2	62.6						
2000					55.8	60.2	60.8	60.4	55.3	49.0	41.7	35.5
2001	37.0	36.7	40.1	47.6	56.0	60.8	62.5	61.9	55.0	47.8	44.4	39.6
2002	37.0	37.0	38.2	46.7	51.7	60.3	64.9	61.5	57.4			
2003						59.4	61.8	62.3	55.5	47.2	42.0	37.4
2004	34.6	36.2	40.7	48.1	53.8	59.6	61.1	58.6	57.4	48.6	42.2	36.0
2005	34.6	36.4	38.5	48.1	52.6	63.7	63.7	61.8	57.4	49.6	41.8	36.4
2006	37.8	36.0	40.4	48.9	55.4	60.6	64.0	61.2	54.7	46.4	42.5	38.4
2007	36.5	34.5	40.3	45.8	56.1	62.0	61.0	60.7	56.3	50.9	40.7	36.3
2008	35.7	34.8	38.0	47.2	53.0	60.2	61.9	60.0	55.1	47.0	41.0	34.9
2009	33.9	35.5	39.1	46.0	53.9	59.0	59.3	60.2				
Ave.	35.1	35.8	39.3	47.0	54.9	60.9	62.1	60.9	55.4	48.1	41.0	36.6

Table 2.—Mainstream Au Sable River at Stephan Bridge. Average of DAILY MAXIMUM water temperatures (⁰F) by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990										48.4	42.7	37.0
1991	35.3	37.9	42.3	50.9	62.2	68.5	65.7	66.2	57.6			
1992							62.0	61.1	56.7			
1993						61.9	67.4	65.1	55.1	48.7	40.7	37.4
1994	34.3	35.8	41.9	48.8	59.2	66.0	66.0	62.9	59.1	50.7	42.8	38.6
1995	36.5	36.2	42.7	47.7	57.4	67.3	68.3	67.4	57.1	51.6	39.0	35.4
1996	35.2	36.9	41.3								39.6	37.0
1997	34.8	37.1									40.3	37.7
1998	36.1	39.6	41.2	50.8	62.2	64.2					43.0	39.0
1999	35.4	38.2	42.9	51.7	60.4	66.5						
2000					59.5	63.7	64.7	64.1	58.2	51.1	42.6	36.5
2001	38.1	38.1	42.8	50.3	59.1	64.8	66.8	65.6	57.7	49.5	45.7	40.5
2002	38.1	38.7	40.3	49.3	54.8	63.5	69.1	65.1	60.6			
2003						63.5	65.9	65.9	58.3	48.9	43.2	38.3
2004	35.5	38.2	42.6	51.1	56.5	63.3	64.6	61.9	60.7	50.3	43.3	36.8
2005	35.4	37.9	41.3	51.4	56.0	67.7	67.4	65.1	60.1	51.5	43.0	37.1
2006	38.7	37.5	42.8	51.8	58.8	64.1	67.3	64.1	56.7	47.8	43.5	39.1
2007	37.6	36.1	42.3	48.4	59.8	65.5	64.8	64.0	58.9	52.6	41.7	37.1
2008	36.8	36.2	40.3	49.6	56.3	63.0	65.3	63.6	57.6	48.7	42.1	35.8
2009	34.9	37.1	41.5	48.7	57.2	62.2	62.6	63.0				
Ave.	36.2	37.4	41.9	50.0	58.5	64.7	65.9	64.3	58.2	50.0	42.2	37.6

Table 3.—Mainstream Au Sable River at Stephan Bridge. **Average of DAILY MINIMUM** water temperatures (°F) by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990										44.6	39.6	34.7
1991	33.0	34.6	37.7	45.8	55.5	59.4	58.6	57.9	52.2			
1992							55.6	54.0	51.4			
1993						56.3	60.6	59.1	51.4	44.5	38.5	35.6
1994	32.6	32.6	36.6	42.7	51.4	57.8	60.5	57.3	54.3	47.3	40.1	36.7
1995	34.6	33.4	38.5	43.0	50.6	59.1	60.4	61.1	51.5	47.9	36.4	33.6
1996	32.9	33.9	35.8								37.4	35.3
1997	33.2	33.7									38.3	36.1
1998	34.2	37.0	36.3	43.2	53.6	55.9					40.8	37.0
1999	33.5	35.1	37.4	45.2	52.5	59.1						
2000					52.6	57.0	57.4	57.3	52.8	47.1	40.8	34.6
2001	36.2	35.5	37.8	45.3	53.4	57.2	58.5	58.6	52.6	46.2	43.1	38.6
2002	36.0	35.4	36.2	44.3	49.1	57.4	61.0	58.2	54.5			
2003						55.6	58.0	59.1	52.9	45.5	40.8	36.6
2004	33.8	34.6	39.1	45.6	51.5	56.3	57.9	55.7	54.3	47.0	41.0	35.2
2005	33.9	35.0	35.9	45.1	49.5	60.1	60.4	59.0	54.9	48.0	40.6	35.7
2006	36.8	34.6	38.4	46.3	52.5	57.3	61.3	58.7	52.8	45.2	41.4	37.6
2007	35.6	33.4	38.4	43.5	52.9	58.9	57.7	57.9	54.0	49.4	39.5	35.3
2008	34.8	33.6	36.0	44.9	50.2	57.9	59.2	57.0	53.3	45.6	39.8	34.0
2009	33.0	34.3	37.2	43.8	51.0	56.1	56.5	57.9				
Ave.	34.3	34.4	37.2	44.5	51.9	57.6	58.9	57.9	53.1	46.5	39.9	35.8

Table 4.—Mainstream Au Sable River at Stephan Bridge. **Highest** water temperature (°F) recorded by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990										56.1	52.0	40.5
1991	38.3	39.9	48.6	59.9	71.4	72.1	69.8	68.9	65.7			
1992							67.3	67.6	62.8			
1993						67.8	73.2	70.0	60.8	63.9	44.2	40.8
1994	36.0	39.4	46.9	77.7	67.5	74.8	70.0	67.6	64.4	55.2	49.8	42.8
1995	39.0	39.6	48.4	52.9	66.4	74.5	74.8	70.7	64.2	71.4	46.6	37.9
1996	40.6	41.0	46.8								48.0	39.9
1997	37.1	40.5									47.8	39.7
1998	40.8	44.4	49.7	58.1	70.2	72.0					50.1	47.9
1999	39.5	42.9	51.8	59.6	67.7	72.4						
2000					66.1	69.7	69.7	68.5	67.9	58.0	49.7	40.0
2001	40.9	40.4	48.2	61.4	64.3	73.0	72.3	73.6	65.5	58.1	51.3	49.6
2002	41.4	41.0	45.1	63.1	66.7	72.3	74.3	69.1	66.1			
2003						72.2	69.8	70.1	63.4	55.8	48.6	41.4
2004	40.8	43.9	47.7	58.6	65.5	70.2	69.2	67.2	65.4	54.1	48.0	39.9
2005	39.3	40.4	49.4	58.6	64.6	72.2	70.4	71.3	65.1	63.7	49.6	39.9
2006	41.3	40.7	50.2	58.3	70.7	70.4	71.3	73.1	62.0	56.6	48.2	41.8
2007	43.2	39.9	50.8	59.1	65.8	70.1	69.0	69.9	64.0	62.0	46.1	41.0
2008	41.3	38.2	44.7	59.2	63.2	68.7	68.4	67.5	64.3	55.0	50.2	39.3
2009	36.2	41.9	47.2	55.5	64.7	70.2	67.6	68.2				
Ave.	39.7	40.9	48.3	60.2	66.8	71.4	70.5	69.6	64.4	59.2	48.7	41.5

Table 5.—Mainstream Au Sable River at Thendara Road. Mean monthly water temperature (°F) by year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989										48.4	40.2	37.3
1990	38.5	37.5	40.0	47.5		56.4	62.8	62.0	57.1	47.3	41.9	36.9
1991	35.2	36.7	40.2	48.4	59.2	64.9	64.6	63.1	55.4	47.2	40.2	35.1
1992	35.1	35.1	37.5	42.9	54.6	58.3	59.9	58.8	55.0	46.4	38.1	35.5
1993	34.0	33.9	38.3	44.4	53.8	59.6	64.6	62.8	53.6	46.0	39.1	36.1
1994	33.2	33.6	38.4	45.5	54.9	61.8	63.4	60.4	57.0	49.0	41.1	37.2
1995	34.9	34.1	39.9	44.9	53.7	63.8	64.7	64.7	54.6	48.6	37.0	34.0
1996	33.5	34.6	37.4	43.0	53.0	60.4	61.9	62.9	56.6	47.1	37.6	35.2
1997	33.1	34.6	37.9	44.1	51.1						38.2	35.6
1998	33.7					61.3	64.7	63.5	58.1	49.4	41.2	37.2
1999	33.3	35.5	39.1	48.4	57.5	64.5	65.2	61.9	54.5	46.9	42.5	37.0
2000	37.0	38.4	42.1	46.3								
2001												
2002						61.1	66.4	63.4	58.8	46.5	40.1	37.1
2003	34.9	35.2	39.3	45.6	53.0	60.8	64.1	64.7	56.7	46.7	40.7	36.9
2004	37.1	38.6	42.0	47.5	51.6	58.8	62.4	60.0	57.4	48.6	42.7	38.0
2005	37.3	38.5	40.5	48.0	52.3	65.4	66.1	63.7	58.9	49.8	40.8	34.9
2006	36.4	34.7	39.6	48.8	55.9	62.2	66.1	63.0	55.6	46.2	41.7	37.2
2007	35.4	33.3	39.6	45.8	55.4	63.8	62.5	61.9	57.2	51.4	41.0	37.3
2008	37.4	36.2	40.6	47.5						47.3	40.2	33.5
2009	33.2	35.1	38.7	45.8	53.5	59.3	60.0	60.4				
Ave.	35.2	35.6	39.5	46.1	54.3	61.4	63.7	62.3	56.4	47.8	40.2	36.2

Table 6.—Mainstream Au Sable River at Thendara Road. Average of DAILY MAXIMUM water temperatures (°F) by month and year; 1989-2009.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989										50.0	41.3	38.6
1990	39.5	39.0	41.8	50.4	54.7	60.5	66.7	64.8	59.6	49.0	43.3	37.8
1991	36.0	38.0	42.2	50.5	62.5	69.6	69.0	67.3	58.4	48.9	41.4	36.1
1992	35.8	36.1	39.3	44.6	57.9	62.5	63.9	62.8	57.9	48.6	39.1	36.4
1993	34.9	35.3	40.9	46.9	56.8	62.3	67.9	65.9	55.5	47.8	40.4	37.1
1994	34.0	35.0	41.2	48.5	59.1	66.2	66.4	63.4	59.6	50.9	42.5	38.1
1995	35.7	35.5	42.0	47.4	57.6	68.2	68.9	68.2	57.8	50.4	38.5	34.8
1996	34.5	36.1	40.5	46.0	56.7	63.7	65.9	67.2	59.5	50.8	38.7	36.0
1997	33.8	36.1	40.2	46.2	53.6						39.1	36.3
1998	34.6					64.6	68.8	66.8	61.0	51.2	42.3	38.2
1999	34.1	37.0	42.0	51.9	61.8	68.4	68.9	65.4	57.0	48.6		
2000												
2001												
2002						64.3	70.5	67.0	61.8	47.8	41.0	37.8
2003	35.7	36.2	41.1	48.5	55.9	65.1	68.3	68.4	59.4	48.5	42.0	37.7
2004	37.7	39.7	43.3	49.4	53.4	62.1	65.9	63.1	60.2	50.0	43.6	38.5
2005	37.8	39.4	42.2	50.4	55.2	69.6	69.9	66.9	61.5	51.6	42.1	35.5
2006	37.3	36.0	41.7	51.0	59.0	65.6	69.1	65.9	57.4	47.4	42.7	38.1
2007	36.3	34.5	41.5	47.3	58.0	67.1	65.9	64.6	59.4	52.8	41.8	37.8
2008	38.2	37.1	41.9	49.5						48.9	41.4	34.3
2009	33.8	36.4	41.0	48.2	56.0	62.2	63.2	62.9				
Ave.	35.9	36.7	41.4	48.5	57.2	65.1	67.5	65.7	59.1	49.6	41.2	37.0

Table 7.—Mainstream Au Sable River at Thendara Road. **Average of DAILY MINIMUM** water temperatures (°F) by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989										46.2	38.9	36.1
1990	37.4	35.9	37.7	44.4		52.9	58.8	59.8	54.6	45.2	40.1	35.8
1991	34.3	35.3	37.6	45.8	56.4	61.3	61.2	60.0	53.2	45.3	38.6	34.0
1992	34.2	33.8	35.5	40.5	50.6	54.9	57.0	55.8	52.8	44.8	37.3	34.8
1993	33.3	32.8	36.2	42.4	51.6	57.4	61.9	60.5	52.1	44.7	38.3	35.5
1994	32.7	32.7	36.3	43.2	51.7	58.9	61.6	58.1	55.2	47.6	39.7	36.1
1995	34.0	33.1	38.0	42.8	51.1	60.3	61.5	62.3	52.3	47.2	35.9	33.4
1996	32.8	33.6	35.4	40.9	50.5	58.1	58.9	59.6	54.7	44.8	36.6	34.5
1997	32.5	33.1	35.8	41.8	48.5						37.2	34.8
1998	33.0					58.1	60.9	60.4	55.4	47.7	40.1	36.4
1999	32.7	34.3	36.6	45.3	53.7	61.0	62.1	58.6	52.0	45.4		
2000												
2001												
2002						58.5	62.8	60.1	56.0	45.2	39.1	36.3
2003	34.2	34.6	37.8	42.8	50.4	56.8	60.3	61.4	54.0	44.9	39.4	36.0
2004	36.7	37.8	40.9	45.8	50.2	55.9	59.3	57.0	54.7	47.2	41.8	37.5
2005	36.8	37.5	38.8	45.8	49.8	61.8	62.6	60.8	56.3	48.2	39.8	34.3
2006	35.6	33.6	37.5	46.6	53.2	58.9	63.3	60.3	53.7	44.9	40.7	36.5
2007	34.6	32.5	37.9	44.4	52.9	60.8	59.4	59.4	55.1	50.1	40.1	36.6
2008	36.9	35.5	39.2	45.4						45.8	39.0	32.8
2009	32.6	34.1	36.9	43.6	51.0	56.6	57.3	58.1				
Ave.	34.4	34.4	37.4	43.8	51.5	58.3	60.6	59.5	54.1	46.2	39.0	35.4

Table 8.—Mainstream Au Sable River at Thendara Road. **Highest** water temperature (°F) recorded by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989										54.1	47.1	40.3
1990	41.7	42.3	47.5	64.9		68.4	73.6	69.8	68.4	57.0	52.2	41.4
1991	38.8	41.2	49.1	60.8	72.5	74.3	74.5	70.7	66.9	55.0	49.6	40.3
1992	38.7	39.4	43.7	52.7	66.9	67.3	68.0	68.4	63.7	56.5	42.8	39.7
1993	37.2	37.9	49.1	54.1	66.2	67.8	73.6	70.9	61.5	55.6	44.6	40.6
1994	35.4	38.5	46.6	54.9	67.3	74.8	70.3	68.0	65.5	55.8	50.0	42.3
1995	38.7	38.7	47.7	52.7	66.4	75.4	75.6	71.4	65.5	57.9	46.2	37.8
1996	39.6	40.3	46.0	52.0	65.8	73.8	70.5	72.9	66.2	59.5	48.0	39.1
1997	36.2	39.4	47.5	53.9	65.0						47.2	38.5
1998	39.4					73.2	74.1	70.8	67.3	55.6	50.0	48.1
1999	38.0	42.2	51.7	60.4	69.4	75.1	77.3	69.4	64.7	55.9		
2000												
2001												
2002						73.0	75.7	71.0	68.5	62.6	48.2	41.4
2003	39.6	38.5	48.2	57.6	61.9	75.7	73.0	73.0	64.9	56.9	48.1	40.5
2004	41.4	43.9	46.9	54.7	58.3	67.5	70.7	69.8	65.5	53.6	48.0	41.0
2005	40.7	41.6	48.5	56.4	63.7	75.3	73.4	74.0	67.5	64.9	49.4	38.5
2006	40.2	39.6	49.7	56.6	72.5	72.5	73.7	76.2	63.4	57.2	48.0	41.3
2007	42.7	38.5	49.7	53.6	67.8	72.9	70.5	71.4	64.6	62.9	46.0	41.5
2008	42.6	40.7	44.9	58.5						56.3	50.7	37.6
2009	35.0	40.7	46.8	54.9	62.4	69.6	67.9	67.9				
Ave.	39.2	40.2	47.7	56.2	66.2	72.3	72.6	71.0	65.6	57.5	48.0	40.6

Table 9.—North Branch Au Sable River at Twin Bridges. Mean monthly water temperature (°F) by year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990						61.4	64.8	63.0	56.2	46.4	40.2	34.6
1991	33.0	35.2	39.3	47.8								
1992							61.2	60.3	56.0			
1993						60.5	65.7	64.2	54.6	46.1	38.8	35.5
1994	32.2	32.9	38.4	44.9	55.5	63.5	64.6	61.5	58.2	49.7	41.4	36.8
1995	34.6	33.6	39.9									
1996												
1997						63.2	64.1	60.1	56.2	48.1	38.9	36.1
1998	34.4	37.7	38.7	47.7	58.6	60.7				49.9	41.8	37.6
1999	34.1	36.1	39.6	48.7	57.7	64.9	66.9	62.5	56.4	47.2	42.1	36.2
2000	33.8	35.8	42.9	47.1	56.9	61.6	63.2	62.7	56.6	49.7	41.0	33.3
2001	34.4	34.7	39.1	47.0	56.5	62.2	64.4	64.6	56.6	48.2	43.9	38.5
2002	36.0	35.8	37.6	46.4	52.2	61.7	67.1	63.9	59.6	47.0	38.8	35.1
2003	33.0	32.9	38.5	45.3	54.2							
2004	33.2	34.7	40.0	47.3	53.7	60.8	63.4	60.6	59.2	49.0	41.5	35.0
2005	33.5	35.8	38.1	47.6	52.8	65.0	65.6	63.6	58.8	50.3	41.0	34.8
2006	36.3	34.7	39.7	48.6	56.3	62.4	65.9	63.1	55.8	46.6	41.3	37.1
2007	35.0	33.3	39.5	45.5							39.8	34.6
2008	34.9	34.2	37.6	46.1						48.0	40.7	33.8
2009	33.1	35.1	39.1	46.3	55.1	61.2	61.3	62.1				
Ave.	34.1	34.8	39.2	46.9	55.4	62.2	64.5	62.5	57.0	48.2	40.8	35.6

Table 10.—North Branch Au Sable River at Twin Bridges. Average of DAILY MAXIMUM water temperatures (°F) by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990						66.9	70.4	67.4	60.2	49.8	42.9	36.3
1991	34.0	37.9	43.7	52.8								
1992							65.9	65.0	59.3			
1993						65.7	71.2	68.5	57.4	48.9	40.7	36.7
1994	32.6	34.2	44.0	51.0	63.3	71.1	70.4	66.8	62.3	52.9	43.7	38.4
1995	35.9	35.5	44.1									
1996												
1997						69.0	69.9	64.3	59.1	50.5	40.3	37.2
1998	35.6	39.9	42.0	52.3	63.8	65.5				52.8	43.4	38.9
1999	35.1	38.2	44.3	54.6	64.2	71.0	72.2	66.4	59.4	49.6	44.4	37.3
2000	34.8	37.7	47.0	52.6	62.2	66.6	68.1	67.0	59.6	52.4	42.3	34.3
2001	35.5	36.3	43.1	51.3	61.7	68.3	70.4	69.3	60.0	50.6	45.9	39.8
2002	37.5	38.0	40.8	50.8	56.9	66.6	72.6	68.1	63.0	49.3	40.5	36.4
2003	34.0	34.4	42.2	51.1	59.9							
2004	33.9	37.1	43.4	52.2	58.2	66.5	68.5	64.5	62.6	50.9	42.9	35.8
2005	34.3	37.5	41.5	52.0	57.1	70.3	70.6	67.5	62.1	52.9	42.8	35.9
2006	37.7	36.7	43.5	53.4	61.6	68.1	71.1	67.2	58.7	48.8	42.8	38.3
2007	36.2	34.7	43.2	50.5							41.3	35.8
2008	36.1	35.8	41.3	51.0						50.3	42.3	34.6
2009	33.9	37.0	43.1	51.2	60.9	66.7	66.0	65.8				
Ave.	35.1	36.7	43.2	51.9	60.9	67.9	69.8	66.7	60.3	50.7	42.6	36.8

Table 11.—North Branch Au Sable River at Twin Bridges. **Average of DAILY MINIMUM** water temperatures (°F) by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990						56.8	59.7	59.0	53.0	44.0	38.3	33.5
1991	32.4	33.7	36.2	44.6								
1992						53.1	56.6	55.4	52.2			
1993						56.3	61.1	60.3	52.0	44.0	37.4	34.6
1994	31.8	32.2	35.0	40.8	50.0	57.9	60.6	57.5	54.6	47.2	39.5	35.4
1995	33.5	32.3	36.6									
1996												
1997						57.7	58.9	56.4	53.2	45.8	37.6	35.0
1998	33.3	35.8	36.0	43.6	53.9	56.3				46.9	40.2	36.2
1999	33.2	34.2	35.5	43.6	51.5	59.2	61.8	58.3	52.8	44.6	40.1	35.1
2000	33.0	34.4	39.2	42.0	51.8	56.7	58.2	58.3	53.5	46.9	39.6	32.6
2001	33.6	33.3	35.5	43.2	50.7	54.4	58.6	59.8	53.2	45.9	42.0	37.3
2002	34.7	34.0	34.8	42.6	48.1	57.6	61.8	59.5	55.9	44.6	36.9	33.8
2003	32.2	32.1	35.5	40.3	48.9							
2004	32.6	32.9	37.2	43.3	50.0	55.7	58.6	56.4	55.2	47.1	40.1	34.3
2005	32.9	34.3	35.0	43.6	48.9	60.0	60.6	59.6	55.1	47.8	39.4	34.0
2006	35.0	33.1	36.3	44.2	51.8	56.9	60.7	58.7	53.0	44.5	39.7	36.0
2007	34.0	32.4	36.4	41.3							38.1	33.4
2008	34.0	32.9	34.3	41.7						45.6	39.1	32.9
2009	32.5	33.6	35.8	42.0	49.9	56.1	56.8	58.3				
Ave.	33.2	33.4	35.9	42.6	50.5	56.8	59.5	58.3	53.6	45.8	39.1	34.6

Table 12.—North Branch Au Sable River at Twin Bridges. **Highest** water temperature (°F) recorded by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990						74.5	80.4	73.6	71.8	57.6	52.9	40.5
1991	38.8	41.9	49.1	62.1								
1992						68.9	71.1	72.7	66.9			
1993						72.5	76.3	73.2	63.9	57.4	44.4	40.6
1994	33.1	41.0	49.6	57.6	72.1	81.3	73.8	71.6	67.1	58.5	51.4	42.6
1995	40.1	40.6	51.4									
1996												
1997						75.1	77.2	72.6	64.7	60.1	47.8	39.4
1998	41.1	46.4	49.2	60.9	71.1	74.1				57.0	49.5	47.2
1999	40.0	43.1	53.7	64.7	71.2	77.3	77.9	69.7	67.0	55.3	52.5	45.0
2000	38.3	47.5	54.8	62.7	70.5	74.8	72.9	70.8	68.8	59.5	51.4	38.0
2001	38.6	39.7	50.0	64.4	69.3	76.3	77.5	78.4	67.6	60.1	52.0	49.1
2002	41.9	43.0	47.5	64.8	68.6	76.5	79.3	72.2	68.9	64.6	49.3	43.2
2003	39.0	40.5	51.3	62.6	67.8							
2004	40.5	46.6	49.3	63.1	66.6	73.4	73.8	70.7	67.8	56.1	47.4	39.6
2005	38.7	41.3	50.5	60.9	66.9	76.6	75.3	74.4	68.1	65.8	51.0	39.6
2006	41.3	40.1	51.3	60.3	75.0	75.0	76.3	78.8	64.3	59.5	48.0	40.7
2007	42.4	40.4	53.8	62.9							45.7	40.1
2008	41.0	38.7	47.6	62.5						57.7	51.0	38.7
2009	35.8	43.7	49.8	59.9	69.1	76.6	71.4	72.7				
Ave.	39.4	42.3	50.6	62.1	69.8	75.2	75.6	73.2	67.2	59.1	49.6	41.7

Table 13.—North Branch Au Sable River at Dam 4. Mean monthly water temperature (°F) by year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990							63.9	61.9	56.3	46.3	40.7	34.9
1991	32.7	34.9	42.9			64.0	63.9	63.0	55.3	47.9	40.1	
1992							60.2	59.4	55.0			
1993						59.6	64.8	63.1	53.6			
1994							63.0	60.1	56.8	48.8	41.0	36.8
1995	35.0	33.6	40.4	44.7	52.9	63.9	65.2	65.0	54.7	49.1	36.8	32.8
1996	32.2	33.9	37.6	43.2	53.2	61.0	62.6	63.8	57.0	47.4	37.8	35.1
1997	32.7	34.9	38.4	44.6	52.7	63.6	64.6	60.2	56.3	48.0	38.9	36.1
1998	34.3	37.7	39.1	48.3	59.7	61.6					41.6	37.1
1999	33.5	35.9	39.8	48.9	58.0	65.2	67.6			46.8		
2000					57.6	62.3	64.0	63.0	56.9	49.7	40.7	32.7
2001	33.9	34.2	39.3	47.9	57.6	63.6	65.5	65.4	56.7	48.2	44.0	38.3
2002	35.8	35.6	37.6	47.2	51.7					46.5	38.4	34.3
2003	32.3	31.9	38.2	45.7	54.7	61.6	65.0	65.0	57.1	46.9	40.7	35.3
2004	32.4	34.1	40.6	47.7	53.8	61.3	63.8	60.9	59.4	48.8	41.0	34.1
2005	33.0	35.2	37.9	48.3	53.3	65.9	66.1	63.8	58.9	49.9	40.8	34.5
2006	36.2	34.3	40.2	49.0	56.5	62.4	66.3	63.3	55.6	46.3	41.3	37.0
2007	34.6	33.1	40.3	45.9	57.3	65.0	64.7	64.3	58.6	52.1	39.7	34.5
2008	34.9	34.0	37.7	48.1	54.2	62.3	64.8	63.1	57.3			
2009					55.3	61.6	61.5	62.0				
Ave.	33.8	34.5	39.3	46.9	55.2	62.8	64.3	62.8	56.6	48.2	40.2	35.3

Table 14.—North Branch Au Sable River at Dam 4. **Average of DAILY MAXIMUM** water temperatures (°F) by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990							69.8	66.7	60.4	49.2	43.0	36.4
1991	33.3	36.6	46.7			71.0	70.3	69.8	59.6	50.4	41.7	
1992							66.6	65.3	59.4			
1993						64.6	70.6	68.2	56.9			
1994							68.5	65.7	61.1	52.1	43.3	38.5
1995	36.0	35.0	44.0	48.3	57.1	70.0	71.5	70.3	59.5	52.4	39.0	33.7
1996	33.1	35.7	42.7	48.9	59.9	66.6	69.7	71.2	61.8	51.4	39.4	36.2
1997	33.4	37.1	42.8	48.9	57.6	69.0	70.7	64.9	60.0	50.9	40.5	37.4
1998	35.4	40.0	42.4	53.3	65.3	66.9					43.3	38.3
1999	34.2	38.0	44.4	54.4	64.2	71.0	73.5			49.9		
2000					63.3	67.9	70.1	69.0	61.6	53.2	42.2	33.2
2001	34.8	36.0	43.6	52.3	62.7	69.7	72.0	71.0	61.2	51.1	46.2	39.6
2002	37.3	38.0	41.0	51.7	56.3					49.0	40.1	35.5
2003	32.9	32.5	40.9	51.5	60.7	68.5	71.4	70.9	61.7	50.1	42.6	36.8
2004	32.8	35.5	43.3	52.0	58.1	66.7	69.4	66.1	64.9	51.6	42.8	34.9
2005	33.6	37.2	42.0	53.7	58.5	71.9	72.4	69.3	63.7	53.2	42.7	35.3
2006	37.7	36.2	44.3	53.9	61.9	68.4	72.2	69.0	59.6	48.9	43.1	38.2
2007	35.7	33.9	43.5	50.1	63.0	71.2	71.0	69.8	63.3	55.0	41.3	35.4
2008	36.0	35.3	41.4	52.3	60.0	67.4	70.5	69.1	61.6			
2009					61.1	67.4	67.0	66.9				
Ave.	34.7	36.2	43.1	51.6	60.6	68.6	70.4	68.4	61.0	51.2	42.1	36.4

Table 15.—North Branch Au Sable River at Dam 4. **Average of DAILY MINIMUM** water temperatures (^oF) by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990							59.0	58.0	53.0	43.6	38.5	33.6
1991	32.0	33.4	39.4			58.5	59.2	58.0	52.2	45.8	37.9	
1992							55.9	54.7	51.8			
1993						55.5	60.1	59.1	50.9			
1994							59.0	56.3	53.4	46.4	39.1	35.5
1995	33.7	32.5	37.5	41.5	49.2	58.4	60.0	61.0	51.0	47.3	35.2	32.2
1996	31.6	32.7	34.6	39.8	48.8	57.1	57.7	58.5	54.0	44.6	36.2	34.3
1997	32.3	33.0	35.1	40.7	48.2	58.1	59.2	56.4	53.3	45.6	37.3	35.0
1998	33.3	35.9	36.3	43.6	54.5	56.9					40.0	36.0
1999	32.9	34.1	36.0	44.3	52.5	60.1	62.7			44.0		
2000					52.9	57.6	58.7	58.3	53.0	46.4	39.3	32.3
2001	33.2	33.1	35.8	44.1	53.3	58.1	59.7	60.4	53.0	45.8	42.0	37.2
2002	34.5	33.9	34.9	43.5	47.6					44.4	36.7	33.3
2003	31.8	31.7	35.9	40.8	49.7	55.6	59.3	59.9	52.9	44.1	38.8	34.1
2004	32.1	33.0	38.3	43.9	50.2	56.2	59.0	56.3	54.6	46.4	39.2	33.3
2005	32.5	33.6	34.6	43.6	48.8	60.7	60.7	59.1	54.5	47.1	39.0	33.8
2006	34.8	32.9	37.0	44.6	52.0	57.0	61.1	58.4	52.5	44.1	39.6	35.8
2007	33.7	32.5	37.7	42.4	52.5	59.6	59.3	59.3	54.8	49.5	38.0	33.4
2008	34.2	33.1	34.7	44.0	49.6	58.1	60.3	58.0	53.8			
2009					50.2	56.6	56.8	57.8				
Ave.	33.0	33.2	36.3	42.8	50.7	57.7	59.3	58.2	53.0	45.7	38.4	34.3

Table 16.—North Branch Au Sable River at Dam 4. **Highest** water temperature (^oF) recorded by month and year; 1990-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990							80.1	72.3	71.6	57.9	53.8	41.5
1991	39.0	42.1	53.8			76.5	75.9	73.8	68.5	55.6	49.1	
1992							71.1	72.0	67.3			
1993						71.4	76.5	73.8	63.0			
1994							72.7	71.1	66.4	57.4	51.4	43.5
1995	40.3	40.5	51.4	54.5	70.2	79.9	80.1	75.6	69.1	74.8	47.7	38.7
1996	41.5	44.1	48.9	54.9	68.5	78.3	74.1	77.2	71.1	57.9	49.2	39.9
1997	36.8	42.2	53.0	57.0	69.0	76.6	78.2	73.8	66.4	61.5	48.3	39.9
1998	42.5	47.5	52.2	61.8	73.8	76.3					50.9	48.4
1999	40.9	43.7	53.7	64.1	71.8	77.3	79.8			57.6		
2000					73.0	77.8	76.4	74.3	73.0	62.0	51.2	38.1
2001	39.5	40.0	51.2	66.1	71.0	79.2	78.4	81.3	69.8	62.1	52.7	50.2
2002	42.8	42.8	48.7	66.7	64.4					66.0	50.2	42.8
2003	38.7	33.4	52.2	63.7	69.1	79.2	77.8	77.1	69.1	59.2	48.2	41.0
2004	40.5	45.7	49.1	62.1	68.5	75.0	74.8	73.6	70.5	57.9	48.6	39.7
2005	39.2	41.7	52.5	62.8	70.5	78.6	77.6	78.0	70.3	67.7	51.7	39.7
2006	41.7	40.6	52.6	61.3	76.1	76.7	78.6	81.4	66.8	61.0	48.9	41.7
2007	43.1	40.6	53.7	61.8	70.7	77.1	77.1	77.5	70.4	68.1	46.3	40.9
2008	42.0	38.9	48.2	62.8	67.5	75.6	74.3	73.4	70.7			
2009					70.5	78.5	72.3	74.8				
Ave.	40.6	41.7	51.5	61.5	70.3	77.1	76.4	75.3	69.0	61.8	49.9	41.9

Table 17.—South Branch Au Sable River at Chase Bridge. Mean monthly water temperature (°F) by year; 1989-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989						61.0	64.7	60.9	55.0	47.0	38.0	32.9
1990	34.1	33.8	36.0	46.8	56.4	62.3	64.7	62.5	57.0	46.2	39.3	33.7
1991	33.1	34.2	37.4	50.0								
1992							61.1	59.3	55.8			
1993						61.3	66.5	63.8	54.3	45.8	37.8	34.6
1994	32.8	33.2	35.7	45.3	56.6	62.8	64.7	62.4	58.9	49.9	40.7	35.6
1995	34.1	34.0	38.3	45.0	55.2	65.0	65.8	66.9	55.9	49.5	35.6	33.3
1996	33.1	33.8	34.9	42.4	54.8	62.9	64.3	64.3	57.1			
1997											38.1	35.4
1998	34.1	36.1				61.6	63.7	61.8	57.4	49.7	40.8	36.7
1999	33.3	34.2	38.5	48.2	56.7	63.1	67.8	62.8	55.9	46.9	42.0	35.9
2000	35.9	37.5	41.7	46.7	58.6				54.6	49.8	40.1	34.4
2001	37.3	36.9	38.1	48.0	59.2	64.4	64.2	62.9	56.0	48.2	42.9	36.8
2002	34.2	34.4	34.6	46.5	53.3	63.4	66.4	61.5	57.2	47.0	40.7	37.2
2003	37.2	37.0	39.8	44.2	52.8	61.5	64.2	64.6	57.0	47.1	39.4	
2004							63.4	60.0	58.2	49.2	40.6	33.9
2005	32.9	34.0	35.4	47.1	54.1	66.3	65.8	63.2	58.2	50.3	40.3	33.5
2006	34.0	33.2	37.0	50.6	57.4	64.0	67.3	63.5	56.0	45.9	39.9	34.8
2007	34.1	33.3	37.8	45.7	59.3	65.8	63.5	62.4	57.4	51.6	40.1	35.1
2008	34.5	33.9	36.8	47.8	55.1	64.3	65.4	62.2	58.1	48.1	40.2	34.5
2009	33.1	33.5	35.5	46.4	57.1	62.7	60.8	60.2				
Ave.	34.2	34.6	37.2	46.7	56.2	63.3	64.7	62.5	56.7	48.3	39.8	34.9

Table 18.—South Branch Au Sable River at Chase Bridge. Average of DAILY MAXIMUM water temperatures (°F) by month and year; 1989-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989						63.9	68.8	64.9	58.2	48.8	39.1	33.6
1990	35.2	35.4	37.8	48.5	58.4	64.8	68.0	65.1	59.3	47.9	40.8	34.4
1991	33.8	35.8	40.4	52.3								
1992							63.7	62.4	57.9			
1993						62.9	69.4	66.6	55.7	47.5	38.9	35.4
1994	33.6	34.7	38.3	47.5	59.7	67.1	67.9	64.9	61.2	51.6	41.8	36.4
1995	34.9	35.4	40.2	47.0	58.3	69.4	70.5	70.2	59.1	50.6	36.8	34.0
1996	34.0	35.2	37.5	44.3	57.2	65.1	67.3	68.4	65.2			
1997											38.8	36.1
1998	34.9	37.4				65.0	68.3	65.6	60.9	51.5	41.8	37.6
1999	34.1	35.7	41.1	51.0	60.2	65.9	70.7	66.2	59.0	48.3	43.4	36.6
2000	36.6	38.5	43.8	49.5	61.1				56.6	51.9	41.0	35.1
2001	37.8	37.7	39.9	49.7	61.3	67.2	68.9	66.8	58.8	49.8	44.0	37.7
2002	35.1	35.9	36.1	48.9	55.6	66.2	70.8	65.6	60.5	48.2	41.6	37.8
2003	37.7	37.8	41.1	46.2	54.7	64.7	68.1	68.4	59.8	48.7	40.5	
2004							66.7	63.4	61.7	50.7	41.6	34.5
2005	33.5	35.0	37.6	49.4	56.9	69.6	69.5	66.6	61.2	52.1	41.4	34.1
2006	34.7	34.3	38.6	52.9	60.2	67.1	70.4	66.6	58.0	47.1	40.8	35.5
2007	34.9	34.4	39.8	47.9	62.1	68.7	67.4	65.8	60.5	53.4	40.9	35.8
2008	35.2	34.7	38.4	49.8	58.2	66.2	68.2	65.9	60.2	49.6	41.3	35.1
2009	33.6	34.5	37.3	48.7	59.4	65.2	63.7	62.8				
Ave.	35.0	35.8	39.2	48.9	58.8	66.2	68.2	65.9	59.6	49.8	40.8	35.6

Table 19.—South Branch Au Sable River at Chase Bridge. **Average of DAILY MINIMUM** water temperatures (^oF) by month and year; 1989-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989						58.5	61.3	57.8	52.4	44.6	36.5	32.3
1990	33.0	32.5	33.9	43.8	53.3	60.1	61.9	60.2	55.2	45.1	38.1	33.0
1991	32.6	33.3	34.9	48.4								
1992							58.4	55.8	53.3			
1993						59.7	64.2	61.6	53.2	44.7	37.0	34.1
1994	32.3	32.4	34.0	43.2	54.4	59.9	62.7	60.7	57.3	48.6	39.2	34.5
1995	33.4	32.9	36.0	42.7	53.3	61.8	62.5	65.0	53.8	47.5	34.7	32.9
1996	32.6	33.1	33.4	40.3	52.9	61.6	62.1	61.6	51.4			
1997											37.3	34.8
1998	33.4	35.1				58.8	60.1	58.7	54.6	48.1	39.8	35.9
1999	32.7	33.0	36.2	45.6	53.6	60.6	65.4	60.0	53.2	45.6	40.8	35.2
2000	35.2	36.5	39.7	44.0	56.2				53.0	48.0	39.2	33.7
2001	36.9	36.4	36.6	46.3	57.2	61.9	60.5	59.6	53.7	46.7	41.8	36.2
2002	33.4	33.2	33.3	44.4	51.3	60.9	62.9	58.3	54.5	45.8	39.9	36.7
2003	36.7	36.3	38.7	42.3	51.0	58.5	60.9	61.6	54.5	45.6	38.5	.
2004							60.7	57.2	55.2	47.8	39.6	33.4
2005	32.6	33.1	33.6	44.9	51.5	63.4	62.9	60.5	55.7	48.8	39.5	33.1
2006	33.4	32.5	35.3	48.4	54.8	61.3	64.6	61.0	54.3	44.7	39.0	34.2
2007	33.5	32.6	36.3	43.8	56.7	63.2	60.4	59.7	55.0	50.1	39.1	34.4
2008	34.0	33.3	35.5	46.0	52.5	62.7	63.2	59.2	56.4	46.8	39.2	34.0
2009	32.7	32.8	34.2	44.6	54.8	60.5	58.4	58.1				
Ave.	33.6	33.7	35.4	44.6	53.8	60.8	61.8	59.8	54.2	46.8	38.8	34.3

Table 20.—South Branch Au Sable River at Chase Bridge. **Highest** water temperature (^oF) recorded by month and year; 1989-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989						72.5	74.7	73.2	66.7	55.6	46.2	36.0
1990	37.9	38.7	42.8	68.9	63.7	71.6	76.3	70.3	68.5	56.5	50.4	36.3
1991	36.3	37.4	61.0	62.4								
1992							68.7	68.4	64.4			
1993						67.6	75.6	71.1	62.2	55.4	42.8	37.9
1994	34.9	38.7	42.3	55.4	68.9	76.3	71.4	69.3	66.9	56.8	48.7	39.2
1995	37.2	38.8	45.7	52.2	67.3	76.6	77.7	72.9	67.1	58.5	45.5	35.6
1996	37.9	38.5	40.6	55.6	66.7	76.1	73.0	73.8	80.4			
1997											46.9	37.9
1998	38.3	41.0				73.6	73.2	69.4	65.8	55.0	48.7	47.7
1999	36.7	38.1	50.7	60.4	66.2	71.8	77.0	70.3	68.0	53.4	50.4	43.4
2000	37.8	41.5	52.6	60.2	71.2				66.2	59.5	49.3	37.2
2001	39.7	39.7	44.2	61.3	66.7	75.2	75.7	75.4	66.6	59.0	48.7	47.1
2002	37.2	37.8	42.1	66.2	69.1	75.2	78.0	70.0	66.2	60.4	48.2	40.6
2003	39.6	40.1	46.2	53.8	59.9	75.2	72.7	72.7	65.0	56.5	47.6	.
2004							72.3	69.4	66.6	54.5	49.5	36.9
2005	35.5	37.2	45.3	60.7	65.6	73.9	72.7	72.7	66.5	65.6	49.5	35.8
2006	36.1	35.5	49.8	59.9	74.5	73.6	74.5	77.9	63.8	56.8	47.3	41.7
2007	40.0	37.8	52.6	60.7	69.4	74.2	72.7	71.5	66.2	63.0	45.9	38.1
2008	37.8	36.4	42.0	62.2	65.7	72.2	72.2	70.4	66.9	56.5	50.7	37.5
2009	34.1	38.1	43.7	57.1	67.5	75.3	68.4	68.7				
Ave.	37.3	38.4	46.8	59.8	67.3	73.8	73.7	71.5	66.9	57.7	48.0	39.3

Table 21.—South Branch Au Sable River at Smith Bridge. Mean monthly water temperature (°F) by year; 1991-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991						62.5	61.5	60.6	54.3			
1992							60.0	58.2	54.8			
1993						60.4	65.1	62.5	53.7	46.0	38.5	35.2
1994												
1995												
1996											36.8	34.4
1997	32.8	33.8									38.5	35.9
1998	34.5	37.0	37.6	48.3	59.3	59.1					42.0	39.1
1999	37.0	37.4	39.9	47.1	56.4	61.5	64.0	60.1	54.5	47.0	42.7	38.7
2000	38.0	39.1	42.8	46.4	57.9	62.1	61.8	61.2	56.1	49.2	40.2	32.8
2001	34.2	33.9	37.5	47.6	58.2	63.5	63.2	65.1	58.6	51.5	47.8	41.9
2002	39.2					62.6	66.4	62.2	57.9	46.5	39.3	35.6
2003	34.3	34.8	39.2	44.5	53.3	60.8	63.7	63.9	56.3	46.8	39.9	34.2
2004	32.6	33.9	36.5	48.1	56.0	63.0	62.9	59.3	57.2	48.7	42.1	39.0
2005	38.0	36.6	37.7	45.3	47.8	62.0	63.7	62.0	57.3	49.6	41.0	33.9
2006	35.3	35.7	39.2	48.0	54.7	62.1	65.9	62.5	55.2	45.9	40.6	35.7
2007	34.2	33.2	38.3	45.5	58.6	65.1	63.0	62.2	57.2	51.3	39.9	34.7
2008	34.1	33.4	36.6	47.6	54.5	63.5	64.8	61.5	57.2	47.6	40.4	34.0
2009	33.0	34.1	36.5	46.2	56.3	61.6	60.8	60.6				
Ave.	35.2	35.2	38.3	46.8	55.7	62.3	63.7	61.9	56.7	48.4	41.2	36.3

Table 22.—South Branch Au Sable River at Smith Bridge. Average of DAILY MAXIMUM water temperatures (°F) by month and year; 1991-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991						65.4	64.5	63.8	57.0			
1992							62.8	61.1	57.1			
1993						63.3	68.8	65.7	55.7	47.8	39.7	36.1
1994												
1995												
1996											37.8	35.0
1997	33.3	35.0									39.4	36.8
1998	35.3	38.2	39.2	50.8	62.6	61.9					43.0	39.9
1999	37.4	38.3	41.7	49.3	60.4	64.7	67.2	62.9	57.0	48.8	44.2	39.3
2000	38.4	39.8	43.9	49.7	61.1	65.7	65.8	65.3	59.3	51.8	41.4	33.4
2001	34.9	35.2	40.1	50.0	61.4	67.4	67.9	68.8	61.9	53.4	49.1	42.8
2002	40.2	.	.	.	.	66.3	71.0	66.7	61.7	48.4	40.6	36.6
2003	34.9	35.4	41.1	47.8	56.4	65.0	68.0	68.1	59.5	49.0	41.1	35.1
2004	32.9	35.2	37.9	50.5	58.2	66.0	66.3	62.4	60.5	50.1	42.9	39.4
2005	38.5	37.6	39.3	46.9	49.3	65.3	67.4	65.5	60.4	51.8	42.1	34.4
2006	36.0	36.4	40.6	49.7	57.6	65.8	69.5	65.9	57.6	47.3	41.6	36.4
2007	35.0	34.0	40.2	48.0	62.3	68.9	66.9	65.8	60.5	53.3	41.1	35.5
2008	34.8	34.3	38.8	49.9	58.3	66.4	68.5	65.6	59.9	49.6	41.6	34.7
2009	33.4	35.1	38.4	48.6	59.7	65.4	64.7	64.2				
Ave.	35.8	36.2	40.1	49.2	58.8	65.7	67.6	65.5	59.8	50.4	42.4	37.0

Table 23.—South Branch Au Sable River at Smith Bridge. **Average of DAILY MINIMUM** water temperatures (°F) by month and year; 1991-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991						60.0	59.1	57.9	52.5			
1992							56.4	54.2	51.8			
1993						57.8	61.7	59.7	52.0	44.4	37.6	34.6
1994												
1995												
1996											35.7	33.7
1997	32.5	32.7									37.5	35.2
1998	33.7	36.0	36.0	46.0	56.1	56.1					41.0	38.5
1999	36.6	36.7	38.2	45.0	52.5	58.5	61.2	57.3	52.1	45.4	41.5	38.2
2000	37.7	38.6	42.0	43.4	54.9	58.6	58.2	57.9	53.3	47.0	39.2	32.4
2001	33.6	33.0	35.2	45.4	55.4	59.9	58.8	61.6	55.9	50.0	46.6	41.2
2002	38.4	.	.	.	.	59.3	62.0	58.2	54.5	44.8	38.0	34.8
2003	33.8	34.2	37.5	41.7	50.6	56.8	59.6	60.4	53.4	45.0	38.8	33.5
2004	32.3	32.9	35.2	46.1	54.1	60.1	59.5	56.4	54.3	47.4	41.3	38.6
2005	37.6	35.8	36.1	44.0	46.8	59.1	60.5	59.0	54.6	47.8	40.1	33.4
2006	34.7	35.1	38.2	46.6	52.2	58.5	62.3	59.2	52.9	44.5	39.7	35.1
2007	33.6	32.7	36.7	43.5	55.1	61.4	59.2	58.9	54.3	49.6	38.8	33.9
2008	33.6	32.8	34.6	45.6	51.3	61.0	61.3	57.6	54.6	45.8	39.2	33.3
2009	32.7	33.4	35.0	44.4	53.3	58.3	57.2	57.4				
Ave.	34.7	34.5	36.8	44.7	52.9	59.0	60.0	58.5	54.0	46.7	40.1	35.7

Table 24.—South Branch Au Sable River at Smith Bridge. **Highest** water temperature (°F) recorded by month and year; 1991-2009.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991						73.4	69.8	66.2	62.6			
1992							67.1	67.3	64.0			
1993						68.9	75.0	70.2	63.0	54.7	42.8	39.0
1994												
1995												
1996											45.8	37.4
1997	35.7	39.1									47.2	38.5
1998	40.8	41.9	48.3	57.5	69.6	67.9					49.0	47.9
1999	40.9	41.2	49.3	60.3	67.5	73.7	71.9	66.6	64.5	56.0	50.2	44.6
2000	40.6	42.3	48.4	59.4	69.8	72.5	71.6	70.1	68.1	59.1	49.0	37.5
2001	38.4	38.1	45.7	61.7	67.2	75.9	75.0	75.9	68.5	62.2	53.6	51.4
2002	43.3					75.3	77.5	71.1	67.8	63.7	48.9	41.9
2003	39.4	40.1	48.6	58.1	62.2	73.5	72.6	72.6	65.8	56.9	47.7	37.2
2004	37.8	41.0	43.7	57.9	66.6	73.4	72.3	68.2	64.9	53.6	48.8	40.7
2005	39.3	39.9	45.2	53.0	54.4	71.0	70.8	71.9	65.5	64.0	49.9	37.0
2006	37.8	38.1	47.6	54.6	70.1	72.5	74.9	76.8	63.7	55.5	47.2	42.4
2007	40.2	38.7	51.4	60.6	69.4	73.6	71.8	71.2	66.2	63.9	46.3	39.3
2008	39.0	36.5	43.8	62.7	65.6	72.4	71.5	69.4	66.8	56.8	50.7	38.1
2009	34.4	40.6	44.6	56.6	67.8	74.6	69.8	70.4				
Ave.	39.0	39.8	47.0	58.4	66.4	73.0	72.7	71.3	66.2	59.2	49.0	41.4