AN ANALYSIS OF STREAM TEMPERATURE PROFILES IN NORTHERN NEW HAMPSHIRE (2014)

STATE:	New Hampshire
GRANT:	F-50-R-31
GRANT TITLE:	Anadromous and Inland Fisheries Operational ManagementInvestigations
JOB 2:	Fish Habitat Surveys in Rivers and Streams
PERIOD COVERED:	July 1, 2014 – June 30, 2015
PRINCIPAL INVESTIGATOR:	Andrew Schafermeyer Fisheries Biologist I

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INTRODUCTION

Prior to making management decisions, it is important to understand water temperature profiles for those rivers and streams sustaining or having the potential to sustain populations of salmonids. It has clearly been shown that water temperatures influence growth, behavior, survival, and distribution of trout and salmon (Cunjak and Green 1986, Ebersole et al. 2001, Selong et al. 2001, Workman et al. 2002). The objective of this study was to examine stream temperature ranges during the months of July and August and identify waters where the duration and extent of stream temperatures are considered lethal to sub-lethal for salmonids. Also, because most salmonid stocking ends in June in New Hampshire, an analysis of July and August stream water temperatures is useful for determining the survivability potential for stocked salmonids as well as the water's "hold-over" capacity for these fish species.

METHODS

During 2014, *Optic StowAway* thermographs (Onset Computer Corp©) were deployed at 23 locations in 3 different waterbodies throughout Coos County and Grafton County (Table 1).

Temperature monitors were deployed from late June through the end of August, and were programmed to record water temperature (°C) every hour. The units were housed in a protective case made of 1.5 in. diameter PVC pipe, capped on both ends and drilled with 1/4 in. diameter holes to allow water to flow through. The cases were attached to cement blocks with steel cable and placed in deep water behind large boulders to afford protection from heavy stream flows as well as anthropogenic disturbance and exposure as water levels receded during the summer months.

Fourteen data loggers were deployed within the Dead and Swift Diamond Rivers, where a remote and unstocked watershed allow for a study of the relationship between temperature and Brook Trout (*Salvelinus fontinalis*) behavior. Temperatures were recorded to assess thermal refuge locations and the suitability of differing habitat to migrating or spawning trout. Within this watershed, temperatures have been monitored for over a decade.

Nine locations within the Ammonoosuc River Watershed were monitored in 2014 to evaluate current habitat conditions and determine if the river is suitable to support salmonids throughout the year and warrant special management. In cooperation with Trout Unlimited (TU), Plymouth State College (PSU), and the Ammonoosuc Conservation Trust (ACT), the Ammonoosuc River watershed will be more closely studied in the 2015 field season.

RESULTS

Data collected from the 23 units are summarized and mean July and August water temperatures are shown in Table 1. Trends, fluctuations, and extremes are displayed in Figures 1 through 3.

In the Dead Diamond River, eight temperature loggers deployed in 2014 recorded a range in July and August from 10.6 to 26.5°C and an average of 17.25°C over the same time period. Six temperature loggers were also deployed in the Swift Diamond River and recorded water temperatures in July and August that ranged from 9.6 to 27.9°C, with an average of 16.4°C.

Because temperature loggers are difficult to observe on a daily basis, it is possible that, with receding water levels, air temperature is recorded. All data points are analyzed with this possibility in mind. In 2014, it is suspected that two loggers on the Dead Diamond River (Halfmoon from July 10 – 15 and Hellgate from July 18 to 23) and one on the Swift Diamond River (HOR from July 18 – 23) were exposed to the air and the data from those time periods was removed.

Within the Ammonoosuc River, nine loggers were deployed and analysis showed healthy conditions for coldwater fish as mean July and August water temperatures averaged 15.8°C and ranged from 9.0 to 27.3°C.

DISCUSSION

For many years, the New Hampshire Fish and Game Department has worked with many partners on projects related to water temperature. Water temperature data is a critical variable used when evaluating new management approaches or evaluating the overall health of an aquatic ecosystem. Building a long-term data set makes it possible to identify trends and fluctuations, and to quantify habitat suitability for salmonids in New Hampshire.

The Dead and Swift Diamond Rivers are unique and natural rivers located mostly in Second College Grant in northern New Hampshire. With no trout stocking since 2009 and limited access, it offers many opportunities to study coldwater fish. Roughly half of both rivers lay within the boundaries of the Dartmouth College Grant which has gated roads and allows for foot traffic only. Since 2001, water temperatures have been catalogued within this watershed and long term trends have been analyzed (Schafermeyer, 2003). This drainage has a diversity of habitat and stream temperatures that support wild trout populations.

In 2014, temperatures followed patterns of years past and with four high water events in July, a critical month for temperature, fish responded well. It is known that water temperatures affect community structure and limit species distribution because species have different fundamental thermal niches (Magnunson et al. 1979). Opportunities to

document spawning behavior, seasonal habitat preference, and thermal limitations to brook trout distribution have all been undertaken within these rivers and a database of water temperatures has been a vital tool.

As part of a much larger inventory designed by the Eastern Brook Trout Joint Venture (EBTJV), the Ammonoosuc River and its tributaries were sampled in 2013 and 2014. Temperatures recorded in 2014 followed a predictable pattern and provided adequate habitat for salmonids. Exposure to lethal temperatures (>22°C) was short lived in 2014 and only observed in lower sections of the river suggesting that the upper portion provides thermal refuge throughout the summer. A very active community and angling group (Ammonoosuc Trout Unlimited) have taken a role in conserving and enhancing this watershed. Surveys of fish, stream crossings, and other habitat variables have been conducted. Water temperatures play an important role in management changes and will be monitored again in the 2015 field season.

Stream temperature is a common focus of study because of its importance in governing many instream processes (Johnson 2004). The information gathered in the 2014 season permitted direct comparisons among sites to illustrate differences in temperature ranges, minimums, maximums, and the extent and duration of temperatures that are stressful or lethal to various salmonids. This information will be useful when formulating trout management strategies and points out the limitations, from a temperature standpoint, to maintaining self-sustaining populations of trout in certain streams.

LITERATURE CITED

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Table 2. The Mean value of July and August Combined Water Temperature (MJAWT), Mean Value of July Water Temperatures (MJWT), and Mean Value of August Water Temperature (MAWT) and ranges observed in selected streams in Northern New Hampshire, 2014.

Stream	Town	Latitude	Longitude	MJAWT (SD) Range	MJWT (SD) Range	MAWT (SD) Range
Ammo headwaters	Crawford's P.	44.26744	-71.37724	11.5 (±0.9) 9.0 – 14.2	11.8 (±1.0) 9.9 – 14.2	11.1 (±0.8) 9.0 – 13.5
Ammo base station	Bretton Wds.	44.25689	-71.43762	14.0 (±1.8) 10.4 – 19.7	14.5 (±1.8) 10.9 – 19.7	13.6 (±1.6) 10.4 – 18.5
Ammo Crawford Brook	Bretton Wds.	44.25438	-71.25438	14.6 (±1.9) 10.7 – 20.7	15.0 (± 1.9) 11.2 – 20.7	14.1 (±1.8) 10.7 – 19.3
Ammo zealand	Carroll	44.26462	-71.49442	15.6 (±2.0) 11.4 – 21.2	16.2 (±2.0) 11.8 – 21.2	15.1 (±1.8) 11.4 – 19.2
Ammo salmon site	Carroll	44.27022	-71.54151	16.2 (±2.2) 11.4 – 23.0	16.8 (± 2.3) 12.0 – 23.0	15.7 (±2.0) 11.4 – 20.8
Ammo haystack brook	Bethlehem	44.27307	-71.58311	16.5 (±2.4) 11.3 – 24.1	17.1 (±2.4) 12.1 – 24.1	15.9 (±2.2) 11.3 – 21.7
Ammo pierce bridge	Littleton	44.27161	-71.63165	16.8 (±2.2) 12.4 – 24.1	17.5 (±2.4) 12.9 – 24.1	16.1 (±1.7) 12.4 – 19.9
Ammo wing road	Bethlehem	44.29980	-71.66745	17.3 (±2.4) 11.8 – 23.8	18.0 (±2.4) 12.8 – 23.8	16.7 (±2.1) 11.8 – 21.3
Ammo pearl lake brook	Lisbon	44.22065	-71.90131	19.9 (±2.7) 14.5 – 27.3	20.6 (±2.8) 14.7 – 27.3	19.1 (±2.4) 14.5 – 24.8
Dead Diamond Emerson Pool	2nd Col. Grnt	44.89431	-71.07861	15.9 (± 2.3) 10.6 – 26.5	16.8 (± 2.3) 11.5 – 26.5	15.0 (±1.8) 10.6 – 21.1
Dead Diamond Fishing Hole	Atk./Gil. Gnt.	44.98836	-71.14119	17.0 (±2.4) 11.3 – 24.2	17.6 (±2.5) 12.0 – 24.2	16.4 (±2.2) 11.3 – 21.3
Dead Diamond Gauge Station	2nd Col. Grnt	44.87720	-71.05740	17.8 (±2.2) 12.6 – 25.1	18.5 (±2.3) 13.9 – 25.1	17.0 (±1.9) 12.6 – 21.7
Dead Diamond Halfmoon[1]	2nd Col. Grnt.	44.94295	-71.08484	17.3 (±2.1) 12.4 – 25.0	17.8 (±2.2) 13.5 – 25.0	17.4 (±1.9) 12.4 – 21.5
Dead Diamond Hellgate[1]	Atk./Gil. Gnt.	44.97523	-71.11809	16.6 (±2.2) 11.5 – 22.9	16.9 (±2.3) 11.9 – 22.9	16.3 (±2.1) 11.5 – 21.6
Dead Diamond Management Ctr.	2nd Col. Grnt	44.88494	-71.07391	18.0 (±2.0) 13.5 – 23.6	18.7 (±2.0) 14.7 – 23.6	17.3 (±1.7) 13.5 – 20.9
Dead Diamond Monahan's	2nd Col. Grnt.	44.92418	-71.09215	17.7 (±2.2) 12.9 – 24.8	18.4 (±2.3) 13.8 – 24.8	17.1 (±2.0) 12.9 – 22.1
Dead Diamond Slewgundy	2nd Col. Grnt.	44.95994	-71.09441	17.5 (±2.3) 12.1 – 24.5	18.1 (±2.4) 13.0 – 24.6	17.0 (±2.1) 12.1 – 21.1
Swift Diamond River -upstr. conf	2nd Col. Grnt.	44.88206	-71.07272	17.3 (±2.7) 11.3 – 26.2	18.2 (±2.8) 12.5 – 26.2	16.6 (±2.4) 11.3 – 22.7
Swift Diamond River -HOR[1]	2nd Col. Grnt.	44.88158	-71.08500	16.8 (±2.7) 9.6 – 26.7	17.2 (±2.9) 9.6 – 26.7	16.4 (±2.3) 11.3 – 22.5
Swift Diamond River 12 mile	Dix's Grant	44.91173	-71.23677	15.0 (±1.6) 10.8 – 21.0	15.5 (±1.7) 12.0 – 21.0	14.5 (±1.3) 10.8 – 17.4
Swift Diamond River below BDP	Dixville	44.94913	-71.30122	17.4 (±1.7) 12.7 – 22.5	18.1 (±1.5) 15.0 – 22.5	16.7 (±1.7) 12.7 – 21.3
Swift Diamond River Ell. Falls	2nd Col. Grnt.	44.87345	-71.13602	16.6 (±2.8) 9.6 – 27.9	17.3 (±3.2) 9.6 – 27.9	15.8 (±2.2) 10.9 – 22.0
Swift Diamond River Robber's R.	2nd Col. Grnt.	44.87648	-71.20943	15.5 (±2.0) 11.3 – 23.6	16.1 (±2.1) 12.4 – 23.6	15.0 (±1.8) 11.3 – 20.5

[1]Temperature logger may have been exposed to record air temperatures

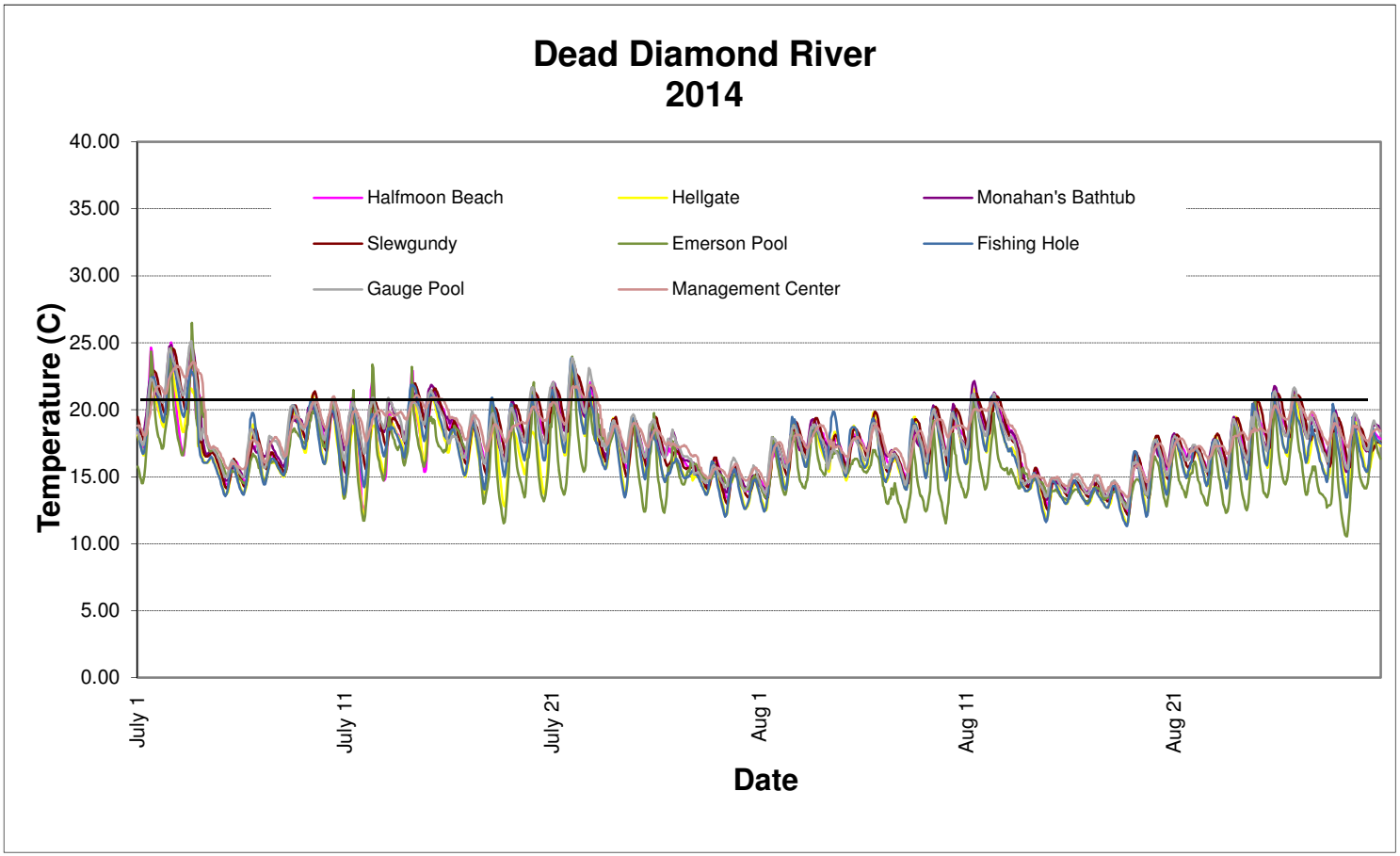

Figure 1. Stream temperature profile for the Dead Diamond River at eight different sites, 2014.

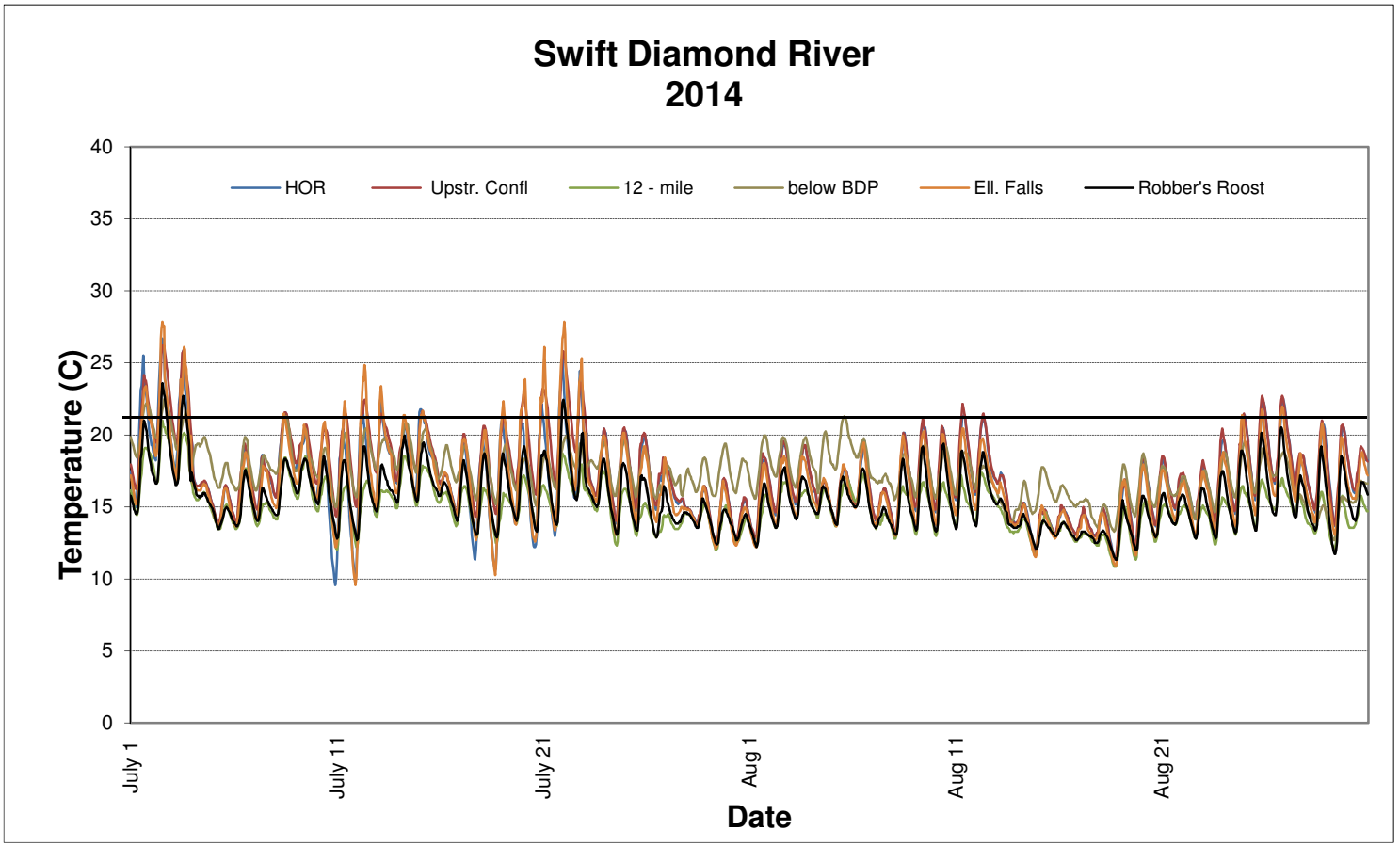

Figure 2. Stream temperature profile for the Swift Diamond River at six different sites, 2014.

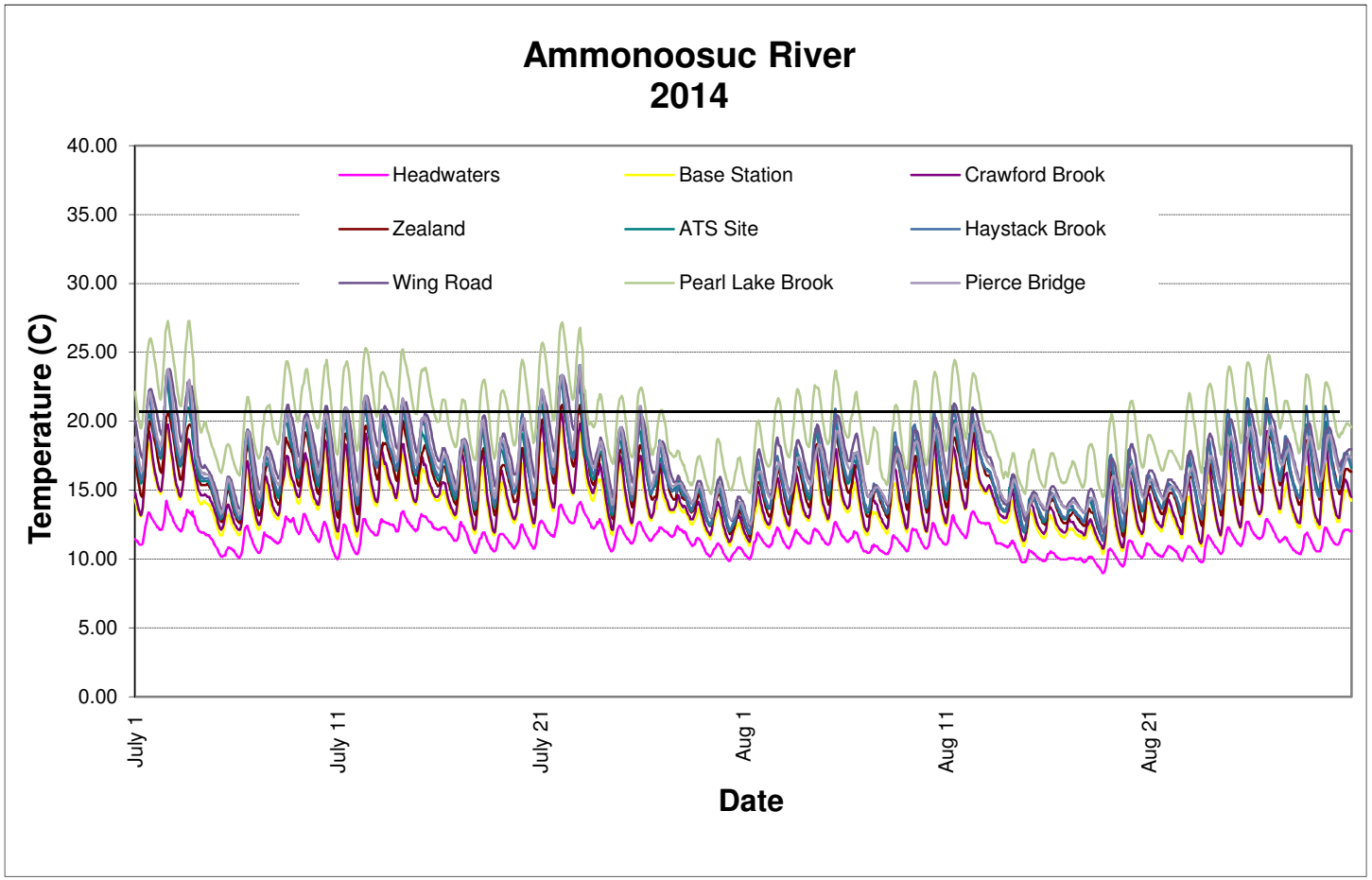

Figure 3. Stream temperature profile for the Ammonoosuc River at nine different sites, 2014.