Hunters Brook
Marquette County, T42N R24W Section 33
Escanaba River Watershed

John M. Bauman, Fisheries Biologist, Escanaba

Environment

Hunters Brook is a warm transitional stream which begins in southeast Marquette County, flows approximately 28 miles in a southeastern direction into Delta County (Figure 1), and ends where it enters the Main Branch of the Escanaba River. Headwater reaches of Hunters Brook are adjacent to the towns of Arnold and Watson. The total drop in elevation from the headwaters to the mouth of Hunters Brook is approximately 225 feet (8 feet per mile). Therefore, the stream gradient is fairly constant with gentle riffle areas and no waterfalls, except at the mouth where Hunters Brook enters the Main Branch of the Escanaba River. This waterfall serves as a barrier to upstream migration of fishes during much of the year.

The Hunters Brook watershed drains an area of approximately 46 square miles with headwater tributaries consisting of several small spring ponds (T42NR25W). Within Marquette County, Hunters Brook originates and flows mostly within the Trempealeau, Prairie Du Chien, and Black River group bedrock formations. As Hunters Brook flows southeasterly through Delta County, the watershed is contained within the Trenton group bedrock formation. The surficial geology of Hunters Brook is characterized entirely by Moraine landforms with medium textured materials which, compared to watersheds comprised of course-textured deposits, results in lower amounts of groundwater input to the stream, warmer temperatures, and less stable flows. Land use surrounding Hunters Brook is dominated by wetland (55.3 percent) and forest (31.7 percent) cover types, followed by agricultural-use (6.7 percent), grasslands (3.5 percent), urban (2.6 percent) and other (0.3 percent). Riparian regions of Hunters Brook are characterized as wetlands or semi-wetlands consisting of cedar and spruce cover types, in addition to an abundance of tag alder. The range in summer discharge at the mouth of Hunters Brook is estimated to be from five to ten cubic feet per second (95 percent exceedance of 8.7 cubic feet per second annually).

On 20 March 1967, Hunters Brook was tested for Total Alkalinity adjacent to the Boney Falls H Rd (County Road 523) bridge crossing. Water samples were collected from the surface of Hunters Brook and Total Alkalinity was later reported to be 130 mg/L. This result suggests Hunters Brook has the capacity to buffer against fluctuations in stream pH due to high discharge events or snow melt, keeping pH within a range considered `normal' for fishes. Physical characteristics within Hunters Brook include riffles, runs, deep holes (5 to 8 feet), undercut banks, and overhanging vegetation. Aquatic vegetation in Hunters Brook includes mostly Potamogeton spp, and Vallisineria spp. Bottom substrate types include rocks, sand, logs and decaying organic matter. Additional physical features of headwater areas of Hunters Brook includes the presence of active and abandoned beaver dams as well as intermittent reaches with downed timber.

The Hunters Brook watershed is largely undeveloped and only sparsely populated, with two communities (Arnold and Cornell) with a combined population of approximately 900. Over 40 percent of the riparian land adjacent to Hunters Brook is listed under the Commercial Forest Act. Nearly 19

percent of the riparian land is managed by the State of Michigan Forestry Division, which in addition to that managed by the Commercial Forest Act comprises nearly 60 percent of riparian areas of Hunters Brook. Therefore, the public can gain access to Hunters Brook at a large number of locations particularly along County Road 426.

History

Fisheries management history in Hunters Brook is best described as having three distinct periods of management; 1) early stocking, 2) habitat manipulation plus stocking and 3) Status and Trends. During the early stocking period, which began in the 1930s and continued through the mid 1960s, Hunters Brook was stocked in attempt to create a Brook Trout fishery. Brook Trout were stocked in Hunters Brook at an average annual stocking rate of 60 fish per mile (based on 28 miles of stream) with a range of 7 to 179 fish per mile. No fisheries surveys were conducted during this period until 1958 when managers conducted a survey to collect baseline information about the fish community at two locations in Hunters Brook. No trout were captured during this survey. However, local residents indicated that Brook Trout could be captured in headwater streams of Hunters Brook. .

In August of 1965 a series of Rotenone surveys were conducted at nine reaches along Hunters Brook to evaluate recent trout plantings and inventory the fish community. A total of 15 Brook Trout were captured during these survey efforts. After this survey managers entered two periods of habitat manipulation which started in the late 1960s and ended initially in 1976, and then resumed in the early 2000s albeit with different goals. For example, in July of 1967 a large channel clearing project began in Hunters Brook in an attempt to improve natural reproduction of Brook Trout. Reports from this period stated that large log jams were detrimental to trout reproduction because they backed up water resulting in an increase in stream temperature and inundation of spawning gravel by sand. As a result, log jams were cleared from approximately five miles of Hunters Brook before the project was terminated due to a lack of funding. However this project was resumed on an additional ten miles in the coming decade. In the early 2000s, the second period of habitat enhancement occurred however with the goal of adding woody debris to the stream where habitat was non-existent and a walk-in fishery could be created.

Prior to the continuation of removal of log jams in Hunters Brook, stocking of alternate trout species had occurred from 1968 to 1970. Rainbow Trout were stocked annually from 1968 to 1970 at an average rate of 71 fish per mile and a range from 54 to 89 fish per mile. Brown Trout were also stocked annually at an average rate of 36 fish per mile with a range from 18 to 54 per mile. In July of 1968 two electrofishing surveys were conducted upstream of the mouth and approximately half-way upstream of Hunters Brook to evaluate recent trout stocking. A total of 4 Rainbow Trout and 2 Brook Trout were captured during these surveys. In July of 1969 an additional four electrofishing surveys were conducted at various reaches in Hunters Brook to quantify the abundance of trout post-stocking and evaluate the effects of log jam removals. Managers noted that the stream appeared to show noticeable improvement based on the number and size of trout captured (11 Brook Trout were captured). Managers recommended at this time that a fish ladder be built at the mouth of Hunters Brook to improve fish migration and increase the likelihood of establishing a resident trout population. No records exist to determine if the construction of a fish ladder was attempted. Currently, no fish ladder exists in Hunters Brook.

In the 1970s Brook Trout, Brown Trout, and Rainbow Trout were stocked until 1973 when stocking of all three species ceased. In November of 1973, four electrofishing surveys were conducted in Hunters Brook to evaluate Brook Trout reproduction. Managers noted that substantial reproduction was occurring, however mostly in the headwater tributaries. At this time, given the reports of natural reproduction, managers noted that additional stocking of Brook Trout in Hunters Brook was unnecessary. Additionally, managers noted that the placement of gravel on the stream bed in areas adjacent to known spawning locations may improve natural reproduction further. However, it is unknown if a gravel project was ever completed.

In September of 1975, four stations on Hunters Brook were surveyed to quantify the abundance of trout prior to resuming the project geared to remove woody debris. Managers noted that the number of Brook Trout captured was low and documented some natural reproduction by Brown Trout. Additionally, managers noted that the abundance of Brook Trout increased in stream reaches in close proximity to headwater areas. A total of 12 trout (10 Brook Trout and 2 Brown Trout) were captured during this survey with a total stream reach sampled of 1050 feet (1 trout per 87 feet of stream).

The large woody debris removal project which began in 1967, started again in fall of 1975 and was completed during summer of 1976. In total, approximately 10 to 15 miles of large woody debris and beaver dams were removed from Hunters Brook encompassing approximately 36 to 54 percent of the total stream length. In September of 1977, four electrofishing surveys were conducted to quantify the abundance of Brook Trout and evaluate the effects of large woody debris removal. A total of one Brook Trout was captured during this survey with a total stream reach sampled of 1200 feet (1 trout per 1200 feet of stream).

Although stocking had not occurred since 1973, in October of 1981, two electrofishing surveys were conducted to assess previous stocking efforts of Brook Trout and Brown Trout as well as evaluate habitat post-removal of large woody debris. No trout were captured during either of these surveys. However, a Brook Trout was observed during the assessment conducted at the upstream reach. At this time, managers recommended stocking Brown Trout in downstream reaches of Hunters Brook. There are no records of Brown Trout or Rainbow Trout being planted after 1970.

In 1998, stocking of Brook Trout in Hunters Brook was restarted and continued annually to 2008 at an average rate of 33 fish per mile (range 21 to 36 fish per mile). During this time, the habitat management strategy for Hunters Brook shifted from that experienced during the 1960s and 1970s, when large woody debris removals took place, to a strategy where woody debris was added to the stream in the form of `tree drops' in an effort to develop a walk-in access recreational trout fishery. Funding was made available to create a walk-in access trout fishery in Hunters Brook through what was called the Hunters Brook Plan. The Hunters Brook Plan included development of instream trout habitat using tree drops, as well as a walk-in access site and parking lot near County Road 426. This project was coordinated in collaboration with the Michigan Department of Natural Resources (MI DNR), Escanaba River Association, and the Upper Peninsula Power Company. As part of the Hunters Brook Plan, MI DNR stated that trout population surveys shall be conducted before and after placement of instream habitat to evaluate the effectiveness of habitat enhancement.

In August of 2000 and August of 2002, electrofishing surveys were conducted at three reach locations to quantify trout abundance prior to the addition of instream habitat. Numbers of Brook Trout

captured were low at each station in each year with one exception, a relatively large number of yearling Brook Trout were captured at one station sampled in 2000. The large number of fish observed at this site were thought to be a result of a recent stocking event and not indicative of a sustainable naturally producing population. Following the completion of several electrofishing surveys, an application was approved by the Department of Environmental Quality in September of 2003 which permitted the placement 50 whole trees in Hunters Brook over a quarter mile stretch of river. In November of 2003, an excavator was used to drop approximately 50 trees into Hunters Brook (Figure 2). To date, no follow-up surveys have been conducted at the site where instream habitat was added. This project concludes the habitat management period which was followed by the Status and Trends period, which began in 2008 and continues today.

In August 2010 an electrofishing survey was conducted, adjacent to the Boney Falls H Rd bridge crossing, to provide updated fish community data to support the fish-flow model for Michigan's Water Withdrawal Assessment Tool. No trout were captured during this assessment.

Current Status

Two surveys were used to determine the current status of the Hunters Brook fishery near the town of Watson. Status and Trends surveys completed by MI DNR in 2008 and 2016 were conducted as part of the random streams program to gather general fish community, water quality, and habitat information. Fisheries and temperature information from general surveys conducted in 1958, 1965, 2000, 2002, and 2017 (temperature data) were also referenced in the Analysis and Discussion section to evaluate long term trend information. These surveys were all conducted adjacent to the Watson Bridge located on Si Rd just north of the town of Watson (GPS 46.023934 -87.408930). Surveys conducted in 2008 and 2016 included a transect which began 800 feet downstream of the bridge and ended approximately fifteen feet from the downstream side of the bridge just below an abandoned beaver dam. A complete stocking history of Hunters Brook can be found in Table 1, and is discussed in the History section above.

A total of 511 fish representing ten species were captured during the 2016 Status and Trends survey (Table 2). No trout were captured during this survey. Blacknose Dace (n = 106) and Central Mudminnow (n = 137) comprised approximately 48 percent of the total fish captured, and Creek Chub (n = 52), Common White Sucker (n = 59), and Pearl Dace (n = 79) collectively comprised 37 percent of the total fish captured. The remaining fish captured included species of dace, shiner, and sculpin. Evidence of angling activity adjacent to the bridge was noted during this survey.

Habitat parameters measured as part of the random Status and Trends program includes the percent pool/riffle/run habitat, riparian class type, bank stability, mean depth of undercut banks, dominant substrate type, linear amount of woody debris, and stream discharge. Generally, Hunters Brook was dominated by pool and run habitat types with some riffles. Riparian areas consisted mostly of tag alder and grassland herbaceous materials with a few large conifers present. The predominant substrate type throughout the reach was sand followed by detritus and silt materials. Stream discharge was calculated to be 3.5 cubic feet per second. An additional summary of stream limnological parameters including percent habitat type and dominant substrate types present can be found in Table 3.

Temperature data were collected from 23 June 2016 to 11 October 2016 using a U22-001 HOBO Water Temp Pro v2 (Serial 10767533). July 2016 mean daily temperature in Hunters Brook averaged

69.0 °F and ranged from 58.9 to 81.2 °F (Figure 3). A summary of monthly temperature data from 2008, 2016, and 2017 can be found in Table 4. In 2016, Hunters Brook water temperatures were above limits tolerable by Brook Trout 70 percent of the time in July (Figure 4) (McCormick et al. 1972, Hayes et al. 1998, and Wehrly et al. 2003). Furthermore, temperatures exceeded limits considered to be lethal for Brook Trout approximately 10 percent of the time in July (Figure 4) (Fry et al. 1946, Hayes et al. 1998). Preferred temperature limits for Brown trout were exceeded 50 percent of the time in July, while the temperature considered to be lethal was exceeded less than one percent of the month of July (Figure 5) (Wehrly et al. 2003, Mills et al. 2004).

Analysis and Discussion

Overall the current fish community is similar to that reported nearly 60 years ago and characteristic of a warm transitional stream, with an abundance of dace, shiners, chubs and suckers. The lack of trout captured at this location is not surprising given that temperatures were determined to be unsuitable and that stocking had not occurred since 2008. After the Status and Trends assessment was conducted in 2008, a recommendation was made to discontinue trout stocking in Hunters Brook at the County Road Si Bridge location due to limited thermal refuge available. This recommendation is continued given the temperature observations from the most recent 2016 Status and Trends survey.

Interestingly, notes from historical surveys (i.e., 1958), reported that natives were interviewed and stated that Brook Trout are often not found at this location, rather headwater streams of Hunters Brook were better known to contain Brook Trout. Research in other area waterbodies (e.g., Ford River) confirm that Brook Trout migrate into headwater streams during the summer to avoid warming temperatures. Assuming that Brook Trout exhibit migration behavior similar to that observed in other waterbodies, migration to headwater areas would likely begin near the end of June which again, could also explain the lack of trout captured at this location. That said, given that Hunters Brook is a relatively warm transitional stream this waterbody may be limited in its ability to support trout populations large enough to support a recreational fishery.

Management Direction

From the 1930s to present day, Hunters Brook has undergone variable management strategies including stocking, removing large woody debris, and adding large woody debris in an effort to provide a walk-in access recreational trout fishery. However, management tactics employed were often not evaluated for effectiveness or enacted to the degree to which a benefit to the resource could be realized. In addition, current survey data indicate warm summer water temperatures limit trout survival in much of Hunters Brook. Warm summer temperatures, those typically associated with a `warm-transitional' stream, may have hampered previous efforts to establish a trout fishery, but historic site-specific temperature data are limited or non-existent. Therefore, should additional funding opportunities exist the following strategies should be implemented:

1. Conduct preliminary assessments to evaluate temperature regimes and fisheries community at various reaches in Hunters Brook for five consecutive years. Deploy temperature loggers for five consecutive years in headwater tributaries and mainstream reaches of Hunters Brook (see Table 5 for logger locations) to evaluate proportion of summer refuge habitat in relation to that in the mainstream reaches of Hunters Brook. Conduct discretionary electrofishing surveys, following random streams

Status and Trends protocols, to quantify the abundance of trout inhabiting headwaters of Hunters Brook during periods (July) of warmer temperatures (see Table 5 for electrofishing locations).

2. Should temperature and habitat conditions exist for trout (Brook Trout or Brown Trout), a stocking prescription should be implemented to stock trout in locations most conducive to holdover based up habitat data gathered from previous 5 years survey (Strategy 1 bullet 2) (6 years).

3. Provided a sufficient holdover of trout is demonstrated from stocking, plans to create a walk-in access site for anglers as described in the Hunters Brook Plan should be finalized. Sufficient holdover for trout should be defined as approximately 2 percent or greater survival from stocking to age 2.

4. Managers will incorporate logger deployment and electrofishing surveys if the unit field schedule permits. Additionally, managers are encouraged to coordinate all efforts in collaboration with the Escanaba River Association, Delta County Wildlife Unlimited and Trout Unlimited.

5. If temperature and habitat conditions do not exist in reaches where temperatures are determined to be unsuitable for trout, stocking and habitat improvement for trout will not occur.

Hunters Brook is currently designated a Type 1 trout stream with a season which opens the last Saturday in April and ends on September 30th of each year. These regulations should continue pending additional survey information. The goal is to continue to gather information in accordance with the Hunters Brook Plan to determine the feasibility of developing a walk-in access recreational trout fishery.

References

Fry, F. E. J., J. S. Hart, and K. F. Walker. 1946. Lethal temperature relations for a sample of young speckled trout (Salvelinus fontinalis). Ontario Fisheries Research Laboratory 66: 9-35.

Hayes, D. B., W. W. Taylor, M. T. Drake, S. M. Marod, and G. E. Whelan. 1998. The value of headwaters to Brook Trout (Salvelinus fontinalis) in the Ford River, Michigan, USA. Headwaters: Water Resources and Soil Conservation. Proceedings of Headwater '98, the Fourth International Conference on Headwater Control, Merano, Italy, April 1998.

McCormick, J. M., K. E. F. Hokanson, and B. R. Jones. 1972. Effects of temperature on growth and survival of young brook trout (Salvelinus fontinalis). Journal of the Fisheries Research Board of Canada 29:1107-1112.

Mills, T. J., P. Bratovich, D. Olsen, A. Pitts, M. Atherstone, A. Niggemyer, A. O'Connell, K. Riggs, B. Ellrott. 2004. Matrix of life history and habitat requirements for Feather River fish species SP-F3.2 Task 2. State of California Department of Water Resources: Oroville Facilities Relicensing FERC Project No. 2100.

Wehrly, K.E. M.J. Wiley, and P.W. Seelbach. 2003. Classifying regional variation in thermal regime based on stream fish community patterns. Transactions of the American Fisheries Society 132:18-38.

Table 1. Stocking history of Hunters Brook (Marquette and Delta counties).

Species	Year	Number Stocked	Number Stocked per Mile
Brook Trout	1933	5000	179
Brook Trout	1934	5000	179
Brook Trout	1935	2000	71
Brook Trout	1936	2500	89
Brook Trout	1937	2000	71
Brook Trout	1938	3000	107
Brook Trout	1940	1000	36
Brook Trout	1941	2000	71
Brook Trout	1947	3950	141
Brook Trout	1950	400	14
Brook Trout	1951	450	16
Brook Trout	1952	300	11
Brook Trout	1953	575	21
Brook Trout	1954	575	21
Brook Trout	1955	600	21
Brook Trout	1956	600	21
Brook Trout	1957	200	7
Brook Trout	1958	250	9
Brook Trout	1959	20400	729
Brook Trout	1960	500	18
Brook Trout	1961	125	4
Brook Trout	1962	50	2
Brook Trout	1963	125	4
Brook Trout	1964	75	3
Brook Trout	1967	7000	250
Brown Trout	1968	1500	54
Rainbow Trout	1968	2000	71
Brook Trout	1969	2500	89
Rainbow Trout	1969	2500	89
Brook Trout	1970	1000	36
Brown Trout	1970	500	18
Rainbow Trout	1970	1500	54
Brook Trout	1971	500	18
Brook Trout	1972	5000	179
Brook Trout	1973	5000	179
Brook Trout	1998	1000	36
Brook Trout	1999	1000	36
Brook Trout	2000	1000	36
Brook Trout	2001	990	35
Brook Trout	2002	1000	36
Brook Trout	2003	600	21

Brook Trout	2004	970	35
Brook Trout	2005	1000	36
Brook Trout	2006	860	31
Brook Trout	2007	800	29
Brook Trout	2008	930	33

Table 2. Total species and number captured during 2008 and 2016 random Status and Trends stream surveys. Additional data from surveys conducted at previous years at the same location are also added (i.e., 1958, 1965, 2000, and 2002).

	Number Captured					
Species Captured	1958	1965	2000	2002	2008	2016
Brook Trout	0	1	1	1	5	0
Blacknose Dace	13	32	NA	NA	48	106
Brook Stickleback	29	0	NA	NA	1	3
Creek Chub	2	10	NA	NA	20	52
Common White Sucker	27	7	NA	NA	25	59
Fathead Minnow	0	0	NA	NA	2	0
Golden Shiner	0	0	NA	NA	2	0
Mottled Sculpin	7	1	NA	NA	2	2
Central Mudminnow	155	0	NA	NA	67	137
Northern Redbelly Dace	22	3	NA	NA	7	79
Pearl Dace	12	2	NA	NA	0	4
Longnose Dace	0	0	NA	NA	0	4
Johnny Darter	4	1	NA	NA	0	0
Finescaled Dace	1	1	NA	NA	0	0
Total Captured	276	81	NA	NA	223	511

Table 3. Summary of percent habitat type (pool, riffle, run) and dominant substrate type (silt, sand, gravel, small cobble (S Cobble), large cobble (L Cobble), wood, and island) at Hunters Brook 2008 and 2016. Average (AVG) percent habitat type and dominant substrate type at Hunters Brook between 2008 and 2016.

	Percent Habitat Type			Dominant Substrate Type						
Year	Pool	Riffle	Run	Silt	Sand	Gravel	S Cobble	L Cobble	Wood	Island
2008	79.9	7.7	15.4	15.4	58.5	3.1	6.2	9.2	3.1	4.6
2016	50.0	8.3	41.7	5.0	81.7	1.7	3.3	5.0	3.3	0.0
AVG	65.0	8.0	28.5	10.2	70.1	2.4	4.7	7.1	3.2	2.3

Table 4. Average, minimum, and maximum temperature (°F) of Hunters Brook in 2008, 2016, and 2017. Dashes indicate where data were unavailable in 2017. Shaded cells include mean July water temperature in 2008, 2016, and 2017.

	Mean Temperature			Minimum Temperature			Maximum Temperature		
Month	2008	2016	2017	2008	2016	2017	2008	2016	2017
June	64.3	67.0	-	58.5	57.3	-	71.8	78.2	-
July	69.3	69.0	65.3	66.5	58.9	52.0	74.6	81.2	84.8
August	66.9	68.5	61.8	62.6	56.6	54.0	71.9	77.8	69.1
September	59.5	60.0	-	54.6	50.9	-	69.4	69.3	-
October	47.2	54.3	-	39.8	43.2	-	54.8	60.2	-

Table 5. Number and recommended GPS locations for temperature loggers to be placed to evaluate temperature regimes in headwater and mainstream reaches of Hunters Brook. Electrofishing locations followed by "Y" should be surveyed following random stream Status and Trends sampling protocols.

N	Logger GPS Location	Electrofishing (Y/N)
1	46.0644347 -87.447001	Y
2	46.042374 -87.438165	Y
3	46.041037 -87.437098	Y
4	46.032202 -87.441766	Y
5	46.034832 -87.431520	N
6	46.021111 -87.425818	N
7	46.023992 -87.408502	Y
8	46.011070 -87.632312	N
9	45.9944636 -87.371493	N
10	45.995790 -87.359957	Y
11	45.983299 -87.355246	N
12	45.991736 -87.324946	N
13	45.971237 -87.296059	Y
14	45.976240 -87.289426	N
15	45.958252 -87.256646	N
16	45.953428 -87.234800	Y
17	45.947728 -87.218094	N

Figure 1. Map of Hunters Brook (Escanaba River Watershed). Mouse pointer indicates location (GPS: 46.023939 -87.408858) of 2008 and 2016 Status and Trends survey. Arrows from text box indicate location of Hunters Brook. Discharge flows from upstream (left) to downstream (right).

Figure 2. Addition of large woody debris with the use of an excavator occurred in 2003 (Top picture). Placement and position of large woody placed into Hunters Brook (bottom picture).

Figure 3. Mean daily water temperature in Hunters Brook at County Road Si Bridge near Watson (2008, 2016, and 2017). Brook Trout temperature criteria are based on published literature (Fry et al. 1946, McCormick et al. 1972, Hayes et al. 1998, Wehrly 2003).

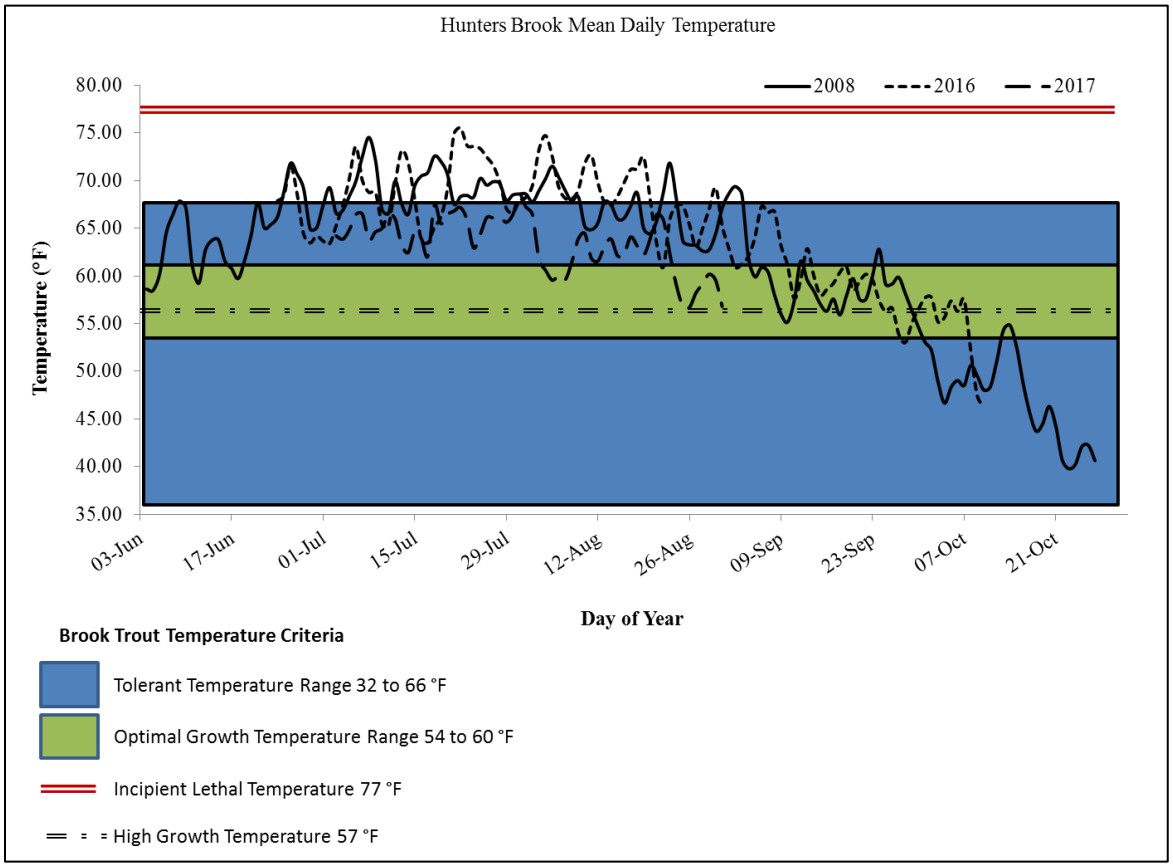

Figure 4. Percent exceedance (occurrence) of Hunters Brook water temperature during the month of July in 2008, 2016, and 2017. Brook Trout temperature criteria are based on published literature (Fry et al. 1946, McCormick et al. 1972, Hayes et al. 1998, Wehrly 2003).

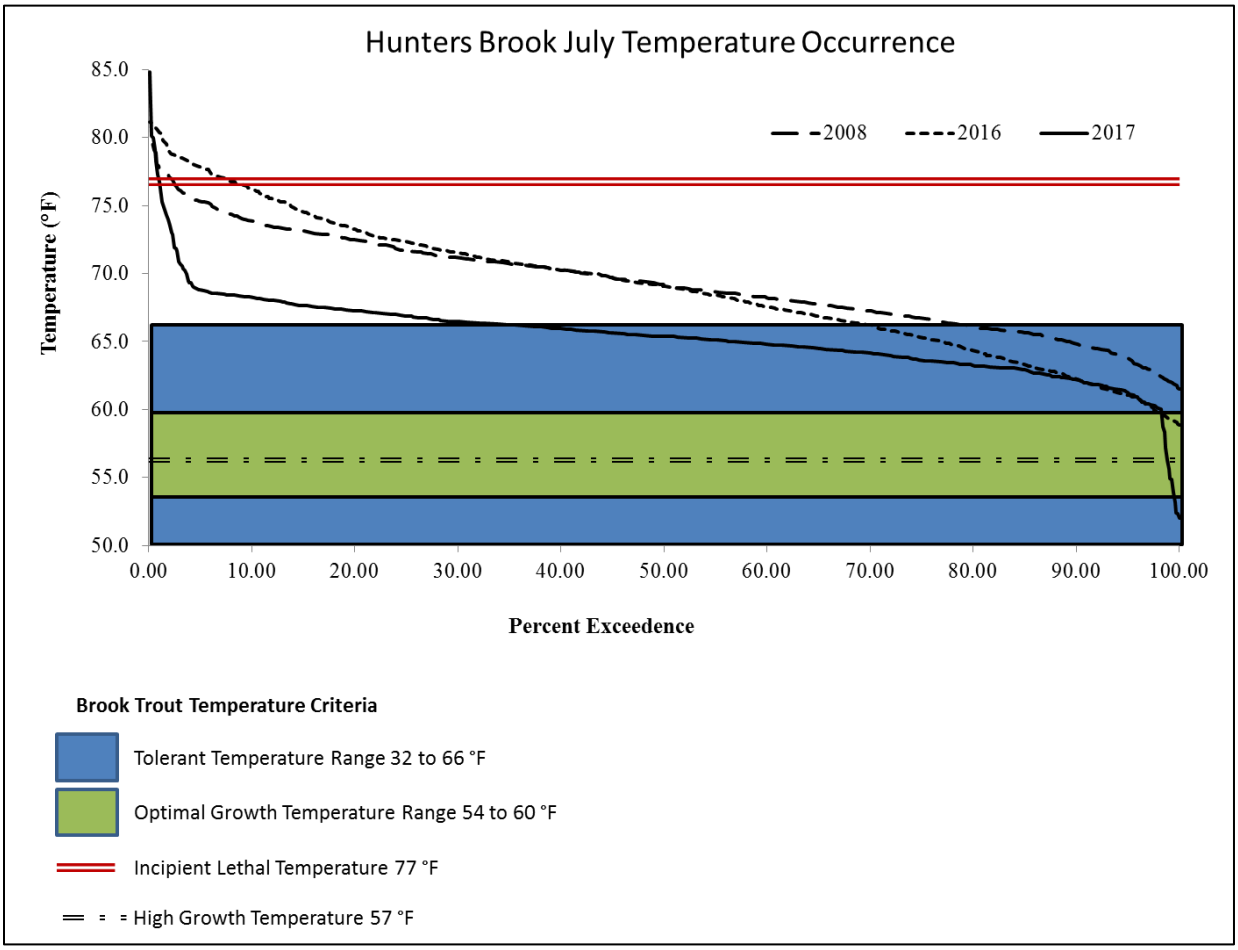

Figure 5. Percent exceedance (occurrence) of Hunters Brook water temperature during the month of July in 2008, 2016, and 2017. Brown Trout temperature criteria are based on published literature (Wehrly et al. 2003, Mills et al. 2004).