Minnesota Department of Natural Resources
Division of Fish and Wildlife
Section of Fisheries

Stream Survey Report

Smarts Creek
2011

By

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SUMMARY

Smarts Creek is a designated trout stream with headwaters located two miles northeast of St. Stephen in northeastern Stearns County, Minnesota. It flows 1.6 miles to the confluence of the Mississippi River. The stream has an agricultural watershed of 2,251 acres. An initial survey was conducted in 1977 and this was the first survey since 2001.

Rosgen classification conducted in 2011 showed improved substrate conditions in the lower reach. Temperatures were favorable for brook trout in the lower reach as was reported in 2001. Seven species of fish were captured via backpack electrofishing. A total of 104 brook trout were sampled in 1.07 hrs of electrofishing. The fish community was dominated by brook trout (57%) and mottled sculpin (19%).

The brook trout population has improved since 2001. Based on length frequency analysis, brook trout sampled in 2011 were dominated by age-0 fish (65%) indicating that spawning and recruitment has taken place. The increase in brook trout density was related to the improvement in substrate quality in the lower section since 2001.

STUDY AREA

Smarts Creek is a designated trout stream with its headwater located approximately two miles northeast of the town of St. Stephen in northeastern Stearns County. The stream flows 1.61 miles to the confluence with the Mississippi River (Figure 1). Smarts Creek has a gradient that ranges from 25 to 53 feet per mile and a sinuosity of 1.43. The stream has a watershed of 2,251 acres (Figure 2) with estimated land uses of 61.8% agriculture, 18.4% forest, 4.5% grassland/shrub, and 4.23% residential (Table 1).

Smarts Creek was designated as a trout stream in 1949 and was stocked almost annually with 250 yearling brook trout from 1949 – 1979. An initial stream survey was conducted in 1977 with subsequent surveys conducted in 1980, 1986, 1993, and 1999, and 2001. A total of 164 brook trout were sampled during the 1977 survey, 26 during the 1980 survey, 24 during the 1986 survey and zero during the 1993 survey. It is thought that a drought during 1987-88 caused the trout to disappear from the stream. After sampling no brook trout in 1993, 1,000 fingerlings were stocked into the stream in 1997 to re-establish the brook trout population.

METHODS

Previous surveys compiled information on fish communities, physical and chemical characteristics, invertebrate communities, and in the 2001 survey, Rosgen stream classification. Analysis of land use and map production was performed using ArcMap 10 and the 2001 international land use/land cover data.

Rosgen stream classification (Rosgen 1996) was performed at one site in the upper reach and one site in the lower reach. The reaches were established during the 2001 survey (Figure 3). Stream classification measurements included the calculation of slope, sinuosity, entrenchment ratio (flood prone width relative to stream channel width), and pebble count. Elevations were recorded using a Trimble Spectra Precision Laser (model LL200-4) level.

RiverMorph© 4.3 software was used to analyze the data and calculate stream classifications (Stream Restoration Software (2001-2011). Water temperatures were measured using a Hobo Pendant® temperature data logger model UA-001-08 in the lower reach of the stream (Figure 3). The data logger was set to collect temperatures each hour. Data was used to evaluate~~,~~ minimum, maximum and daily fluctuation in temperature between May 1, 2011 and October 30, 2011.

Fish were sampled using a Smith Root BP-15D backpack electrofisher, using pulsed direct current, at three sampling stations similar to those sampled in 2001. All fish were enumerated, identified and bulk-weighed by species. Brook trout were measured to the nearest mm and released. Mean length at age was estimated using a mixed distribution model developed from a length frequency histogram. Length frequency histograms were divided into 10-mm length groups; and using the mixdist package (Macdonald and Du 2010) in the software program R (R Development Core Team, 2009), a finite mixture distribution model was fit to the length frequency histogram.

RESULTS

Land use practices within the Smarts Creek watershed continue to be dominated by agriculture, similar to 2001. Pasture (35.1%) and cultivated crops (26.7 %) made up the bulk of the of the land use in 2011 (Table 1). However, less acreage was devoted to cultivated crops in 2011 than in 2001. Other land uses within the watershed consisted of forest (18.4%), wetlands (10.8%), shrub grassland (4.5%), residential (4.2%) and lakes (0.~~8~~2%; Table 1).

A temperature monitor collected hourly readings from May 1 through October 30, 2011. A total of 4,392 readings were taken during the time period with 8.7% and 1.8% of the readings above 64°F and 68°F, respectively (Figure 4). Hourly temperatures ranged from 37.5°F to 72.7°F with an average temperature of 55.1°F.

Rosgen stream classification was performed at two locations along the length of the stream (Figure 3). The lower station was located approximately 150 ft upstream of the confluence of the Mississippi River. This station meanders through the St. Stephen Lion's Park. This station was moderately entrenched (1.5), had a moderate width/depth ratio (7.7) and moderate sinuosity (1.4). The substrate within this cross section had a D_{50} particle size classified as very fine gravel (3.4 mm). Fines (sands or silts) made up 44.1% of the cross sectional pebble count. The station was classified to be a B4 stream type (Table 2). This stream type is considered relatively stable and is not a high sediment supply stream channel. Large woody debris is an important component for fisheries habitat when available (Rosgen 1996).

The upper station, located 0.3 miles west of the CR 1crossing (Figure 3), was slightly entrenched (9.4), had a low width/depth ratio (5.6), and was very sinuous (1.6). The substrate within this cross section had a D_{50} particle size classified as medium sand (0.28 mm). Fines made up 98.~~1~~3% of the cross sectional pebble count. The station was classified as an E5 stream type (Table 2). This stream type is relatively stable unless direct changes to the stream bank occur or if there are significant changes in sediment supply and/or streamflow (Rosgen 1996).

Fish sampling using backpack electrofishing collected seven species. Numbers were dominated by brook trout (57%), mottled sculpin (19%) and brook stickleback (10%; Table 3). Other species sampled included: burbot, creek chub, central mudminnow, and Johnny darter. A total of 1.07 hours were spent electrofishing. Twenty-five percent of the stream length was electrofished.

Brook trout catch per unit effort ranged from 87.1/hr in station 1 to 108.6/hr in station 2 (Table 4); while the catch per 100 ft ranged from 3.4 at station 3 to 7.0 at station 2 (Table 4). A total of 104 brook trout were sampled. Brook trout ranged in length from 69 – 280 mm with an

average length of 142 mm (Figure 5). Length frequency analysis indicated the presence of three year classes of brook trout in the stream, dominated by young-of-the-year (65%; Table 5).

DISCUSSION

Land use practices within the Smarts Creek watershed have remained largely agricultural from 2001 to 2011. However, in 2011 fewer acres were classified as crops and more acres classified as pasture. There was also a decrease in the amount of acres classified as forest in 2011 compared to 2001; and the amount of acres classified as wetland increased between 2001 and 2011. Newer data was available in 2011 and likely used a different classification scheme compared to the 2001 data. There continues to be a general lack of development, road crossings, and agricultural practices near the stream which is favorable for trout.

Temperature data in the lower section indicates that temperatures are adequate for brook trout survival with relatively few readings over 68°F. However, Altena (2002) found that temperatures in the upper reach suggested that the springs flowing into Smarts Creek may not be able to maintain ideal temperatures for the length of the stream. Favorable conditions for brook trout include a stable temperature profile with areas that allow refuge from temperatures above 68°F (Scott and Crossman 1979). Relatively few readings above 68°F indicate that there are favorable conditions for brook trout survival during most of the summer.

Stream classification in 2011 indicated that the upper station has not changed much since 2001. This section had a similar classification in 2011 (E5) as was found in 2001 (E5b; Altena 2002). Substrates in this section continued to be dominated by sand and silt providing limited areas for brook trout to spawn. The lower station appears to have changed since 2001. Altena (2002) classified this lower section as a C5 stream dominated by sand and silt substrates. In 2011, this station was classified as a B4 stream and was dominated by gravel substrates with a lower percentage of sands and silts. Brook trout prefer gravel substrates for spawning. An increase in the number of brook trout was related to the gravel substrate.

Evidence of reproduction and survival were documented during this survey because three year classes of brook trout were sampled. The number of brook trout sampled in 2011 was the most sampled since 1977. Previous surveys all sampled less than 30 trout implying that less than favorable conditions existed for adequate spawning and recruitment. Over the past ten years, the substrates in the lower reach have changed from sands and silts to more gravel. This change has increased the amount of spawning habitat and recruitment.

Management Implications

The brook trout population appears to be stable but small. The sample of fish was dominated by young-of-the-year indicating that spawning has taken place. Survival of age 1 and age 2 fish was also observed. Temperature data and Rosgen classification indicate that the stream is favorable for trout and they continue to reproduce and survive. Natural improvements to the substrate conditions within the lower reach of Smarts Creek have improved the overall density of trout within the stream. Additional effort to offer some type of canopy for the stream in the upper reach may lessen extreme temperature changes.

Smarts Creek is one of only six cold water streams within this area of central Minnesota that supports a naturally reproducing trout population. Access is available at the lower end of the stream through the Lion's Park, but no other public access is available. Although limited fisheries potential exists for Smarts Creek, it is unique and worth protecting for its ecological and intrinsic value.

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Table 1. Smarts Creek (M-79) watershed estimated land use comparison 2001 to 2011.

Land Use	2011*	2001**
Cultivated Crops	26.7	41.9
Grassland/Pasture	35.1	23.6
Forest	18.4	22.5
Residential	4.3	5.8
Grassland Shrub	4.5	4.3
Wetland	10.8	0.8
Gravel Pits	0.0	0.7
Lakes	0.2	0.1

* Based on 2001 National Land Cover Data
** Based on 1991 National Land Cover Data

Table 2. Results of Rosgen classification sites for Smarts Creek sampled during Fall 2011.

Parameter	Upper station	Lower Station
Bankfull width (ft)	5.35	9.28
Mean Depth@ bankfull (ft)	0.96	1.21
Cross sectional area (ft^2)	5.12	11.25
Max depth @ bankfull (ft)	1.27	1.48
Flood prone width (ft)	50.07	13.77
Width/depth ratio	5.57	7.67
Entrenchment ratio	9.37	1.48
Water surface slope (ft/ft)	0.002	0.021
Sinuosity	1.64	1.43
Pebble count D_{50} (mm)	0.28	3.43
% fines	98.3	44.1
Stream type	**E5**	**B4**

Table 3. Species sampled by backpack electrofishing from Smarts Creek on September 12, 2011.

Species	Site 1	Site 2	Site 3	Total
Brook trout	44	47	13	104
Brook stickleback	1	4	13	18
Burbot	1	1		2
Creek chub	5	1		6
Central mudminnow	6	2	4	12
Johnny darter	5			5
Mottled sculpin	13	18	4	35
Total	75	73	34	182

Table 4. Electrofishing station information and catch rates of brook trout from Smarts Creek on September 12, 2011.

Station	Length (m)	Length (ft)	Effort (sec)	N	CPUE	N/100 ft
EF 1	337	1,105	1,819	44	87.1	4.0
EF 2	204	670	1,558	47	108.6	7.0
EF 3	116	380	476	13	98.3	3.4
Total	657	2,155	3,853	104	97.2	4.8

Table 5. Length at capture (mm) and standard errors for brook trout sampled from Smarts Creek during September 2011.

Age	N	Mean	Min	Max	SE
0	68	104	69	136	1.79
1	29	207	172	241	3.34
2	7	258	248	280	6.45

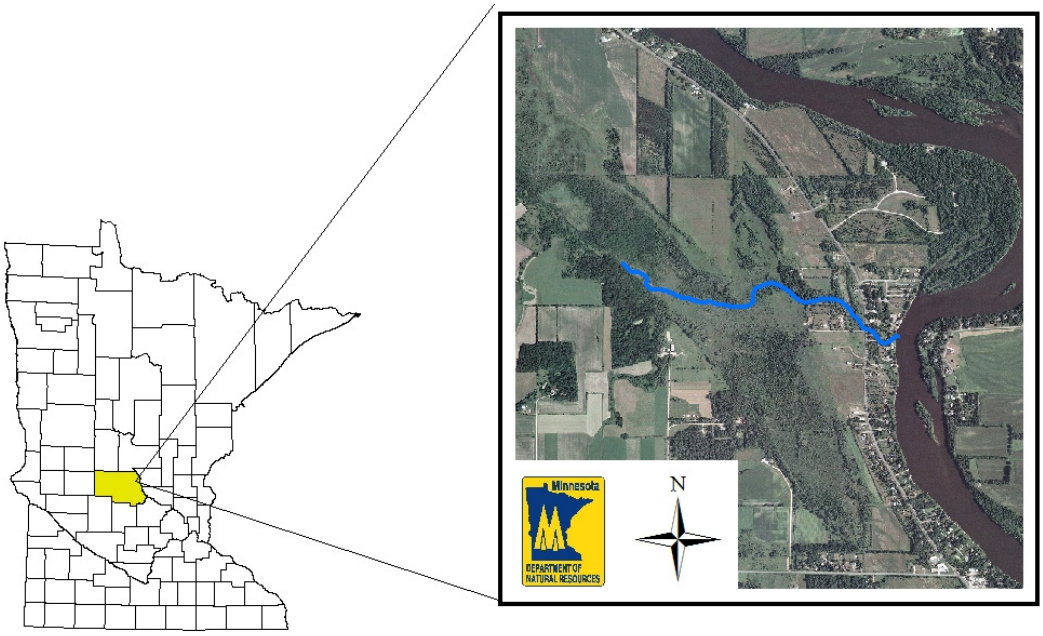
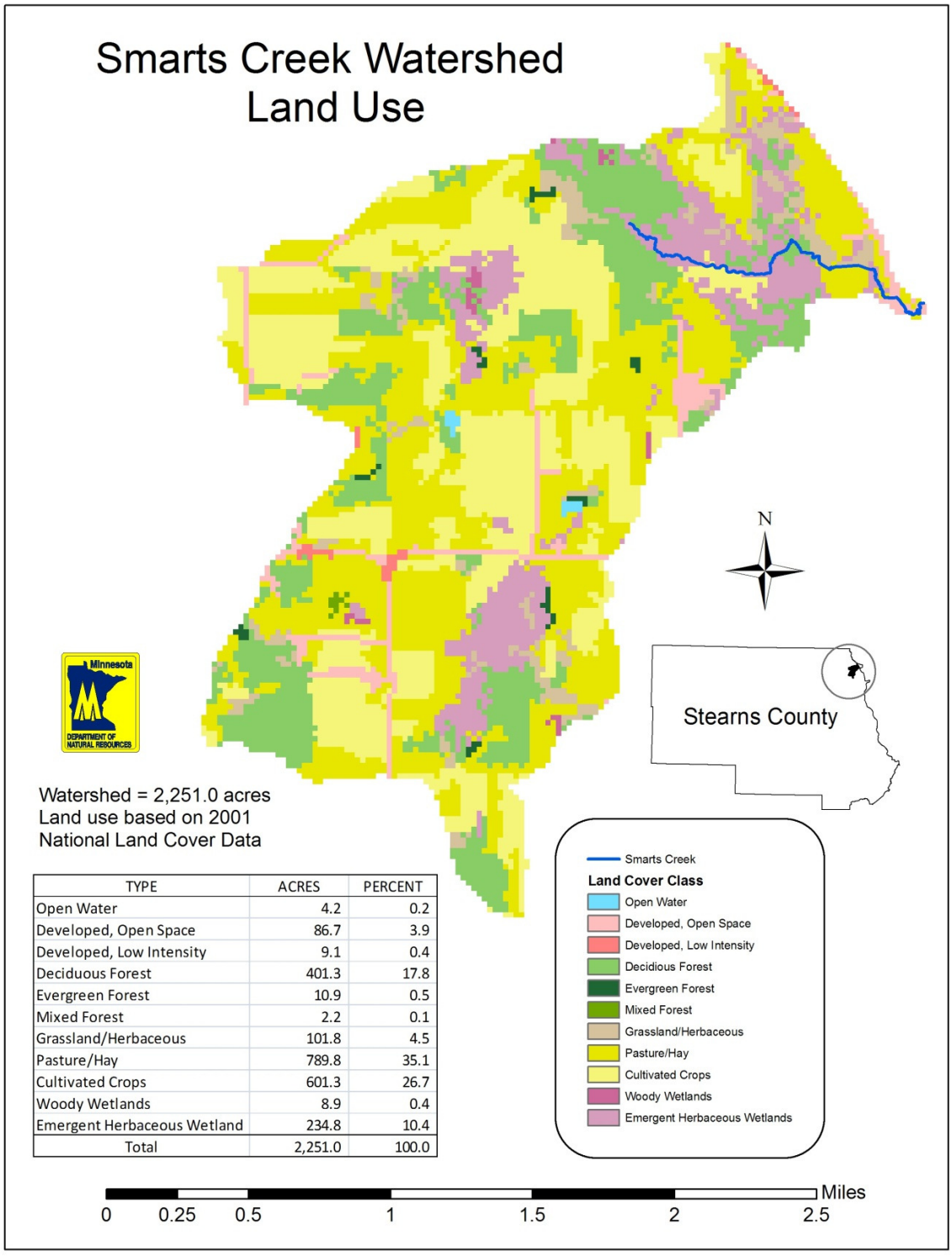


Figure 1. Location of Smarts Creek, Stearns County, Minnesota.



TYPE	ACRES	PERCENT
Open Water	4.2	0.2
Developed, Open Space	86.7	3.9
Developed, Low Intensity	9.1	0.4
Deciduous Forest	401.3	17.8
Evergreen Forest	10.9	0.5
Mixed Forest	2.2	0.1
Grassland/Herbaceous	101.8	4.5
Pasture/Hay	789.8	35.1
Cultivated Crops	601.3	26.7
Woody Wetlands	8.9	0.4
Emergent Herbaceous Wetland	234.8	10.4
Total	2,251.0	100.0

Figure 2. Smarts Creek watershed land use estimates based on 2001 National Land Cover Data.

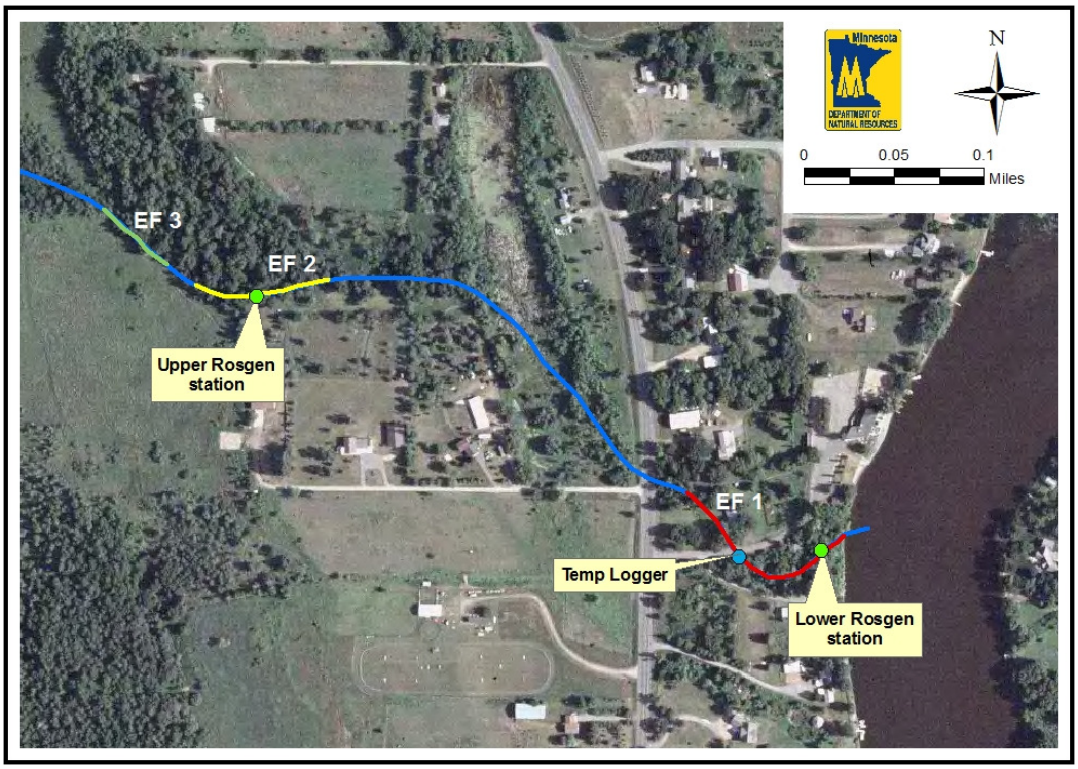


Figure 3. Location of electrofishing, temp logger, and Rosgen classification stations on Smarts Creek 2011.

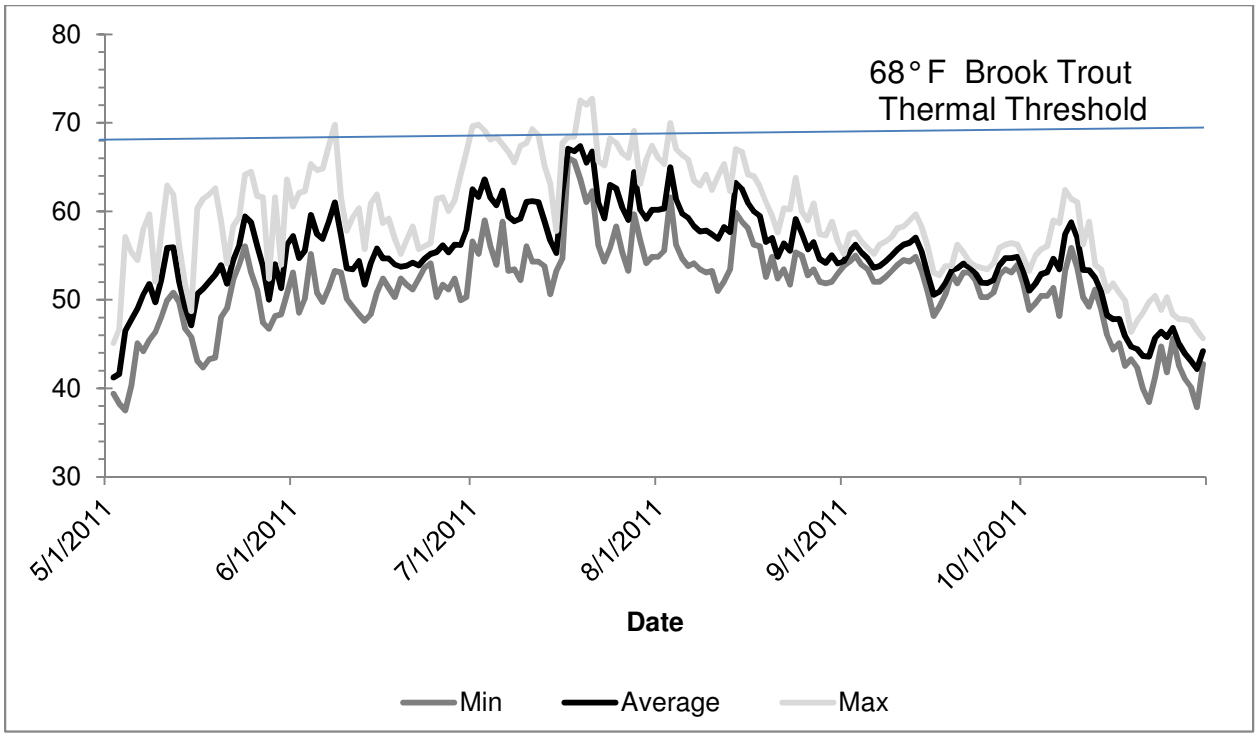


Figure 4. Mean daily temperatures (° F) recorded by a Hobo Temp pendant monitor located in Smarts Creek from May through October 2011.

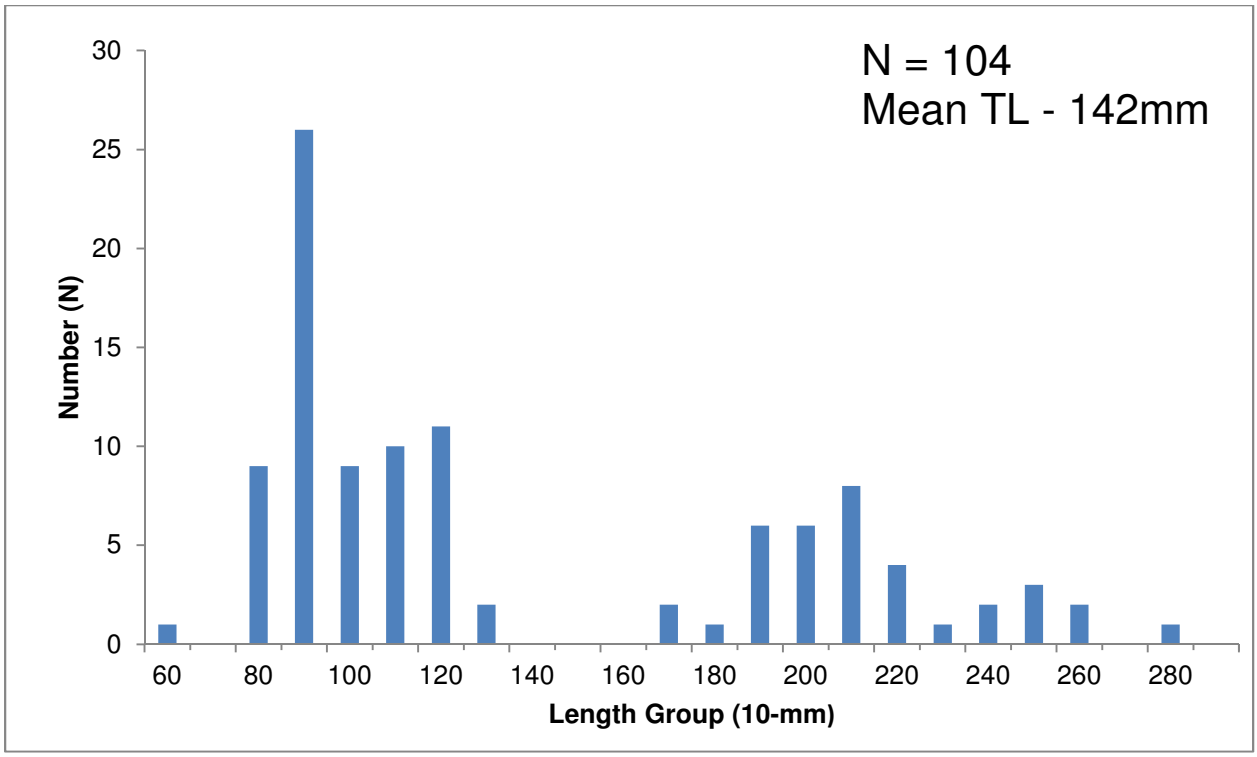


Figure 5. Length frequency of brook trout sampled from Smarts Creek on September 12, 2011.

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