TEMPLE FORK
Stream Survey Report

Logan Ranger District
Wasatch-Cache National Forest

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ABSTRACT

A stream survey was conducted in 1999 on Temple Fork, tributary to the Logan River, Wasatch-Cache National Forest. The purpose of the survey was to assess fish abundance and habitat.

Temple Fork, of the Logan River is a small, clear, third order stream located in the Bear River Range of the Wasatch-Cache National Forest. The stream heads at a large spring (elevation 1,988 m above sea level), flows northwest for 7.3 km, and empties into the Logan River in Logan Canyon**.** The slow water habitat : fast water habitat ratio was 1 : 1.15, and the average stream width at the time of the survey was 4.5 meters (m) with an average depth of 0.27 m.

The fish community in Temple Fork includes cutthroat trout *(Oncorhynchus clarki*) and brown trout (*Salmo trutta*). Cutthroat trout were found throughout Temple Fork, while brown trout decreased in numbers in an upstream direction.

The stream survey identified that Temple Fork habitat conditions are good but could be improved. Comparison to natural condition descriptors indicate Temple Fork was below average in the number of pools per 100 meters. Due to this lack of deeper slow water habitats, Temple Forks' width to depth ratio was greater than natural condition descriptors. Large woody debris was scant within the bankfull channels, and did not contribute to pool formation. Instream structures may help to increase pool numbers and depth, and would provide additional fish habitat.

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INTRODUCTION

A stream survey was conducted in 1999 on Temple Fork, tributary to the Logan River, Wasatch-Cache National Forest. The purpose of the survey was to assess fish abundance and habitat. Additionally, comparison of the results from this survey to ones conducted earlier allowed us to determine if current management practices have improved fish populations and habitat conditions.

PROJECT AREA

Temple Fork, of the Logan River is a small, clear, third order stream located in the Bear River Range of the Wasatch-Cache National Forest. The stream heads at a large spring (elevation 1,988 meters (m) above sea level), flows northwest for 7.3 kilometer (km), and empties into the Logan River in Logan Canyon (Pearson and Kramer 1972). The survey encompassed 6.6 km, starting at the confluence with the Logan River and concluding at the confluence of the Left and Right Forks of Temple Fork just below the Temple Sawmill Monument. Management in the area includes cattle grazing, and recreation (hunting, fishing, hiking, camping, ATV use).

METHODS

Fish Counts

During the stream survey, Temple Fork was divided into 3 reaches that ranged from 1,905 m to 2,607 m in length (Figure 1). Fish abundances and size distributions were estimated through snorkeling surveys. Temple Fork was stratified into distinct habitat units, with snorkeling surveys conducted at every 10^{th} slow water habitat encountered throughout each reach. In addition, one fast water habitat was snorkeled in reach 1.

Snorkeling surveys were conducted by two snorkelers. Pools surveyed were divided in half, with each snorkeler responsible for counting all fish within their half. Snorkelers would enter the water downstream from the unit to be surveyed to prevent disturbing fish. All fish were counted by species and size class. Data collected from snorkeling surveys was entered into the FBASE software program which was designed for data collected under the R1/R4 (Northern Region / Intermountain Regions / USFS) Fish and Fish Habitat Standard Inventory Procedures Handbook (Overton et al. 1996).

Habitat Survey

The Forest Service R1/R4 stream habitat inventory was conducted on Temple Fork in 1999. Survey began July 21, and ended August 6, 1999. On July 21, discharge from Temple Fork was measured at 1.83 m^3/s at the confluence with the Logan River and was relatively consant throughout the survey. Each of the three reaches were divided into discrete habitat units. Slow water habitats (pools) were broken down into damned and scour habitat types. Damned pools were classified according to their position in the stream channel (main, backwater) and according to their formative feature (large woody debris (LWD), boulder, artificial, beaver, landslide, other). Scour pools were categorized by scour position (lateral, mid-channel, plunge, or underscour) and formative feature (LWD, boulder, artificial, bedrock, tributary, meander, culvert beaver, other). Fast water habitats were further broken down into turbulent and non-turbulent habitat types. Turbulent habitat types include cascades, step runs, high gradient riffles, and low gradient riffles. Non-turbulent habitat types include runs, and glides.

Within each habitat unit the following variables were measured: Length, average wetted width, average wetted

depth, total length of undercut bank if undercut $5 centimeter (cm), the length of stable banks (right and left), and the riparian community types. Number of pocket pools and average depth of pocket pools were recorded for fast water habitats. In addition, maximum depth, and crest depth were measured in slow water habitats.

Substrate composition was measured using an ocular estimate. The estimated percentage of each substrate class was made from bankfull stage to bankfull stage in selected habitat units. Estimates were taken in low gradient riffles and scour pool tails.

Large woody debris within the bankfull width was identified as either single ($3 m length and >10 cm diameter), aggregates ($2 singles in contact with one another), or rootwads. Length, width, depth and percent submergence was measured in each category. The number of single pieces within each aggregate was recorded.

RESULTS

Reach 1

Reach 1 started at the confluence with the Logan River and ended at the mouth of Spawn Creek. The reach was 1,905 m long, and had a total of 61 habitat units. This reach was defined by a highly confined channel on both banks and an average gradient of approximately 3.5% - 4.5%. Due to these two characteristics there was reduced slow water habitat. The slow velocity: fast velocity ratio by count was 1 : 1.65 (Table 1). The ratio by surface area was 1 : 9.91 (Table 1) . Most slow water was found on the edges along the banks and throughout the willow complexes. The reach had an average width of 5.1 m and an average depth of 0.31 m (Table 2). Substrate was variable throughout the reach (Figure 2), with the largest percentage (28.3%) being small cobble (64-128 mm). A total of 14.4% of the bank length was undercut, which provided cover for fish. Stream banks overall appear to be in good shape in Reach 1, with over 94% of the bank classified as stable. The bank instability observed appears to be due to ungulate use and human activity. Riparian vegetation consisted of grasses/forbs and willow complexes. Forty-two single pieces and five aggregates of LWD were counted in Reach 1. Additionally, one root wad was found. Bonneville cutthroat trout *(Oncorhynchus clarki utah*) and brown trout (*Salmo trutta*) were the only fish species recorded during the snorkeling survey. Cutthroat trout had an average density of 3.40 fish per 100 m² in fast water habitats, and 4.31 fish per 100 m² in slow water habitats. The population estimate for cutthroat trout in Reach 1 was 341. Cutthroat observed during snorkeling varied in size from less than 100 millimeter (mm) to over 300 mm (Figure 3). Brown trout densities were 2.26 fish per 100m² in fast water habitats, and 0.86 fish per 100m² in slow water habitats. The population estimate for brown trout was 208. Brown trout varied in size from less than 100 mm to 300 mm (Figure 4). Fisheries biologists from the Utah Division of Wildlife Resources (UDWR) conducted a stream survey along a 100 m section of Reach 1 on August 10, 1999. Using a modified Zippin multiple pass depletion electrofishing formula, UDWR officials estimated there were 194 cutthroat trout and 179 brown trout per stream kilometer within this reach (Thompson et al. 2000). This is very close to the estimated 179 cutthroat and 109 brown trout per stream kilometer determined from Forest Service surveys.

Reach 2

Reach 2 continued from the mouth of Spawn Creek to the culvert under the old Temple Fork road (GPS: 0453211 E 4628871 N, note: culvert has since been removed). The reach was 2,607 m long, and had a total of 121 habitat units. This reach was defined by a relatively low gradient and unconfined channel, except for a half kilometer section that was relatively steep. The slow velocity: fast velocity ratio by count was 1 : 1.05 (Table 1). The ratio by surface area was 1 : 4.72 (Table 1). Many of the pools within this reach were artificially created by wooden structures. These structures have created scours directly downstream of their placement. The reach had an average width of 4.1 m and an average depth of 0.26 m (Table 2). Substrate was variable throughout the reach (Figure 2), with the largest percentage (25.6%) being gravel (8-64 mm). A total of 17.4% of the bank length was undercut, which provided

good cover for fish. Over 77% of the bank was classified as stable, although almost all habitat units within this reach had identified bank damage. Riparian vegetation consisted of grasses and forbs with interspersed willows. Overhead cover was relatively low and outside the riparian corridor there were few woody plants besides sage brush. Due to this, LWD was relatively low. Thirty-one single pieces and nine aggregates of LWD were counted in Reach 2. No root wads were observed. Cutthroat trout and brown trout were identified during snorkeling surveys. Cutthroat trout had an average density of 6.54 fish per 100m² in slow water habitats. No fast water habitats were snorkeled in Reach 2, so fast water fish densities from Reach 1 were used in population estimates. The population estimate for cutthroat trout in Reach 2 was 425. Cutthroat observed during snorkeling varied in size from less than 100 mm to over 300 mm (Figure 3). Brown trout densities were 2.18 fish per 100m² in slow water habitats. The population estimate for brown trout was 242. In Reach 2, brown trout varied in size from over100 mm to less than 400 mm (Figure 4).

Reach 3

Reach 3 continued from the culvert under the old Temple Fork Road (GPS: 0453211 E 4628871 N, note: culvert has since been removed) to the confluence of the Left Fork with Temple Fork just below the Temple Sawmill monument. The reach was 2,184 m long, and had a total of 67 habitat units. This reach was identified by a confined channel and relatively high gradients. Few large pools were found and most slow water was associated with the banks. The slow velocity : fast velocity ratio by count was 1.03 : 1 (Table 1). The ratio by surface area was 1 : 11.79 (Table 1). The reach had an average width of 4.4 m and an average depth of 0.23 m (Table 2). Substrate was variable throughout the reach (Figure 2), with the largest percentage (26.3%) being gravel (8-64 mm). Over fourteen percent of the total bank length was undercut, thereby providing cover for fish. Stream banks within Reach 3 were found to be 91.6% stable. Riparian vegetation included grasses/forbs and willow communities. Tree species included aspen, cottonwood, and conifer. As would be expected LWD was more abundant within this reach. Sixty-three single pieces and twenty-four aggregates of LWD were counted in Reach 2. In addition, 11 root wads were observed. The majority of the LWD (86% of singles, 67% of aggregates, and 91% of root wads) were found in riffle habitats and were doing little to provide fish cover or habitat at that time. Cutthroat trout were observed during snorkeling surveys. Cutthroat trout had an average density of 2.62 fish per 100m² in slow water habitats. Reach 1 fish densities in fast water habitats were used to estimate population size. The population estimate for cutthroat trout in Reach 3 was 311. In Reach 3 cutthroat trout varied in size from 100 mm to over 300 mm (Figure 3). Fisheries biologists from the UDWR conducted a stream survey along a 100 m section of Reach 3 on August 10, 1999. Using a modified Zippin multiple pass depletion electrofishing formula, UDWR officials estimated there were 146 cutthroat trout per stream kilometer (Thompson et al. 2000). This is very close to the estimated 142 cutthroat trout per stream kilometer determined from Forest Service surveys. Brown trout are likely to exist within this reach but were not observed during either snorkeling or electrofishing surveys.

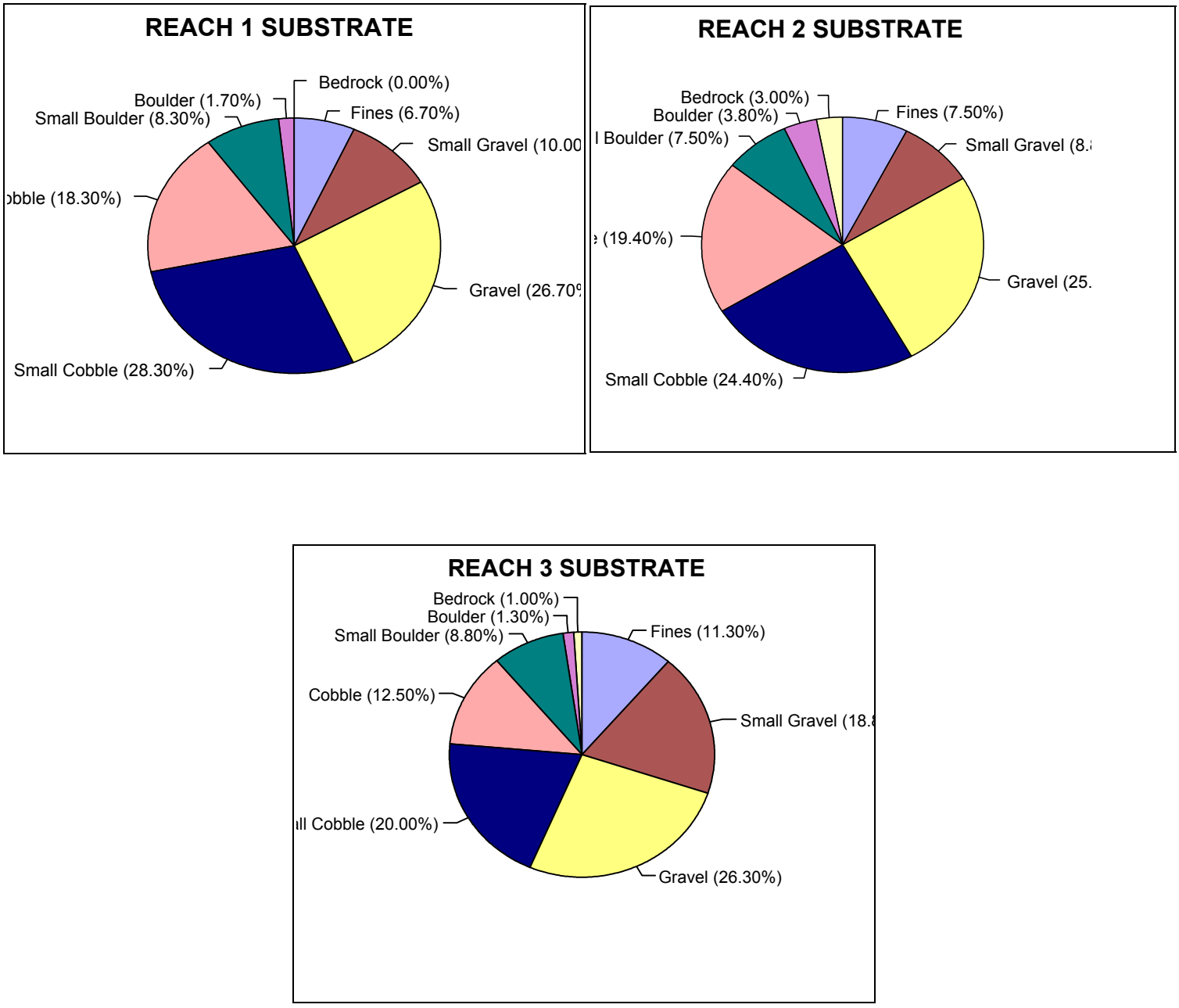

FIGURE 2. Substrate composition of Temple Fork for 1999. Values represent percent occurrence in each reach.

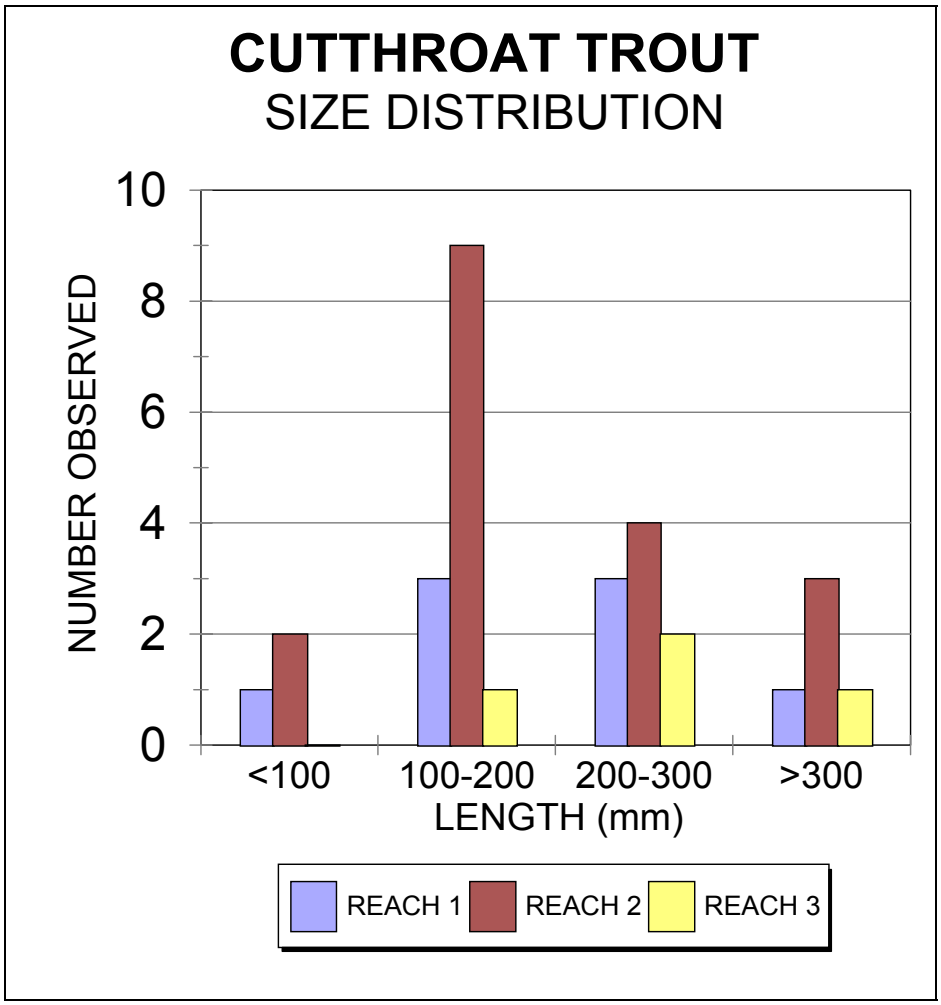

FIGURE 3. Size frequency distribution of cutthroat trout observed by snorkeling in Temple Fork in 1999.

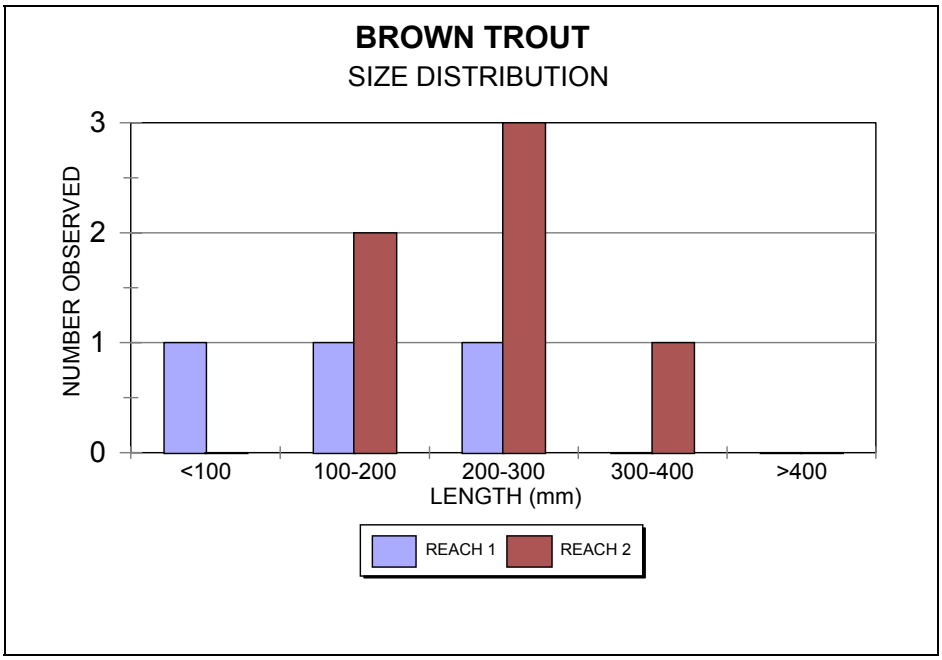

FIGURE 4. Size frequency distribution of brown trout observed by snorkeling in Temple Fork in 1999.

Table 1. Temple Fork - summary data, Summer 1999. Number and area of habitat types by reach.

Count of Habitat Type by Reach

REACH	FAST	SLOW	TOTAL
1	38	23	61
2	62	59	121
3	33	34	67
	133	116	249

Percent of Habitat Type by Reach

REACH	FAST	SLOW	TOTAL
1	62%	38%	100%
2	51%	49%	100%
3	49%	51%	100%

Count of Habitat Area (m²) by Reach

REACH	FAST	SLOW	TOTAL
1	8,879.0	895.6	9,774.6
2	8,880.0	1,882.9	10,762.9
3	8,588.9	728.1	9,317.0
	26,347.9	3,506.6	29,854.5

Percent of Habitat Area (m²) by Reach

REACH	FAST	SLOW	TOTAL
1	91%	9%	100%
2	84%	17%	100%
3	92%	8%	100%

Table 2. Temple Fork - summary data, Summer 1999. Habitat lengths and average width and depth by reach.

Total Length (m)

REACH	FAST	SLOW	TOTAL
1	1,741.1	163.6	1,904.7
2	2,185.5	421.6	2,607.1
3	1,932.9	183.2	2,116.1
	5859.5	768.4	6627.9

Average Length (m)

REACH	FAST	SLOW	
1	45.8	7.1	
2	35.3	7.1	
3	58.6	5.4	
	46.6	6.5	Overall Avg

Average Width (m)

REACH	FAST	SLOW	AVG
1	5.1	5.5	5.1
2	4.1	4.5	4.1
3	4.4	4.0	4.4
	4.5	4.7	Overall avg

Average Depth (m)

REACH	FAST	SLOW	AVG
1	0.31	0.39	0.31
2	0.25	0.32	0.26
3	0.22	0.30	0.23
	0.26	0.34	Overall avg

DISCUSSION

Habitat conditions within Temple Fork were good but could be improved. Comparison to natural condition descriptors (Overton et al. 1995) indicate Temple Fork was below average in the number of pools per 100 meters. Results from the 1999 survey indicate that Temple Fork had 1.75 pools/100 m, and many of these pools were artificially formed. This compares to 2.49 pools/100 m in streams demonstrating natural conditions. Due to this lack of deeper slow water habitats, Temple Forks' mean width/depth was 18.1, and continued to be greater than natural condition descriptors (#10). Brown (1935) found Temple Forks' width to be 4.27 m and depth to be 0.12 m during the summer of 1934. This is very similar to survey results from 1999 which found a width of 4.5 m and a depth of 0.27 m, with the differences being explained by drought conditions encountered in 1934. In 1999, large woody debris was scant within the bankfull channels, and did not contribute to pool formation.

Temperature fluctuations were low in Temple Fork. A high temperature of 12E C was observed at the confluence of Temple Fork and the Logan River. In-stream temperatures ranged from 5E C to 8E C during survey. These temperatures are slightly below the optimal temperature range of 12-15E C for cutthroat trout reported by Hickman and Raleigh (1982).

Bank stabilities in Temple Fork have improved since 1980. Surveys completed by the Forest Service in 1980 found only 44% of the banks stable (Shaw 1981). Currently, over 86% of the banks along Temple Fork are classified as stable. The meadows area of reach 2 has had the least amount of stable bank over both surveys. This reach has been impacted heavily by both cattle grazing and human activity over the years. Current conditions indicate management practices have improved fish habitat. In 1999, surface fines (silt/sand) covered less than nine percent of pool bottoms and low gradient riffles indicating few land-disturbing activities. A large beaver pond blew out on a small tributary to Temple Fork after the survey was completed. This blowout decreased bank stability and increased surface fines in Reach 1.

Bonneville cutthroat are the only trout native to the Bear River drainage, and are listed as "sensitive" by the Regional Forester. Rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), brown trout, and the Yellowstone subspecies of cutthroat trout (*Oncorhynchus clarki bouvieri*) have been introduced into Temple Fork (Pettengill 1994). During snorkeling surveys brown trout and cutthroat trout were observed. Brook trout were not observed in Temple Fork but are known to exist in Span Creek, a tributary to Temple Fork. Genetic testing is being conducted to determine if hybridization has occurred between Bonneville cutthroats and introduced rainbow and Yellowstone cutthroat trout.

Cutthroat trout were represented in all reaches. Juvenile cutthroat trout were also observed, indicating natural recruitment within Temple Fork. Brown trout densities decreased in an upstream direction, and were not observed in Reach 3.

Whirling disease was verified in fish within the Logan River drainage in the summer of 1999. How this disease will affect fish within Temple Fork is unknown at this time but in most instances cutthroat trout have been found to be more susceptible than brown trout, and less susceptible than rainbow trout.

PROJECT OPPORTUNITIES

Habitat conditions in Temple Fork should improve now that the road has been shifted up the slope away from the stream. The old road allowed for dispersed recreation throughout the Temple Fork drainage. Fewer access points to the stream should allow riparian vegetation, lost through human activity, the chance to restore itself. Additionally, in the spring of 2000 Forest Service personnel will plant willow cuttings. This should help stabilize banks and provide overhead cover for fish. Other improvements include the removal of several culverts from the stream and side tributaries during the road relocation. These culverts may have been inhibiting fish passage as well as preventing the stream from narrowing.

Bernard and Israelsen (1982) found few resident cutthroat trout in Temple Fork, rather, cutthroat trout were migrant using the stream for spawning then returning to the Logan River during the fall and winter. Habitat improvements within Temple Fork should focus at improving spawning or adult holding habitat and juvenile fish cover. Increasing

the number of pools per 100 meters would enhance fish habitat as well as improving width to depth ratios. Currently, over 80% of Temple Fork consists of fast water habitats. Increasing pool habitat would help reduce this percentage.

Allowing anglers to keep more brown trout could help reduce competition between cutthroat and brown trout. The main concern with using anglers to reduce brown trout numbers is the misidentification of fish species by the anglers. During a creel survey of the Logan River UDWR biologists found anglers often misidentified cutthroat trout as brown trout and vice versa (Pettengill 1994). Fishing regulations for Temple Fork currently allow anglers to keep any two trout. Since cutthroat trout have been found to be more susceptible to angling than brown trout this could promote the harvest of cutthroat trout.

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Appendix A

Information sheet for Temple Fork, tributary of the Logan River, Wasatch-Cache National Forest. Survey completed summer 1999.

Date surveyed: July 21, - August 4,1999

County: Cache, Utah

Survey Length: 6,696 m
Reach 1: 1,905 m (Confluence with Logan River to mouth of Spawn Creek)
Reach 2: 2,607 m (Mouth of Spawn Creek to GPS 0453211 E 4628871 N)
Reach 3: 2,184 m (GPS 0453211 E 4628871 N to Temple Sawmill monument)

Climate: Mountainous climate with wide ranging temperatures (-24° C to 35° C). Mean annual precipitation is 64 cm, two-thirds of which is received as snow. The stream does not freeze over in winter, but anchor ice forms on the streambed when the air temperature falls below -18° C (Pearson and Kramer, 1972).

Elevation: Headwaters - 1,988 m
Mouth - 1,761 m

Riparian Vegetation: Riparian vegetation includes grasses/forbs, willow, chokecherry, aspen, and Douglas-fir.

Fish Species: Bonneville cutthroat trout (*Oncorhynchus clarki utah*)
Brown trout (*Salmo trutta*)

Distribution: Reach 1. cutthroat trout, brown trout
Reach 2. cutthroat trout, brown trout
Reach 3. cutthroat trout

Management: Grazing, Recreation (hunting, fishing, camping, hiking, ATV use)