# NEVADA DEPARTMENT OF WILDLIFE
# STATEWIDE SPORT FISHERIES MANAGEMENT

## FEDERAL AID JOB PROGRESS REPORTS
## F-20-54

## 2018

## LAHONTAN CUTTHROAT TROUT
## EASTERN REGION

**NEVADA DEPARTMENT OF WILDLIFE, FISHERIES DIVISION**
**ANNUAL JOB PROGRESS REPORT**

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**NEVADA DEPARTMENT OF WILDLIFE, FISHERIES DIVISION**
**ANNUAL JOB PROGRESS REPORT**

**State:** *Nevada*
**Project Title:** *Statewide Fisheries Program*
**Job Title:** *Lahontan Cutthroat Trout*
**Period Covered:** *January 1, 2018 through December 31, 2018*

## SUMMARY

Electroshocking of Segunda Creek (SFHR), North Furlong Creek (SFHR), Long Canyon Creek (SFHR), Gennette Creek (SFHR), Mahogany Creek (SFHR) Green Mountain Creek (SFHR), Smith Creek (SFHR), and Sherman Creek (EFHR) to delineate LCT distribution were completed in 2018. Sampling of Rattlesnake Creek (SFHR) was not completed, but it will be rescheduled for 2019. Lahontan cutthroat trout (LCT) genetic samples were collected from Long Canyon Creek (SFHR), Gennette Creek (SFHR), Segunda Creek (SFHR), Mahogany Creek (SFHR), Smith Creek (SFHR), North Furlong Creek (SFHR), Pearl Creek (SFHR), Sherman Creek (EFHR), South Fork Little Humboldt River (SFLHR), First Creek (SFLHR), Snowstorm Creek (SFLHR), Winters Creek (SFLHR), Pole Creek (SFLHR), Sheep Creek (SFLHR), Secret Creek (SFLHR), Oregon Canyon Creek (SFLHR), Gance Creek (NFHR), Road Creek (NFHR), Warm Creek (NFHR), Marys River (MR), and Marys River Basin Creek (MR).

Pretreatment surveys of fish and stream conditions at Brown Creek were completed; however, no treatment was conducted. Sampling the upper limits for trout in Big Sawmill Creek (RR) and Little Sawmill Creek (RR) was completed and spring surveys are scheduled for the Upper Reese River (RR), Trail Creek (RR), Big Sawmill Creek (RR), and Beason Creek (RR). The approach to remove Brook Trout (*Salvelinus fontinalis*) from Pearl Creek (SFHR) and the Marys River (MR) was completed in 2018.

LCT was reintroduced into Marysville Creek (RR) to augment the existing population, but none was reintroduction into Stewart Creek (RR) since the treatment to remove non-native trout was postponed. Currant Creek (MR), North Fork Humboldt River (NFHR), and Pratt Creek (NFHR) were augmented with appropriate LCT and non-game fish species. Post-treatment surveys on the NFHR, Peterson Creek (NFHR), McAfee Creek (NFHR), Dell Creek (NFHR), and Walker Creek (NFHR) were conducted and non-native brook trout were found in the NFHR and McAfee Creek.

Electroshocking and aquatic and riparian habitat surveys were conducted on the South Fork Little Humboldt River (SFLHR), First Creek (SFLHR), Snowstorm Creek (SFLHR), Winters Creek (SFLHR), Pole Creek (SFLHR), Sheep Creek (SFLHR), Secret Creek (SFLHR), Oregon Canyon Creek (SFLHR), Gance Creek (NFHR) Road Creek (NFHR), Warm Creek (NFHR), and Hanks Creek (MR) to evaluate LCT demographics and habitat conditions. Fencing projects to protect LCT habitat within the SFLHR Basin were investigated in 2018 and thermograph loggers were placed along the East and West Forks of Beaver Creek to monitor water temperatures.

Electroshocking surveys were not conducted on the NFHR proper, Winters Creek (NFHR), California Creek (NFHR), Mahala Creek (NFHR), Jim Creek (NFHR), Pie Creek (NFHR), and Pratt Creek (NFHR) due to other priorities. Assessing the distribution of nonnative trout using eDNA sampling was not conducted on the mainstem Marys River (MR) and T Creek (MR) because an assessment of the entire Marys River Subbasin will occur in 2019. The reintroduction of LCT and all native nongame fish species into Currant Creek (MR) was postponed until eDNA sampling and genetic testing has been evaluated.

## BACKGROUND

Lahontan Cutthroat Trout (LCT, *Oncorhynchus clarkii henshawi*) is the only salmonid native to the Lahontan basin. LCT were distributed in the drainages of ancient Lake Lahontan and as conditions became more arid during the last 5,000 to 12,000 years, they survived as small populations in isolated headwaters of many mountain ranges in Nevada, Oregon, and California.

The settlement of the Great Basin resulted in the loss of LCT habitat as livestock grazing, urban and mining development, water diversions, hybridization, and competition with nonnative trout led to significant declines in the range and numbers of this unique trout species. In response to these declines, LCT was listed as endangered in 1970 and reclassified as threatened in 1975. In January of 1995, the United States Fish and Wildlife Service (USFWS) released the recovery plan for LCT.

Historically, LCT may have inhabited as much as 2,210 miles of streams in the major subbasins of the Humboldt River during wet cycles (Coffin 1983). Early emigrant journals documented LCT in nearly all the major subbasins and occasionally as far downstream as the Humboldt Sink during wet years. The major impacts to LCT populations in the Humboldt Basin result from loss of habitat, displacement by introduced fish, and hybridization by nonnative trout species.

## OBJECTIVES and APPROACHES

Objective: Native Sport Fisheries Management

Approaches:

- Augment the LCT population in the NFHR with NFHR strain LCT and augment native non-game species populations.
- Augment the LCT population in Currant Creek with Marys River strain LCT and augment the native non-game species populations.
- Conduct post-rotenone treatment surveys on the NFHR, Peterson Creek, McAfee Creek, Dell Creek, Walker Creek, and the canal paralleling the NFHR.
- Reintroduce Reese River strain LCT into Marysville Creek.
- Conduct post-treatment surveys on lower T Creek.
- Reintroduce native non-game fish species into T Creek.

- Reintroduce LCT into lower T Creek once treatment success is confirmed.
- Plan, permit, and conduct the rotenone treatment on Brown Creek and its tributaries to remove non-native trout.
- Electroshock the following streams to evaluate LCT populations and to delineate their distribution: Long Canyon Creek (SFHR), Segunda Creek (SFHR), Mahogany Creek (SFHR), North Furlong Creek (SFHR), Smith Creeks (SFHR), Gennette Creek (SFHR), Green Mountain Creek (SFHR), and Sherman Creek (EFHR).
- Evaluate fish habitat, population status, and distribution in Rattlesnake Creek (SFHR).
- Determine upper fish limits in Upper Reese River (RR), Little Jet Creek (RR), Trail Creek (RR), Little Sawmill Creek (RR), Big Sawmill Creek (RR), Stewart Creek (RR), and Beason Creek (RR).
- Mechanically remove Brook Trout from the mainstem Marys River and selected streams in the SFHR Subbasin.
- Reintroduce LCT into Stewart Creek (RR).
- Electroshock and perform GAWS surveys on the SFLHR, First Creek (SFLHR), Snowstorm Creek (SFLHR), Winters Creek (SFLHR), Pole Creek (SFLHR), Sheep Creek (SFLHR), Secret Creek (SFLHR), Oregon Canyon Creek (SFLHR), NFHR, Winters Creek (NFHR), California Creek (NFHR), Mahala Creek (NFHR), Jim Creek (NFHR), Gance Creek (NFHR), Road Creek (NFHR), Warm Creek (NFHR), Pie Creek (NFHR), and Pratt Creek (NFHR) to evaluate LCT populations and delineate their distributions.
- Collect eDNA samples in the mainstem Marys River to assess the distribution of nonnative trout.
- Spot electroshock Hanks Creek, a tributary to the Marys River, to assess the distribution of LCT.
- Investigate and implement fencing projects to protect LCT habitat in the SFLHR Basin.
- Augment the Pratt Creek LCT population with NFHR strain LCT.
- Place thermographs in the East and West Forks of Beaver Creek to monitor water temperatures to assess the possibility of reintroducing LCT in the future.
- Collect LCT fin samples (at least 30 per stream) from various populations in the Upper Humboldt Basin for genetic analysis and phylogenetic mapping.
- Coordinate with the Trout Unlimited funded Safe Harbor Biologist to develop and implement site-based agreements and recovery actions for LCT with private landowners included under programmatic Safe Harbor Agreements.
- Provide the lead in management activities that provide for maintenance and enhancement of LCT.

## PROCEDURES

### LCT Population and Habitat Assessments

The final draft of the Upper Humboldt River LCT Species Management Plan (2004) provides historic and status information for all known LCT populations in the nine subbasins as well as the out-of-basin populations. Efforts should be made to keep this information up to date by prioritizing populations to be monitored during each field season with special attention given to donor and introduced populations. The general method used for sampling consists of a single pass electroshocking survey at historic sampling locations. If greater confidence is needed, multiple pass with depletion surveys will be performed. Additionally, spot electroshocking may be conducted to improve examining LCT distribution, and it is often the best way to confirm and sample small populations. Monitoring stream habitat is generally the responsibility of the land management agencies unless assessment of a priority system is needed to help facilitate LCT recovery goals. Stream habitat assessments should be conducted using the General Aquatic Wildlife Survey (GAWS) methodology and/or photo points.

### Non-Native Trout Control

Non-native trout have been identified as a major threat to LCT in the USFWS 1995 recovery plan and Upper Humboldt River LCT SMP. Hybridization risks and subsequent loss of genetic integrity, as well as displacement or confinement of LCT to certain habitats due to competition with more aggressive introduced species are the primary reasons. Pure LCT populations that share drainages with non-native salmonids will be monitored to track their status and threat levels. Populations that are threatened by an introduced species will be evaluated and management strategies developed to deal with the threat. This may result in the chemical or mechanical removal of non-native salmonids and may support the construction or enhancement of an instream fish barrier.

### LCT Reintroductions

LCT is reintroduced primarily after a stream is treated to remove treats, but it also is used to secure genetic viability or bolster a new population. Before reintroduction occurs, the recipient stream is evaluated to find reintroduction sites. Sites are marked by GPS to be easily found during translocation. Transplanted LCT come from a donor source having a similar genetic composition within the same subbasin. Fish were collected by electroshocking, transported via an oxygenated tank to the recipient stream, and released at predetermined sites.

### Stream Habitat Surveys

The USFS Region 4, GAWS survey method was used to sample stations within a creek system. Stations were 50 m long and sampled with a Smith Root LR-20B Backpack Electrofisher using a single pass method. Fork lengths were measured on all LCT and genetic samples were taken on all subadults and adults for hybridization

analysis. Three habitat transects placed at 0, 25, and 50 m were surveyed at each station. This habitat sampling was not intended to serve as a full survey, but rather to capture general stream conditions at fish sampling sites. GPS location, temperature (air and water), flow (float method), riparian and upland vegetation types, and aquatic habitat conditions were noted. Visual estimating the percentage of undercut banks occurred throughout an entire station length. Three photos were taken at the first transect of each station, one perpendicular to the stream channel, one downstream, and one upstream.

Habitat Condition Index (HCI; indicates the quality of stream habitat) is used to determine the quality of stream habitat using the parameters pool measure (PM), percent pool structures or quality pools (PS), bank cover (BC), bank vegetation stability (BVS), bank soil stability (BSS), and stream bottom (SB). These indicators helped determine the habitat factors that would generate the greatest stream habitat benefit, if improved. HCI's of less than 100% can reflect a certain degree of improvement or potential to increase the habitat condition of a stream. An HCI is based on the BLM ratings of 0-49 (poor), 50-59 (fair), 60-69 (good), and 70-100 (excellent).

## FINDINGS

NFHR LCT and Non-Game Fish Population Augmentation (HUC 16040102)

LCT, Speckled Dace (*Rhinichthys osculus*), and Paiute Sculpin (*Cottus beldingi*) were captured using a Smith Root LR-20B Backpack Electrofisher and transported to the NFHR in livewell in the back of a truck. Total length was measured on all subadult/adult LCT and a subsample of YOY LCT was measured. Genetic samples (fin clips) were collected from all subadult and adult LCT for hybridization analysis. A subsample of Paiute Sculpin was also measured for total length.

Two hundred four LCT (105 subadults/adults and 99 YOY) were captured in Gance Creek (as part of the Gance Creek Fire Salvage Project) and released into the NFHR at three locations. Locations were located upstream of the area that burned during the 2018 Sugar Loaf Fire. Approximately six to seven age classes, including YOY, were present (Figure 1) and the average length excluding YOY was 165 mm. In addition to LCT, three Speckled Dace were released. The first reintroduction of Paiute Sculpin occurred in 2018 when 284 were released at the same locations as LCT. The average length of Paiute Sculpin was 84 mm. No fish showed any signs of stress when released. Currently, 399 LCT from Foreman and Gance creeks were translocated to reestablish the LCT population in the NFHR.

Augmentations of LCT, Speckled Dace, Lahontan Redside Shiner (*Richardsonius egregious*), Paiute Sculpin, and Mountain Sucker (*Catostomus platyrhynchus*) populations should be continued in 2019. Additionally, a fish population survey should be conducted next year to assess recruitment and success of reintroductions.

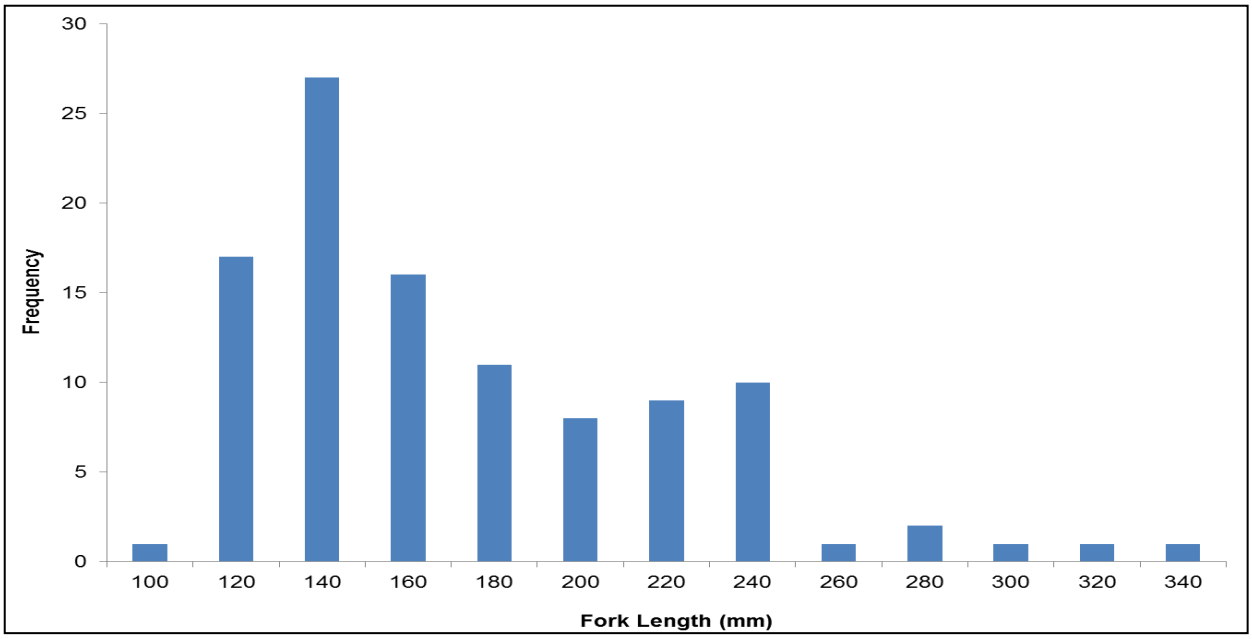


**Figure 1.** Absolute length frequency histogram for LCT that were released into the North Fork Humboldt River.

Currant Creek LCT and Non-Game Fish Population Augmentation (HUC 16040101)

All species of fish were captured using a Smith-Root LR-20B Backpack Electrofisher. Length measurements (FL) and fin clips (for genetic analysis) were taken on all LCT caught. Fish collected were either placed into dry bags filled with water and backpacked out on October 1 or were placed into aerated buckets being carried by a USFS pack string on October 30. Fish were transported to the Marys River Trailhead and placed into a live well in the back of a truck.

Fifty-four LCT were captured in the Marys River and transplanted into Currant Creek to augment the LCT population. LCT came from two locations, between UTM (NAD 83) 11 E 0633661 N 4616657 and 11 E 0633716 N 4616819 and between UTM 11 E 0633804 N 4616924 and 11 E 0633978 N 4617957, and placed at three locations in Currant Creek. Eight LCT were released downstream of the reservoir, 38 upstream of the reservoir, and 8 were placed in the stock watering pond on the upper tributary. Approximately four LCT age classes were represented (Figure 2). Thirty-five Paiute Sculpin and three Tahoe Suckers (*Catostomus tahoensis*) were placed in Currant Creek upstream of the reservoir in riffle habitat.

Genetic samples taken from LCT used for augmenting Currant Creek in 2017 were analyzed for hybridization in 2018. Of 46 samples taken, one was determined to be a LCT/Rainbow Trout (*Oncorhynchus mykiss*) hybrid and the others were pure LCT. Unfortunately, the hybrid was placed upstream of the reservoir in 2017. With the reintroduction of LCT, Speckled Dace, Lahontan Redside Shiner, Paiute Sculpin, Tahoe Sucker, and Mountain Sucker into Currant Creek, the native fish assemblage has been completely furnished.

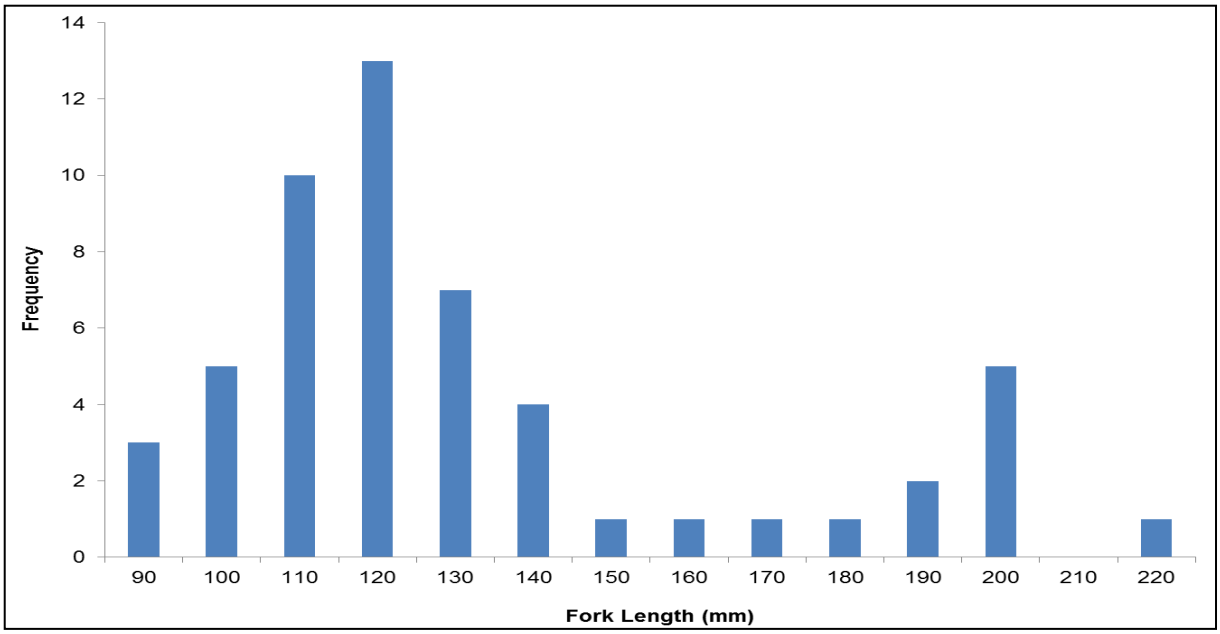

**Figure 2.** Absolute length frequency histogram for LCT that were released into Currant Creek.

Augmentation of the LCT population using LCT identified as pure should continue in 2019. In addition, non-game fish species should be augmented in 2019. A fish population survey should be conducted on Currant Creek in 2019 to assess recruitment and success of reintroductions. In addition, genetic samples should be taken from LCT to determine the extent of any further hybridization.

NFHR Post-Treatment Survey (HUC 16040102)

A Smith Root LR-20B Backpack Electrofisher was used to survey the area of the NFHR that was treated to remove nonnative trout in 2017. Fifteen Brook Trout and multiple Speckled Dace, Lahontan Redside, Mountain Sucker, and Tahoe Sucker were caught during the post-treatment survey. All Brook Trout captured were euthanized. Based on survey results, the 2017 Rotenone Treatment Project was unsuccessful in eradicating Brook Trout from the NFHR. The stream system will need to be retreated.

Peterson Creek Post-Treatment Survey (HUC 16040102)

A Smith Root LR-20B Backpack Electrofisher was used to survey the area of Peterson Creek treated in 2017 and no fish were detected. Because Brook Trout were found in the NFHR and McAfee Creek during post-treatment surveys, Peterson Creek should also be retreated with rotenone in 2019.

McAfee Creek Post-Treatment Survey (HUC 16040102)

A Smith Root LR-20B Backpack Electrofisher was used to survey the area of McAfee Creek that was treated to eradicate brook trout in 2017 and one Brook Trout and multiple Speckled Dace were found. The Brook Trout was found on USFS land and

Speckled Dace were found on land owned by the Ellison Ranch Company. The Brook Trout was euthanized while the Speckled Dace were released. McAfee Creek should be retreated with rotenone in 2019.

Dell Creek Post-Treatment Survey (HUC 16040102)

A Smith Root LR-20B Backpack Electrofisher was used to survey the area of Dell Creek that was treated in 2017 and no fish were detected. Because Brook Trout were found in the NFHR and McAfee Creek during post-treatment surveys, Dell Creek additionally should be retreated with rotenone in 2019 since it is a tributary to the NFHR.

Walker Creek Post-Treatment Survey (HUC 16040102)

A Smith Root LR-20B Backpack Electrofisher was used to survey the area of Walker Creek that was treated in 2017 and no fish were detected. Because Brook Trout were found in the NFHR and McAfee Creek during post-treatment surveys, Walker Creek additionally should be retreated with rotenone in 2019 since it is a tributary to the NFHR.

Segunda Creek (HUC 16040103)

Six stations were sampled along Segunda Creek using a 50-m single pass survey with a Smith-Root LR-20B Electrofisher. All fish caught were measured, checked for body condition, and released. Water temperature, air temperature, flow, and pictures (upstream/downstream) were collected at each site. A fin clip was collected from captured LCT for genetic analysis.

Water temperatures of Segunda Creek ranged from 50 to 59°F, with stream flows ranging from 0.34 to 1.95 cfs. Fin clips were sent to UNR Genetics Lab and were identified as hybrids (Lahontan Cutthroat Trout X Rainbow Trout). These fish were captured only at SEG1 at a density of 193.2 fish/mile. They averaged 2.4 in (6.1 cm), with a range from 2.0 to 2.7 in (5.1 to 6.9 cm). All were considered to be in good to excellent body condition and represented only one age class. Brook Trout were found at four of the six survey sites (SEG1 to SEG4) at densities ranging from 998.2 to 1,288.0 fish/mi. Brook Trout averaged 4.2 in (10.6 cm), with a range from 1.7 to 10.5 in (4.2 to 26.7 cm). All Brook Trout were in excellent body condition, with at least five age classes represented. No fish were found at SEG5 or SEG6.

Habitat conditions were considered "healthy" overall. No cattle damage was found and all stations displayed a healthy riparian plant community. Riparian conditions were photographed at all survey stations.

Segunda Creek should be a high priority LCT recovery stream in the South Fork Humboldt River. It is a high elevation stream with immaculate habitat capable of supporting a large trout population. However, a brook/hybrid trout removal project or rotenone treatment is necessary to sustain an LCT population. There is available habitat

at stations SEG5 and SEG6 even though no fish were found, suggesting there is a natural fish barrier located downstream between SEG4 and SEG5. An effort should be made to locate the barrier and utilize it for establishing an LCT population upstream. Another option would be to build a fish passage barrier near the confluence of Long Canyon Creek with Segunda Creek.

Long Canyon Creek (HUC 16040103)

Ten stations were sampled along the mainstem Long Canyon Creek and were in the same general location as the 2012 sample sites. A 50-m single pass survey was conducted using a Smith-Root LR-20B Electrofisher. All fish were measured, checked for body condition, and released. Water temperature, air temperature, flow, and pictures (upstream/downstream) were collected at each site. A fin clip was collected from LCT for genetic analysis.

Water temperatures along Long Canyon Creek ranged from 50 to 60°F, with stream flows ranging from 0.21 to 6.45 cfs. LCT, Rainbow Trout, Brook Trout, hybrid trout, and sculpin were caught. During the survey no LCT were caught at survey transects, however, two were electroshocked just below the upper barrier. The UNR Genetics Lab conducted the hybrid analysis and found hybrids (Lahontan Cutthroat Trout X Rainbow Trout) and Rainbow Trout at LNG1.5 at a density of 515.2 fish/mi. They averaged 2.5 in (6.3 cm), with a range from 1.8 to 3.2 in (4.5 to 8.1 cm) and body conditions were considered good to excellent. All hybrids were of one age class.

Brook Trout were found at eight of ten survey sites (LNG1 through LNG9), with densities ranging between 257.6 fish/mi and 1,416.8 fish/mi. They averaged 5.4 in (13.6 cm), with a range from 1.9 to 11.5 in (4.9 to 29.3 cm) and were in excellent body condition. At least five age classes were represented. Sculpin were captured at two of the ten stations (LNG1.5 and LNG3). No fish species were found at LNG10 and LNG11, which occurred upstream of a natural barrier [UTM (NAD 83, zone 11T) 632229.09E 4484918.23N].

Riparian conditions along Long Canyon Creek were considered "healthy" overall. All stations displayed a healthy riparian plant community with minimal ungulate damage along the upper watershed (LNG9 through LNG11). Photographs documented riparian conditions at all survey stations.

Long Canyon Creek should be a high priority for LCT recovery in the South Fork Humboldt River as it is a high elevation stream with immaculate habitat capable of supporting a large trout population. A mechanical Brook Trout removal project should be completed as soon as possible to reduce interspecific competition and bolster the pure LCT population. LCT should be translocated above the natural fish barrier after a genetic analysis confirms their purity.

Mahogany Creek (HUC 16040103)

Five stations were sampled along Mahogany Creek through 50 m single pass surveys using a Smith-Root LR-20B Electrofisher. Fish were measured, checked for body condition, and released. Water temperature, air temperature, flow, and pictures (upstream/downstream) were collected at each site. A fin clip was collected from LCT for genetic analysis.

Water temperatures of Mahogany Creek ranged from 58 to 68°F, with stream flows ranging from 2.30 to 3.14 cfs. LCT was found at one of the four survey sites (MAH4) at a density of 161.0 fish/mi. They averaged 3.0 in (7.7 cm), with a range of 2.0 to 3.6 in (5.0 to 9.2 cm) and all were considered to be in good to excellent body condition. Two age classes were represented.

Brook Trout were found at all survey sites at densities between 515.2 and 2,093.0 fish/mi. They averaged 3.7 in (9.5 cm), with a range from 1.9 to 9.8 in (4.9 to 25.0 cm) and showed excellent body condition. At least five age classes were represented.

Habitat conditions on Mahogany Creek were considered "healthy" overall. No cattle damage was found and stations displayed a healthy riparian plant community. Photographs of riparian conditions were collected at survey stations.

Mahogany Creek should be a high priority LCT recovery stream in the South Fork Humboldt River. It is a high elevation stream having immaculate habitat and capability of supporting a large trout population. The LCT population appears to be continuing its decline due to interspecific competition with Brook Trout. A mechanical Brook Trout removal project or chemical treatment will be necessary to sustain the LCT population. There is a good location just upstream of MAH1 for construction of a temporary fish barrier. The barrier would be built by hand and materials transported in by helicopter. USFS permitting and funding opportunities for a barrier should be discussed at the next GMU meeting.

North Furlong Creek (HUC 16040103)

Three stations in the same general location as in 2003 were sampled along North Furlong Creek. A 50 m single pass survey was conducted using a Smith-Root LR-20B Electrofisher. All fish were measured, checked for body condition, and released. Water temperature, air temperature, flow, and pictures (upstream/downstream) were collected at each site. A fin clip was collected from LCT for genetic analysis.

Water temperatures of North Furlong Creek ranged from 50 to 55°F, with stream flows ranging from 1.81 cfs to 1.99 cfs. LCT was found at all stations (NFL3 through NFL5) at densities ranging from 161.0 and 289.8 fish/mi and averaging 5.4 in (13.8 cm). They ranged from 3.2 to 8.3 in (8.2 to 21.1 cm) and considered to be in good to excellent body condition. At least three different age classes were represented. The

UNR Genetics Lab found all LCT were pure.

Brook Trout were also found at all stations, with densities ranging between 579.6 and 998.2 fish/mi. They averaged 4.9 in (12.5 cm), ranged between 1.9 and 9.6 in (4.8 and 24.4 cm), and were in excellent body condition. At least five age classes were represented. No other fish species were found during the survey.

Riparian conditions along North Furlong Creek were considered "healthy" overall and displayed a healthy riparian plant community with excellent fish habitat. Photographs of riparian conditions were collected at all survey stations.

North Furlong Creek should be a high priority for LCT recovery in the South Fork Humboldt River. It is high elevation stream with immaculate habitat supporting one of the largest LCT populations in the basin. Brook Trout expanding into the upper portions of the stream is a major concern to the future stability of LCT. A mechanical Brook Trout removal project should be completed as soon as possible to reduce interspecific competition and bolster the LCT population. The upper portion of the stream should be surveyed in an effort to document Brook Trout expansion and a thorough hybrid analysis should be completed, as Rainbow Trout are known to occupy Long Canyon Creek. LCT from North Furlong Creek could be translocated above Long Canyon Creek and/or Segunda Creek natural fish barriers to help provide security and facilitate genetic migration.

Smith Creek (HUC 16040103)

Eleven stations were sampled along Smith Creek. A 50 m single pass survey was conducted using a Smith-Root LR-20B Electrofisher. All fish were measured, checked for body condition, and released. Water temperature, air temperature, flow, and pictures (upstream/downstream) were collected at each site. A fin clip was collected from LCT for genetic analysis.

Water temperatures of Smith Creek ranged from 50 to 66°F and stream flows ranged from 0.50 to 2.71 cfs. LCT was found at two of the eleven survey sites (SMN4 and SMM3) at densities of 32.2 fish/mi. They averaged 7.0 in (17.7 cm), with a range of 6.8 to 7.1 inches (17.3 to 18.1 cm) and considered to be in good to excellent body condition. These fish represented one age class (3+). Genetic samples were sent to the UNR Genetics Lab and were confirmed to be pure LCT.

Brook Trout were found at ten of the eleven survey sites (SMN1 through SMN6, SMM1 through SMM3, and SMS1) at densities ranging from 32.2 to 1,706.6 fish/mi. They averaged 5.8 in (14.7 cm), with a range of 3.3 to 9.9 in (8.5 to 25.2 cm) and showed excellent body condition. At least five age classes were represented.

Habitat conditions on Smith Creek were considered "healthy" overall. No livestock damage was found and all stations displayed a healthy riparian plant community. Photographs of riparian conditions were collected at all survey stations.

Smith Creek should be a high priority LCT recovery stream in the South Fork Humboldt River. It is a high elevation stream with immaculate habitat capable of supporting a large trout population. The LCT population appears to be continuing its decline due to interspecific competition with Brook Trout. A Brook Trout removal project or rotenone treatment will be necessary in order to sustain an LCT population and a fish migration barrier would need to be installed prior to any large-scale Brook Trout removal efforts. A comprehensive genetic analysis is also needed as both Rainbow Trout and hatchery raised LCT have been stocked into this stream. Efforts should be made to examine if Paiute sculpin exist, they have not been found since 1979.

Gennette Creek (HUC 16040103)

Five stations were sampled along Gennette Creek. A 50 m single pass survey was conducted using a Smith-Root LR-20B Electrofisher. All fish were measured, checked for body condition, and released. Water temperature, air temperature, flow, and pictures (upstream/downstream) were collected at each site. A fin clip was collected from LCT for genetic analysis.

Water temperatures of Gennette Creek ranged from 32 to 38°F, with stream flows ranging from 0.56 to 0.85 cfs. LCT was found at two of the five survey sites (GEN5 and GEN6) with densities ranging between 32.2 and 354.2 fish/mile. LCT averaged 3.4 in (8.6 cm), with a range of 2.6 to 5.4 in (6.8 to 13.7 cm) and considered to be in good to excellent body condition. These fish represented at least two age classes, with the majority being young-of-year.

Brook Trout were found at four of the five survey sites (GEN1 through GEN5) at densities between 805.0 and 3,638.6 fish/mi. The captured Brook Trout averaged 4.6 inches (11.6 cm) in length, with a range of 1.92 to 9.4 inches (4.9 to 23.8 cm). All Brook Trout were in excellent body condition, with at least five age classes represented.

Habitat conditions on Gennette Creek were considered "excellent" overall. No cattle damage was found and all stations displayed a healthy riparian plant community. Photographs of riparian conditions were collected at all survey stations.

Gennette Creek should be a high priority LCT recovery stream in the South Fork Humboldt River. It is a high elevation stream with immaculate habitat capable of supporting a large trout population. The LCT population appears to be continuing its decline due to interspecific competition with Brook Trout. A Brook Trout mechanical removal project or chemical treatment will be necessary in order to sustain the LCT population. There is a natural fish barrier located at station GEN1 that could be utilized for future management in protecting LCT.

Green Mountain Creek (HUC 16040103)

Six stations on the North Fork and eight stations on the South Fork of Green Mountain Creek were sampled. A 50 m single pass survey was conducted using a

Smith-Root LR-20B Electrofisher. All fish found were measured, checked for body condition, and released. Water temperature, air temperature, flow, and pictures (upstream/downstream) were collected at each site.

Green Mountain Creek was surveyed during mid-July, with water temperatures ranging from 53 to 70°F and discharges ranging from 0.04 to 0.34 cfs. All of the South Fork and the majority of the North Fork were essentially dry or had intermittent flow. No LCT was found and Brook Trout was found only at GRN2. Their density was 96.6 fish/mi, and they averaged 7.1 in (18.1 cm), with a range of 6.8 to 7.4 in (17.2 cm to 18.8 cm). All were considered to be in fair body condition. Two days were also spent removing Brook Trout from the stream through electroshocking. This effort removed 54 Brook Trout that averaged 6.7 in (17.1 cm) and ranged from 2.5 to 11.7 in (6.4 to 29.6 cm).

The riparian condition of the South Fork Green Mountain Creek was "healthy" overall at the time of survey. However, there was little to no measurable flow at any of the survey sites. Riparian conditions of the North Fork Green Mountain Creek was "healthy" at stations GRN3, GRN5, and GRN6, but were poor at GRN1, GRN2, and GRN4 due to heavy cattle damage leading to excessive bank shearing, hummocking, and high sedimentation. Photographs of riparian conditions were collected at all survey stations.

Green Mountain Creek should be electroshocked in 2019 to remove Brook Trout. Fortunately, there were several beaver dams acting as barriers, inhibiting Brook Trout from migrating into the upper portions of the stream. At the time of survey, there was less than two miles of available fish habitat due to the lack of water. Green Mountain Creek will not be able to support an LCT fishery if current weather conditions continue.

Pearl Creek Brook Trout Removal (HUC 16040103)

A Smith Root LR-20B Electrofisher was used to removal Brook Trout. LCT caught were netted and released. Eighty LCT were caught and randomly measured. All Brook Trout were measured and removed from the stream.

This was the twelfth year of mechanical removal in Pearl Creek, resulting in removing 38 Brook Trout from 2.5 mi of stream over six days. The total number of Brook Trout removed since 2006 was 1,677. Their average fork length was 8.2 cm (3.2 in), and range was from 5.2 to 9.9 cm (2.0 to 3.9 in). Also captured were 1,349 LCT that averaged 11.9 cm (4.7 in) and ranged from 4.5 to 22.4 cm (1.8 to 8.8 in). The total number of LCT contacted since 2006 was 7,966. Figure 3 shows Brook Trout length frequency of measured individuals and Figure 4 shows LCT length frequency of measured individuals. Figure 5 shows species composition of fish in Pearl creek over the past 11 years.

LCT in Pearl Creek represents the largest single stream LCT population in the South Fork Humboldt River Subbasin. With this being the case, the stream has become

an important donor stream for LCT reintroduction efforts within the subbasin. A chemical treatment is not feasible due to the expanded range of LCT, therefore, mechanical removal of Brook Trout should be continued in order to protect the LCT population.

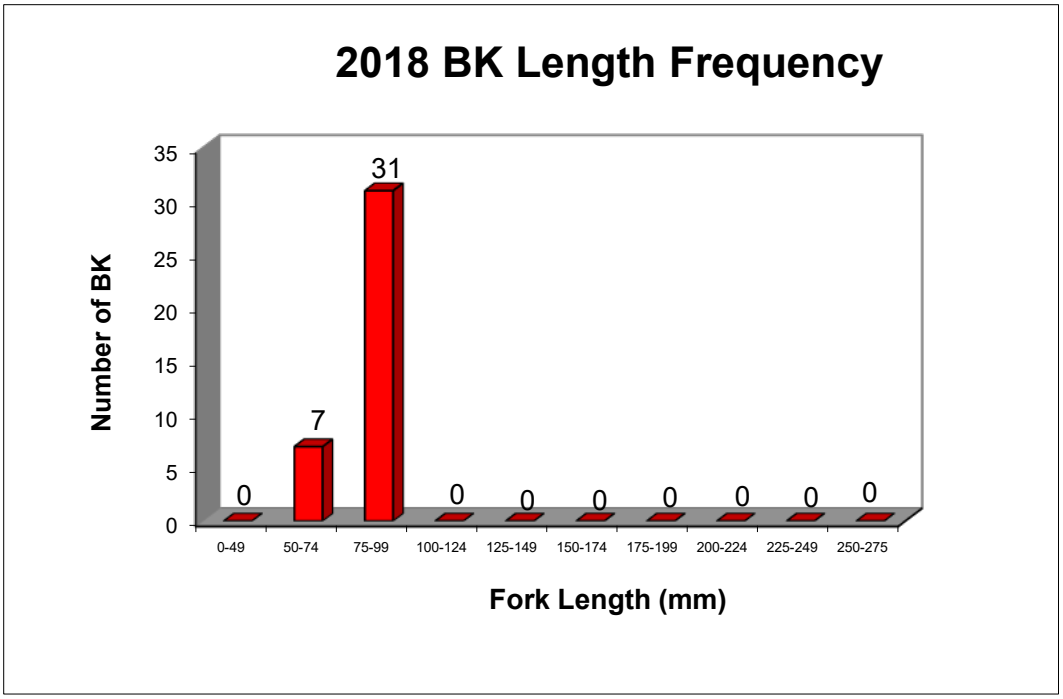


**Figure 3.** Pearl Creek Brook Trout length frequency.

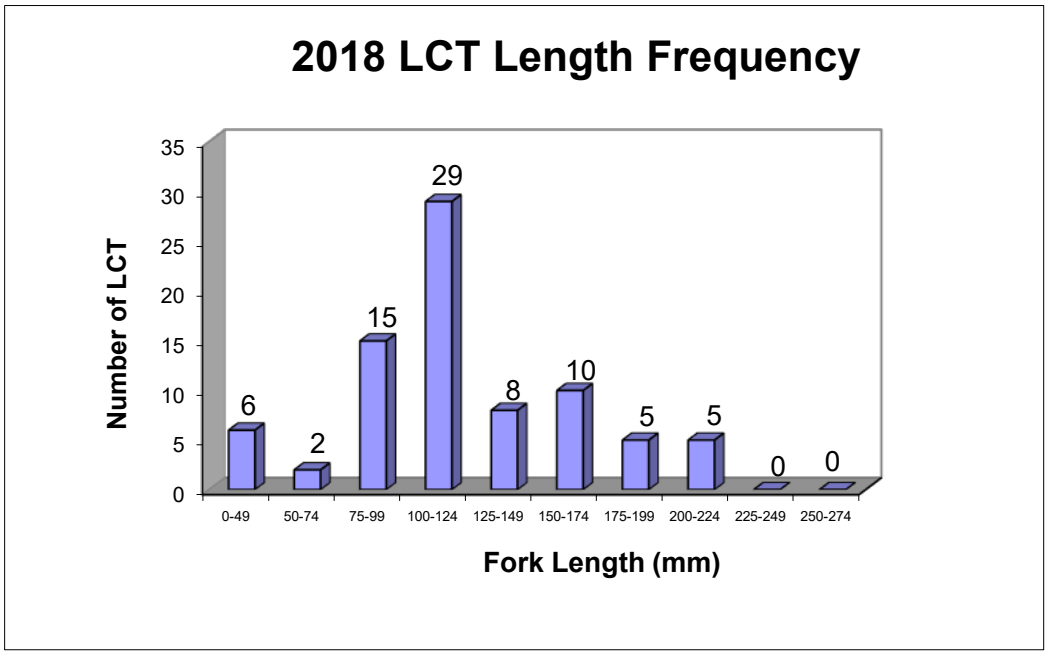


**Figure 4.** Pearl Creek LCT length frequency.

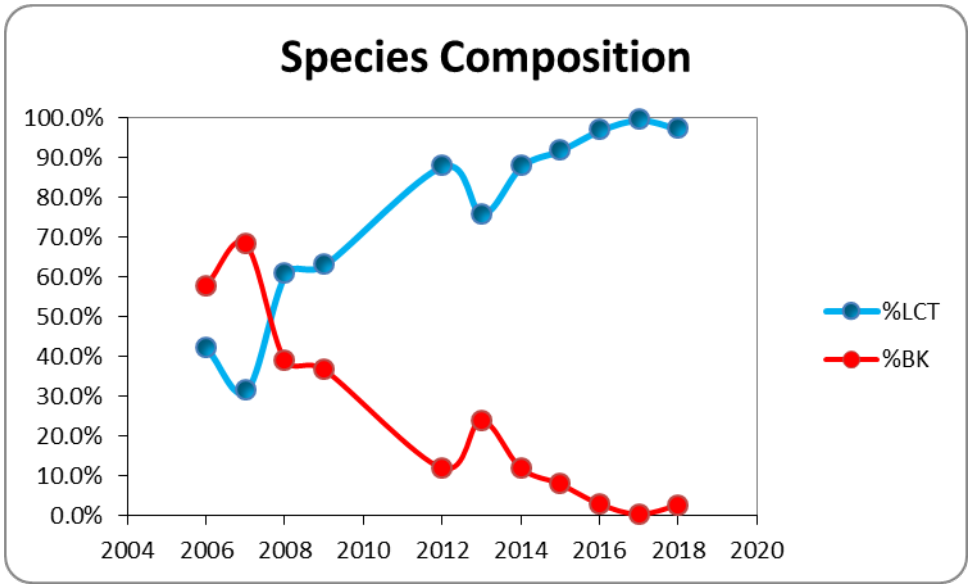


**Figure 5.** Species composition, 2006 to 2018.

Marysville Creek LCT Reintroduction (HUC 16040107)

Twenty-eight LCT from Shoshone Creek (HUC 16060004) were captured using a Smith-Root LR-20B Electrofisher and dip-nets. Fish were transported via truck and live well to Marysville Creek Trailhead, and then carried in backpacks and released into quality habitats.

Marysville Creek has had 88 LCT reintroduced since the 2016 treatment. Augmentations should continue in 2019 to bolster the population in other portions of the creek. In addition, a fish population survey should be conducted in 2020 to document the success of reintroductions and to assess recruitment.

Sherman Creek (HUC 16040101)

In Sherman Creek, 12 stations that were in the same general location as the 2003 survey sites were sampled in 2018. A 50 m two-pass depletion survey was conducted at each station using a Smith-Root LR-24B Electrofisher and block nets. All fish were measured, checked for body condition, and released after the second pass. Water temperature, air temperature, and pictures (upstream/downstream) were collected at each site. A fin clip was collected from LCT for genetic analysis.

Water temperatures in Sherman Creek ranged from 55 to 70°F. LCT occurred at stations SHR2, SHR3, and SHR5 at densities ranging between 32.2 and 160.98 fish/mi. They averaged 6.1 in (15.4 cm), with a range of 5.1 to 6.9 in (13.0 to 17.6 cm) considered to be in good body condition. At least two different age classes were represented and no YOY LCT were found. Fin clips were analyzed at UNR Genetics Lab and all were pure LCT.

Riparian conditions along Sherman Creek were considered "fair" overall. The stream was in a stable/slight upward trend when compared to the 2003 survey, and riparian recovery seems to be occurring at a slow pace. The creek still lacks complex instream habitat, with poor stream shading. The survey was conducted in early June before most cattle grazing occurs. Photographs of riparian conditions were collected at all survey stations.

The Sherman Creek population was small, but it seems to be persisting. A genetic bottleneck is likely occurring in this population given that it was started with only fifty fish. It also has been subject to frequent population fluctuations. The riparian area seems to be recovering at an extremely slow pace. Future efforts should focus on working with BLM and private land managers to ensure the best grazing strategy. Increasing quality pools (possibly beaver analogs) would help expand LCT habitat by storing water in the upper portions of the watershed.

Marys River and Marys River Basin Creek Hybrid Genetic Survey (HUC 16040101)

All LCT were captured using a Smith-Root LR-20B Backpack Electrofisher. In 2018, 235 PIT tags were used to identify individual fish in the Marys River. Approximately 10 to 15 fish were collected at a time and placed in a bucket containing clove oil until they were sedated and could be handled with minimal stress. After sedation, a uniquely identified Biomark HPT9 PIT tag was inserted behind the right pectoral fin using an implanter syringe and a 12-gauge injector needle. In addition, a caudal fin clip was taken for hybrid analysis. The fish was then scanned and placed into a livewell until it fully recovered. After each use, needles were disinfected in 70% isopropyl alcohol. Needles were discarded after approximately 10 uses because they dulled beyond use. Once all PIT tags were issued, the remaining LCT collected from Marys River and Marys River Basin Creek were fin clipped for genetic analysis. Fork lengths were measured on all captured fish. Additionally, 554 fin clips from LCT collected in 2017 (Table 1) as part of the Marys River BLM Survey and the Currant Creek LCT Population Augmentation Project were tested for hybridization along with fins collected in 2018.

In 2018, approximately two miles of the Marys River was electroshocked and 356 salmonids were captured. However, no Brook Trout were caught. PIT tags were issued to 234 salmonids along with and fin clipping. The remaining 122 salmonids were fin clipped only. Twelve salmonids (1 PIT tagged fish) were found to be LCT/Rainbow Trout hybrids (approximately 3%) and 344 were found to be pure LCT. During the 2017 Currant Creek Augmentation Project, the single PIT tagged hybrid fish was not recaptured. Hybridization levels varied from fish to fish, with multiple fish having Rainbow Trout alleles at one locus while others were highly introgressed, with most alleles being Rainbow Trout. In 2017 from 49 fish collected, one was classified as a LCT/Rainbow Trout hybrid. Unfortunately, this hybrid was used to augment the LCT population in Currant Creek at the reservoir.

Marys River Basin Creek was electroshocked in 2018 for 0.34 mi and 149 salmonids were captured. Genetic testing found 140 to be pure LCT and nine as LCT/Rainbow Trout hybrids (approximately 6%). No testing was done on fish from 2017.

**Table 1.** Results from Marys River and Marys River Basin Creek genetic testing.

| Stream | Total Number of Fish | Number of Pure LCT | Number of Hybrids |
|---|---|---|---|
| Marys River | 405 | 392 | 13 |
| Marys River Basin Creek | 149 | 140 | 9 |

Genetic samples need to be taken from salmonids across the Marys River Subbasin to determine the distribution of Rainbow Trout and LCT/Rainbow Trout hybrids. Identifying where these fish exist will help determine the best course of action to remove them from the Marys River Subbasin.

South Fork Little Humboldt River Population and Habitat Survey (HUC 16040109)

A GAWS survey was used to sample 34 stations on the SFLHR (Table 2). Stations sf1 through sf26 and sfl8 were located on BLM land and stations sfl1 through sfl7 were located on State of Nevada land. Survey stations were in the same general locations as those sampled in 1998 (stations downstream of Pole Creek) and 1977 (stations upstream of Pole Creek).

*Habitat Conditions*

Of the 34 stations surveyed, 24 were flowing, 4 had water but not measureable (large beaver ponds, large boulder substrate), and 6 were dry. Water flows averaged 0.47 cfs and water temperatures averaged 15°C. Water clarity was poor from sf26 to sfl3 due to high siltation.

The HCI rating for SFLHR was 62% (good), and when dry stations were excluded from the analysis the rating was 65% (good). Table 3 shows the summary of the habitat survey along the SFLHR.

PM is a rating of the pool-riffle ratio for a stream or stream reach. It is assumed that a pool-riffle ratio of 1 to 1 is the accepted standard. Overall, PM averaged 26% (poor) and when dry stations were excluded from analysis, PM averaged 33% (still poor). PM was the most limiting habitat parameter in the SFLHR.

Good PS is defined as pools having widths or lengths greater or equal to the average stream width, being at least one foot in depth, and has adequate cover. A high PS rating is an important component because good quality pools provide desirable habitat for rearing, resting, and wintering for fish. PS for the SFLHR averaged 69% (good) and when dry stations were excluded PS averaged 72% (excellent). Most of the quality pools were associated with beaver ponds and deep natural channels. Beaver ponds provide habitat for LCT but are not as substitute for pools created by root balls and stream meanders. Pools created by natural features typically provide increased

cover (deep undercut banks and hanging vegetation) and typically do not fill with sediments, creating high quality pool-riffle habitats. Undercut banks are an important component of quality pool habitat because they provide shelter for fish. Across all stations surveyed, channels were comprised of only 8% undercuts banks.

**Table 2**. UTM coordinates (NAD 83) for stations surveyed on SFLHR.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| sf1 | 505824 | 4588898 | 11T |
| sf2 | 506228 | 4588528 | 11T |
| sf3 | 506609 | 4588075 | 11T |
| sf4 | 506941 | 4587808 | 11T |
| sf5 | 507050 | 4587574 | 11T |
| sf6 | 507066 | 4587287 | 11T |
| sf7 | 507325 | 4587132 | 11T |
| sf8 | 507834 | 4586648 | 11T |
| sf9 | 508139 | 4585807 | 11T |
| sf10 | 508269 | 4585164 | 11T |
| sf11 | 508508 | 4584499 | 11T |
| sf12 | 508443 | 4584059 | 11T |
| sf13 | 508486 | 4583258 | 11T |
| sf14 | 509031 | 4582737 | 11T |
| sf15 | 509543 | 4582261 | 11T |
| sf16 | 509669 | 4581999 | 11T |
| sf17 | 510033 | 4581797 | 11T |
| sf18 | 510259 | 4581592 | 11T |
| sf19 | 510586 | 4581076 | 11T |
| sf20 | 510639 | 4580674 | 11T |
| sf21 | 510456 | 4580106 | 11T |
| sf22 | 510632 | 4579372 | 11T |
| sf23 | 510995 | 4578232 | 11T |
| sf24 | 511201 | 4577446 | 11T |
| sf25 | 511264 | 4576247 | 11T |
| sf26 | 511365 | 4574997 | 11T |
| sfl1 | 511513 | 4574184 | 11T |
| sfl2 | 511904 | 4572871 | 11T |
| sfl3 | 511883 | 4571866 | 11T |
| sfl4 | 511574 | 4570533 | 11T |
| sfl5 | 511075 | 4568888 | 11T |
| sfl6 | 510012 | 4567965 | 11T |
| sfl7 | 509048 | 4567157 | 11T |
| sfl8 | 508625 | 4566214 | 11T |

BVS relates to the stability of the bank generated by vegetation along the bank. BSS relates to the resiliency of banks from eroding. BVS averaged 70% and BSS averaged 66% suggesting stream banks were in stable condition.

SB is the percent of the total station covered by preferred substrates (gravel and rubble). On average, gravel and rubble made up 62% of the substrate. Stream substrate consisted of 4% boulder, 28% rubble, 34% gravel, and 34% sand/silt. Embeddedness is the percent of large particle substrate, such as gravels, cobbles, and

boulders that are covered by fine sediments (sand/silt). Elevated embeddedness can decrease salmonid spawning success by limiting the amount of clean oxygenated gravel needed for spawning. Embeddedness was high, averaging 56% and numerous stations showed a large amount of fine silt covering the bottom. Downstream of station sf7, sand and silt comprised a large portion of the substrate.

**Table 3**. HCI and parameter ratings for stations surveyed along the SFLHR. Stations with an * were dry during the survey and the highlighted parameters are those that can be improved at each station.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| sf1 | 56 | 0 | 100 | 54 | 88 | 88 | 7 |
| sf2 | 51 | 5 | 87 | 54 | 58 | 63 | 38 |
| sf3 | 68 | 75 | 23 | 83 | 71 | 79 | 80 |
| sf4 | 67 | 0 | 82 | 79 | 100 | 92 | 47 |
| sf5 | 64 | 45 | 53 | 63 | 88 | 88 | 50 |
| sf6 | 69 | 0 | 100 | 83 | 88 | 71 | 73 |
| sf7* | 56 | 0 | 100 | 88 | 50 | 42 | 57 |
| sf8* | 51 | 0 | 100 | 83 | 33 | 33 | 58 |
| sf9 | 36 | 0 | 49 | 42 | 38 | 46 | 43 |
| sf10* | 42 | 0 | 0 | 75 | 63 | 63 | 53 |
| sf11 | 58 | 14 | 53 | 79 | 75 | 79 | 50 |
| sf12 | 70 | 69 | 100 | 50 | 63 | 71 | 67 |
| sf13 | 58 | 40 | 85 | 46 | 67 | 58 | 50 |
| sf14 | 43 | 0 | 63 | 50 | 46 | 50 | 47 |
| sf15 | 56 | 0 | 70 | 92 | 54 | 46 | 77 |
| sf16* | 40 | 0 | 0 | 100 | 58 | 50 | 32 |
| sf17 | 64 | 0 | 100 | 100 | 58 | 54 | 74 |
| sf18 | 71 | 0 | 90 | 92 | 83 | 71 | 93 |
| sf19 | 64 | 19 | 93 | 100 | 50 | 46 | 75 |
| sf20 | 72 | 23 | 81 | 92 | 75 | 71 | 88 |
| sf21* | 50 | 0 | 100 | 83 | 58 | 42 | 15 |
| sf22 | 82 | 51 | 100 | 88 | 88 | 75 | 88 |
| sf23 | 61 | 54 | 0 | 100 | 71 | 71 | 72 |
| sf24 | 76 | 0 | 100 | 88 | 100 | 100 | 70 |
| sf25 | 77 | 31 | 100 | 79 | 96 | 88 | 68 |
| sf26 | 65 | 46 | 0 | 83 | 96 | 88 | 78 |
| sfl1 | 71 | 61 | 55 | 100 | 75 | 67 | 68 |
| sfl2 | 74 | 0 | 100 | 100 | 100 | 100 | 45 |
| sfl3 | 65 | 74 | 51 | 71 | 67 | 67 | 59 |
| sfl4 | 76 | 81 | 100 | 92 | 79 | 75 | 28 |
| sfl5 | 71 | 50 | 100 | 88 | 63 | 54 | 70 |
| sfl6* | 41 | 0 | 0 | 63 | 50 | 50 | 85 |
| sfl7 | 64 | 65 | 31 | 71 | 63 | 63 | 93 |
| sfl8 | 71 | 88 | 82 | 54 | 63 | 54 | 86 |
| Average | 62 | 26 | 69 | 78 | 70 | 66 | 61 |

BC provides stream shading, protection from erosion, and cover for fish. A plant community that is dominated by brush or shrubs with an understory of tall dense forbs and grasses is considered optimum. BC averaged 78%, with 60% of the dominant vegetation as shrubs, 5% as trees, 24% as grasses, and 11% exposed. Canopy cover,

the percentage of the stream that is covered by riparian vegetation, was rated good and averaged 64%. A high percentage of canopy cover aides in cooling the water during hot summer months, when water temperatures may reach or exceed lethal limits for LCT.

Riparian habitat conditions along the SFLHR varied from good to excellent (Table 4). Seral stage is defined as the intermediate stage the riparian zone exists in in an ecosystem that is advancing towards its climax community. Ratings are based on a scale of very poor to excellent. Seral stages consisted of Tree Potential Natural Community (PNC), Shrub PNC, and Grass Forb PNC. PNC is the biological community an area can support if given enough time for succession to occur and without the interference of humans. PNC is defined as decreasing riparian plants (due to excessive grazing) that are present and regenerating. Numerous large stands of Canada, scotch, and musk thistle were found downstream of station sf20. These stands degrade wildlife habitat and are a poor bank stabilizer.

*Fish Population Survey*

A total of 220 LCT (131 sub adults/adults and 89 YOY) were captured at 13 of the 34 stations surveyed along the SFLHR (Table 5). Multiple stations and areas between stations were dry. Population estimates for stations that had LCT ranged from 32 to 2,479 fish/mi. When YOY were excluded from the estimate, the density ranged from 32 to 1,159 fish/mi. It was estimated that LCT occupied approximately 14 miles of the SFLHR with several sections dry within this distance. The average fork length was 140 mm and approximately five to six age classes were represented. During the survey, three LCT mortalities occurred, but the remaining LCT were released alive and in good condition.

Other species captured included Speckled Dace, Mountain Sucker, Tahoe Sucker, and Lahontan Redside. Differentiating between sucker species was difficult so, in most cases, both species were identified as suckers. Speckled Dace was collected from station sf1 up to station sf23, suckers were collected from station sf1 up to station sf22, and Lahontan Redside was collected from station sf1 up to station sf21.

*Aquatic Invertebrates*

Aquatic invertebrates documented in the SFLHR included individuals from the Classes Clitellata, Gastropoda, Insecta [orders Odonata, Trichoptera, Plecoptera, Coleoptera, Ephemeroptera, Diptera (chironomids), Hemiptera (backswimmers and water striders)], and Malacostraca (Signal Crayfish *Pacifastacus leniusculus*).

**Table 4**. Riparian habitat condition seral stages and ratings for stations surveyed along the SFLHR.

| Station | Seral Stage | Ratings |
|---|---|---|
| sf1 | Shrub PNC | good |
| sf2 | Grass Forb PNC | good |
| sf3 | Shrub PNC | good |
| sf4 | Shrub PNC | excellent |
| sf5 | Shrub PNC | good |
| sf6 | Shrub PNC | good |
| sf7* | Shrub PNC | fair |
| sf8* | Shrub PNC | fair |
| sf9 | Grass Forb PNC | poor |
| sf10* | Shrub PNC | good |
| sf11 | Shrub PNC | good |
| sf12 | Shrub PNC | good |
| sf13 | Shrub PNC | good |
| sf14 | Shrub PNC | good |
| sf15 | Shrub PNC | good |
| sf16* | Shrub PNC | good |
| sf17 | Shrub PNC | good |
| sf18 | Shrub PNC | good |
| sf19 | Shrub PNC | good |
| sf20 | Shrub PNC | good |
| sf21* | Shrub PNC | good |
| sf22 | Shrub PNC | excellent |
| sf23 | Shrub PNC | excellent |
| sf24 | Shrub PNC | good |
| sf25 | Shrub PNC | excellent |
| sf26 | Shrub PNC | good |
| sfl1 | Shrub PNC | good |
| sfl2 | Shrub PNC | good |
| sfl3 | Shrub PNC | good |
| sfl4 | Tree PNC | excellent |
| sfl5 | Tree PNC | good |
| sfl6* | Tree PNC | good |
| sfl7 | Tree PNC | good |
| sfl8 | Tree PNC | good |

*Land Management*

Multiple grazing exclosures exist along the SFLHR, with the first exclosure being located near sf1 and the uppermost exclosure ending between stations sfl3 and sfl4. From station sf2 up to sf19, multiple water gaps are present within the exclosures allowing cattle and feral horses to access water. The size of the water gaps and condition of fencing varies, with numerous non-functional fences allowing unauthorized cattle access. From station sf21 up to sf26, the SFLHR lies in an exclosure that is created by rocky cliffs and several small fences. Most of these fences are properly functioning except at the confluence of SFLHR and Waterfall Spring. Cattle crawl under this fence, but because riparian vegetation is extremely thick, damage was minimal. Aquatic and riparian habitats in this area were in good condition except for water

temperature, siltation, and sedimentation, a result of habitat degradation occurring upstream in the headwaters.

**Table 5.** Total number of and density estimates for LCT in the SFLHR. The adult column includes subadults and adults and the * indicates the station was dry.

| Station | Station length (m) | Number of LCT Captured | | Population Estimate (fish/mile) | |
|---|---|---|---|---|---|
| | | YOY | adult | With YOY | Without YOY |
| sf1 | 50 | 0 | 0 | 0 | 0 |
| sf2 | 50 | 0 | 0 | 0 | 0 |
| sf3 | 50 | 0 | 0 | 0 | 0 |
| sf4 | 50 | 0 | 0 | 0 | 0 |
| sf5 | 50 | 0 | 0 | 0 | 0 |
| sf6 | 50 | 0 | 0 | 0 | 0 |
| sf7* | 50 | 0 | 0 | 0 | 0 |
| sf8* | 50 | 0 | 0 | 0 | 0 |
| sf9 | 50 | 0 | 0 | 0 | 0 |
| sf10* | 50 | 0 | 0 | 0 | 0 |
| sf11 | 50 | 0 | 0 | 0 | 0 |
| sf12 | 50 | 0 | 0 | 0 | 0 |
| sf13 | 50 | 0 | 1 | 32 | 32 |
| sf14 | 50 | 0 | 0 | 0 | 0 |
| sf15 | 50 | 0 | 0 | 0 | 0 |
| sf16* | 50 | 0 | 0 | 0 | 0 |
| sf17 | 50 | 0 | 0 | 0 | 0 |
| sf18 | 50 | 0 | 0 | 0 | 0 |
| sf19 | 50 | 0 | 1 | 32 | 32 |
| sf20 | 50 | 0 | 2 | 64 | 64 |
| sf21* | 50 | 0 | 0 | 0 | 0 |
| sf22 | 31 | 0 | 4 | 208 | 208 |
| sf23 | 50 | 0 | 7 | 225 | 225 |
| sf24 | 27 | 4 | 12 | 954 | 715 |
| sf25 | 50 | 5 | 8 | 419 | 258 |
| sf26 | 50 | 6 | 18 | 773 | 580 |
| sfl1 | 50 | 0 | 5 | 161 | 161 |
| sfl2 | 50 | 5 | 9 | 451 | 290 |
| sfl3 | 50 | 41 | 36 | 2,479 | 1,159 |
| sfl4 | 50 | 0 | 0 | 0 | 0 |
| sfl5 | 50 | 20 | 16 | 1,159 | 515 |
| sfl6* | 50 | 0 | 0 | 0 | 0 |
| sfl7 | 50 | 0 | 0 | 0 | 0 |
| sfl8 | 75 | 8 | 12 | 429 | 258 |

From station sfl1 to sfl3, the SFLHR lies within the Oregon Flat exclosure. Prior to 2002, the SFLHR within this exclosure was grazed annually from May to October, causing extensive damage to aquatic and riparian habitats. Due to extensive cattle damage, grazing on Oregon Flat was not permitted from 2002 to 2004 and then it was permitted at reduced rates from 2004 to 2015. In 2016, cattle were not permitted, however, in 2017 and 2018, several trespass cattle were found in the exclosure. Because of the change in grazing management, aquatic and riparian habitats have shown significant improvement such as increased bank stability and canopy cover.

Since 2010, willow densities have shown a major increase resulting in improving bank stability and canopy cover.

Upstream of station sfl3, the SFLHR lies within the Basin South Pasture of the Little Humboldt Allotment. In 2002, the USFWS generated a Biological Opinion (BO) and the BLM generated a Grazing Decision that stipulates what grazing management practices would be implemented to protect LCT and their associated habitats within the pasture. In 2018, cattle were permitted in the Basin South Pasture until June 30, however, trespass cattle were observed on September 18, 2018. Cattle damage ranged from moderate to high upstream of station sfl5. Cattle were spending most of their time along the riparian corridor resulting in numerous trails running along and through the stream. At numerous locations, stubble height was three inches or less, even though the Grazing Decision stipulates a minimal stubble height of four inches. Bank alteration caused by cattle grazing was very devastating upstream of station sfl5, with bank shearing caused by cattle loafing on the stream and using the stream as a travel corridor. No LCT was captured at station sfl4 suggesting it was due to habitat degradation in the upper portions of SFLHR and Secret Creek. That is, water quality was too poor to support LCT. While surveying station sfl4, the survey crew sank approximately six inches into the stream bottom, which was mostly comprised of sand and silt.

The SFLHR has had three recorded mass LCT mortalities (1988, 1994, and 2000) attributed to low flow and high-water temperatures. During a BLM field tour of the Little Humboldt Allotment on July 27, 1994, several dead LCT were found near station sfl3 (Oregon Flat) and the water temperature was 28ºC. On July 30, 2018, water temperature in the same general location was 19ºC, a significant decline from what was observed in 1994. This decline was likely attributed to changes in grazing management allowing for recovery of the riparian habitat. Improved canopy cover helped keep water temperatures below the lethal limit for LCT.

Waterfall Spring is a small spring flowing into the SFLHR about 85 m upstream of station sf26. It produces approximately 5-gal/min and it is 0.24 mi from the uppermost springhead to the SFLHR. Waterfall Spring lies within the Castle Ridge Pasture of the Little Humboldt Allotment and does not have special regulations (i.e., BO or Grazing Decision) even though it flows into the SFLHR. Livestock utilization is extremely high; with excessive tramping that has turned the spring into a mud hole and severely degraded water quality. Poor water quality flows down to the SFLHR. If water quality at the spring were improved, it would provide a cold-water refuge for LCT within the SFLHR.

Exclosure and water gap fences that are not functioning must to be repaired to prevent/eliminate further damage to aquatic and riparian habitats important to the various life stages of LCT. Additional mapping needs to occur in order to delineate the locations of all water gap fences and their condition. Water gaps should be investigated to examine if they can be reduced in size and still function to provide adequate water for cattle and feral horses. The Oregon Flat exclosure needs resting from cattle grazing

until aquatic and riparian habitats fully recover. Various willow species should be planted along the stream to increase shading and provide woody debris for development of quality pools. Livestock grazing should be monitored within the South Basin Pasture in accordance with the BO and Grazing Decision to prevent further bank trampling. Land management strategies within the Basin South Pasture should be evaluated and modified to improve aquatic and riparian habitats. In addition, crossing the stream downstream of station sfl3 is troublesome and must be improved to help reduce erosion, siltation, and sedimentation. This will also reduce or prevent vehicles from seeking access elsewhere and causing further damage to aquatic and riparian habitats. The SFLHR LCT population and habitat conditions should be resurveyed in 2023 to check status and note improvements.

First Creek Population and Habitat Survey (HUC 16040109)

A GAWS survey was used to sample eight stations on First Creek (Table 6). Stations fst1, fst2, fst3, and fst4, were located on BLM land and stations fst5, fst6, fst7, and fst8 were located on private land. The 2018 stations occurred at the same general locations as those sampled in 1997.

**Table 6.** UTM (NAD 83) coordinates for stations surveyed on First Creek.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| fst1 | 508526 | 4584265 | 11T |
| fst2 | 507203 | 4583853 | 11T |
| fst3 | 506552 | 4582710 | 11T |
| fst4 | 505742 | 4581645 | 11T |
| fst5 | 504344 | 4581127 | 11T |
| fst6 | 502921 | 4580818 | 11T |
| fst7 | 501513 | 4579906 | 11T |
| fst8 | 500882 | 4579193 | 11T |

*Habitat Conditions*

Of the eight stations surveyed, only one station had flowing water, but flows were too low for making measurements. The HCI rating for First Creek was 49% (poor), a decline from the good (68%) rating derived during the 1997 survey. Table 7 shows the summary of the habitat survey.

PM is a rating of the pool-riffle ratio for a stream or stream reach and averaged 8% (poor). When dry stations were excluded from analysis, PM averaged 62% (good). The lack of pool habitat is attributed to seven of eight stations being dry during the survey.

PS is defined as pools with widths or lengths that are greater or equal to the average stream width, greater or equal to one foot in depth, and have adequate cover. A high PS rating is an important component of fish habitat because good quality pools provide desirable habitat for rearing, resting, and wintering fish. PS for First Creek averaged 0% (poor). No quality pools that could support LCT were detected since

seven of eight stations were dry. Undercut banks are an important component of quality pool habitat because they provide shelter for LCT. Undercut banks were only detected at station fst1 making for only 8% of the entire stream area surveyed.

**Table 7.** HCI and parameter ratings for stations surveyed along First Creek.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| fst1* | 61 | 0 | 0 | 100 | 100 | 100 | 63 |
| fst2* | 47 | 0 | 0 | 67 | 50 | 100 | 67 |
| fst3* | 45 | 0 | 0 | 50 | 50 | 100 | 70 |
| fst4* | 54 | 0 | 0 | 100 | 96 | 100 | 27 |
| fst5* | 58 | 0 | 0 | 100 | 75 | 88 | 87 |
| fst6* | 49 | 0 | 0 | 92 | 67 | 67 | 67 |
| fst7* | 38 | 0 | 0 | 50 | 46 | 58 | 73 |
| fst8 | 39 | 62 | 0 | 54 | 38 | 42 | 40 |
| Average | 49 | 8 | 0 | 77 | 65 | 82 | 62 |

BVS relates to the stability of the bank generated by vegetative cover. BSS relates to the resiliency of the bank from eroding. BVS averaged 65% and BSS averaged 82%. In general, stream banks along First Creek were in stable condition due to rocky banks throughout the canyon area. However, banks at stations easily accessible to livestock were unstable.

SB is the percent of the total station that was covered by preferred substrates (gravel and rubble) and, on average, gravel and rubble made up 69% of the substrate. Stream substrate consisted of 15% boulder, 27% rubble, 35% gravel, and 24% sand/silt. Embeddedness is the percent of large particle substrate, such as gravels, cobbles, and boulders covered by fine sediments (sand/silt). Elevated embeddedness can decrease salmonid spawning success by limiting the amount of clean oxygenated gravel. Embeddedness was moderate, averaging 42%.

BC describes stream shading, protection from erosion, and cover for fish. A plant community that is dominated by brush or shrubs with an understory of tall dense forbs and grasses is considered optimum. BC averaged 77%; with 56% of the dominant vegetation being shrubs, 38% was grass, and 6% was exposed. Canopy cover, the percentage of the stream that is covered by riparian vegetation, was rated as poor averaging 31%. A high percentage of canopy cover aides in keeping water temperatures low during hot summer months when water temperatures can reach or exceed lethal limits for LCT.

Riparian habitat conditions along First Creek varied from very poor to excellent (Table 8). Seral stages consisted of Shrub Potential Natural Community (PNC) and Grass Forb PNC. PNC is the biological community an area can support if given enough time for succession to occur and without the interference of humans. PNC is defined as decreasing riparian plants (riparian plants that decrease with excessive grazing) that are present and regenerating. It was noted throughout First Creek that the riparian zone was very narrow or there was little to no riparian vegetation present. This was probably

partially attributed to low flows in previous years. Stations with very poor and poor ratings were generally described as having easy livestock watering access.

**Table 8.** Riparian habitat condition seral stages and ratings for stations surveyed along First Creek.

| Station | Seral Stage | Ratings |
|---|---|---|
| fst1 | Shrub PNC | Excellent |
| fst2 | Grass Forb PNC | Very Poor |
| fst3 | Grass Forb PNC | Good |
| fst4 | Shrub PNC | Fair |
| fst5 | Shrub PNC | Fair |
| fst6 | Shrub PNC | Good |
| fst7 | Grass Forb PNC | Poor |
| fst8 | Grass Forb PNC | Very Poor |

*Fish Population Survey*

No fish were collected or observed during the survey.

*Aquatic Invertebrates*

No aquatic invertebrates were collected or observed during the survey.

*Land Management*

Ungulate damage averaged 17%, however, when excluding stations that were not accessible to ungulates, damage increased to 34%. Livestock utilization was high along First Creek in areas where livestock had reasonably easy access to the stream resulting in heavy bank trampling and shearing. Canopy cover was very limited in these locations. Stations fst7 and fst8 had the highest observed livestock use and these stations had little to no riparian vegetation. The stream channel was also incised. A fence was found at station fst2, but nonfunctioning, allowing livestock to gain access to downstream reaches.

Because water is very limited in First Creek, water gap fences should be repaired to prevent cattle from having access to reaches outside of designated water gaps. In addition, land management strategies within the First Creek drainage should be evaluated and modified to improve aquatic and riparian habitats. The LCT population and habitat conditions should be resurveyed in 2023.

Snowstorm Creek Population and Habitat Survey (HUC 16040109)

A GAWS survey was used to sample eight stations on Snowstorm Creek (Table 9). Stations snw1, snw2, snw3, snw4, and snw5 were located on BLM and stations snw6, snw7, and snw8 were located on private land. Stations were found in the same general locations as those sampled in 1997.

**Table 9**. UTM (NAD 83) coordinates for stations surveyed on Snowstorm Creek.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| snw1 | 509472 | 4582218 | 11T |
| snw2 | 508442 | 4581872 | 11T |
| snw3 | 507814 | 4580854 | 11T |
| snw4 | 507014 | 4579975 | 11T |
| snw5 | 505697 | 4579911 | 11T |
| snw6 | 505034 | 4579139 | 11T |
| snw7 | 504090 | 4577965 | 11T |
| snw8 | 503493 | 4577141 | 11T |

*Habitat Conditions*

Of the eight stations surveyed, five had flowing water and three were dry. Water flows averaged 0.12 cfs and water temperatures averaged 16°C. The HCI rating for Snowstorm Creek was 62% (good) and when dry stations were excluded, the rating was 66% (good).

**Table 10.** HCI and parameter ratings for stations surveyed along Snowstorm Creek. Stations with an * were dry during the survey and the highlighted parameters are those that can be improved at each station.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| snw1 | 79 | 83 | 100 | 83 | 67 | 63 | 77 |
| snw2 | 83 | 46 | 100 | 100 | 83 | 92 | 77 |
| snw3 | 73 | 52 | 45 | 92 | 88 | 100 | 60 |
| snw4* | 63 | 0 | 0 | 100 | 100 | 75 | 100 |
| snw5 | 55 | 38 | 0 | 10 | 100 | 100 | 10 |
| snw6 | 40 | 0 | 0 | 48 | 67 | 67 | 48 |
| snw7* | 51 | 0 | 0 | 83 | 50 | 71 | 83 |
| snw8* | 50 | 0 | 0 | 83 | 58 | 75 | 83 |
| Average | 62 | 27 | 31 | 67 | 77 | 80 | 67 |

PM is a rating of pool-riffle ratio for a stream or stream reach, which averaged 27% (poor). When dry stations were excluded from analysis, PM averaged 44% (poor). PM was the most limiting HCI parameter.

PS is defined as pools having widths or lengths greater or equal to the average stream width, greater or equal to one foot in depth, and have adequate cover. A high PS rating is an important component of fish habitat because good quality pools provide desirable habitat for rearing, resting, and wintering fish. PS for Snowstorm Creek averaged 31% (poor) and when dry stations were excluded, PS averaged 49% (poor). Undercut banks are an important component of quality pool habitat because they provide shelter for LCT. Across all stations, undercut banks comprised of 2% of the stream bank.

BVS relates to the bank stability from vegetation. BSS relates to the resiliency of the bank from eroding. BVS averaged 77% and BSS averaged 80%. Stream banks at the stations surveyed were in stable condition.

SB is the percentage of the total station covered by preferred substrates (gravel and rubble) and, on average, gravel and rubble made up 67% of the substrate. Stream substrate consisted of 26% rubble, 41% gravel, and 32% sand/silt. Embeddedness is the percentage of large particle substrate, such as gravels, cobbles, and boulders that are covered by fine sediment (sand/silt). Elevated embeddedness can decrease salmonid spawning success by limiting the amount of clean oxygenated gravel. Embeddedness was moderate, averaging 46%.

BC provides stream shading, protection from erosion, and cover for fish. A plant community that is dominated by brush or shrubs with an understory of tall dense forbs and grasses is considered optimum. BC averaged 88%, with 75% of the dominant vegetation being shrubs and 25% being grass. Canopy cover was rated as good, averaging 69%. A high percentage of canopy cover aides in keeping water temperatures low during hot summer months, as water temperatures may reach or exceed lethal limits for LCT.

Riparian habitat conditions along Snowstorm Creek varied from fair to good (Table 11). Seral stages consisted of Shrub Potential Natural Community (PNC) and Early to Late Grass PNC. PNC is the biological community an area can support if given enough time for succession to occur and without the interference of humans. Early to Late is defined as decreasing riparian vegetation that are not present or are present but not regenerating. No riparian plants were found at station snw7 and snw8, however, the stream bottom was primarily comprised of angular substrate indicating the channel was generally dry. Intermediate flows contribute to the lack of riparian vegetation at stations snw7 and snw8. The riparian corridor at station snw6 was severely trampled by feral horses and cattle.

*Fish Population Survey*

Twenty-seven LCT (19 sub adults/adults and 8 YOY) were captured at two of the eight stations (snw2 and snw3) surveyed (Table 12). Electroshocking efficiency at these stations, however, was poor. Fish density was derived between stations snw1 and snw3 (2 miles), because passage was not interrupted and no LCT occurred upstream of snw3. LCT density averaged 290 fish/mi and when YOY were excluded, the population estimate was 204 fish/mi. The average fork length was 128 mm and approximately three to four age classes were represented. There was a potential fish observed below station snw6, but the area was not electroshocked because the water temperature was 24°C, too high for safely sampling LCT. Intermittent flows near snw4 appeared to create seasonal barriers to fish movement. Speckled Dace was the only other species collected, one individual at station snw1.

*Land Management*

At the time of the survey, cattle grazing had not started for the season along Snowstorm Creek except at station snw6, where sign of light grazing was evident. However, evidence of heavy, historical use from cattle and feral horses was evident at

snw1, snw3, and snw6. These areas have perennial water and with the canyon width and sparse vegetation, livestock are able to move freely travel up and down the stream. The riparian corridor and upper banks showed evidence that cattle and feral horses loafed in these areas. On the other hand, a gorge located between snw2 and snw3 limits ungulate accessibility to these sites. Overall, evidence of historic and continuous livestock use and damage was found along Snowstorm Creek in areas where livestock and feral horses had reasonably easy access to the stream.

**Table 11.** Riparian habitat condition seral stages and ratings for stations surveyed along Snowstorm Creek.

| Station | Seral Stage | Ratings |
|---|---|---|
| snw1 | Shrub PNC | Good |
| snw2 | Shrub PNC | Good |
| snw3 | Shrub PNC | Fair |
| snw4 | Shrub PNC | Fair |
| snw5 | Shrub PNC | Good |
| snw6 | Shrub PNC | Fair |
| snw7 | Shrub PNC | Fair |
| snw8 | Grass Forb Early to Late | Good |

**Table 12.** The total number and relative abundance population estimates for LCT in Snowstorm Creek. The adult column includes subadults and adults. * indicates that the station was dry, and an $^{n}$ indicates that the station was not electrofished.

| | Station length | Number of LCT Captured | | Population Estimate (fish/mile) | |
|---|---|---|---|---|---|
| Station | (m) | YOY | adult | With YOY | Without YOY |
| snw1 | 50 | 0 | 0 | 0 | 0 |
| snw2 | 50 | 7 | 11 | 580 | 354 |
| snw3 | 50 | 1 | 8 | 290 | 258 |
| snw4* | 50 | 0 | 0 | 0 | 0 |
| snw5$^{n}$ | 50 | 0 | 0 | 0 | 0 |
| snw6$^{n}$ | 50 | 0 | 0 | 0 | 0 |
| snw7* | 50 | 0 | 0 | 0 | 0 |
| snw8* | 50 | 0 | 0 | 0 | 0 |

Land management strategies within the Snowstorm Creek drainage should be evaluated and modified to improve aquatic and riparian habitats. Limiting grazing during the warmer part of the year is recommended to prevent further LCT habitat degradation and allow for the recovery of aquatic and riparian habitats. Off-site water sources should be developed so livestock do not rely solely on Snowstorm Creek as the primary water source. With this, livestock and feral horse AMUs in the Bullhead Allotment should not increase regardless of greater water availability. Feral horses in the Bullhead Allotment also need better management to between 90 and 140 individuals. The area between stations snw1 and snw2 should be monitored after the grazing season to verify that livestock are not having negative impacts on aquatic and riparian habitats. The LCT population and habitat conditions of Snowstorm Creek should be resurveyed in 2023.

Winters Creek Population and Habitat Survey (HUC 16040109)

A GAWS survey was used to sample three stations on Winters Creek (Table 13). Stations wnt1, wnt2, and wnt3 were located on BLM and were in the same general locations as those sampled in 1997.

**Table 13.** UTM coordinates (NAD 83) for stations surveyed on Winters Creek.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| wnt1 | 511254 | 4577233 | 11T |
| wnt2 | 510440 | 4576306 | 11T |
| wnt3 | 509691 | 4576280 | 11T |

*Habitat Conditions*

Two stations had flowing water and the uppermost station was dry. Flow averaged 0.4 cfs and water temperatures averaged 13°C. The HCI rating for Winters Creek was 66% (good) and when dry stations were excluded from the analysis, the rating was 73% (excellent). Table 14 shows the summary of the habitat survey.

**Table 14.** HCI and parameter ratings for stations surveyed along Winters Creek. Stations with an * were dry during the survey and the highlighted parameters are those that can be improved at each station.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| wnt1 | 84 | 32 | 77 | 100 | 100 | 100 | 93 |
| wnt2 | 62 | 17 | 0 | 88 | 100 | 92 | 73 |
| wnt3* | 52 | 0 | 0 | 58 | 100 | 96 | 55 |
| Average | 66 | 16 | 26 | 82 | 100 | 96 | 66 |

PM is a rating of the pool-riffle ratio for a stream or stream reach and averaged 16% (poor), and when dry stations were excluded from analysis PM averaged 25% (poor). PS is defined as pools with widths or lengths that are greater or equal to the average stream width, greater or equal to one foot in depth, and have adequate cover. A high PS rating is an important component because good quality pools provide desirable habitat for rearing, resting, and wintering fish. PS averaged 26% (poor) and was the most limiting parameter in Winters Creek. When dry stations were excluded, it averaged 38% (poor). Station wnt1 was the only station that contained quality pools able to support LCT. Undercut banks are an important component of quality pool habitat because they provide shelter for LCT. Across all stations surveyed, 5% of the stream banks were undercut.

BVS relates to the stability of the bank generated by vegetative cover and BSS relates to the resiliency of the bank from eroding. BVS averaged 100% and BSS averaged 96%. Stream banks along Winters Creek were in stable condition due to thick riparian vegetation and rocky banks throughout the canyon area.

SB is the percent of the total station that is covered by preferred substrates (gravel and rubble), which made up 74% of the substrate. Stream substrate consisted

of 10% boulder, 32% rubble, 42% gravel, and 16% sand/silt. Embeddedness is the percent of large particle substrate, such as gravels, cobbles, and boulders that are covered by fine sediments (sand/silt). Elevated embeddedness can decrease salmonid spawning success by limiting the amount of clean oxygenated gravel. Embeddedness was moderate, averaging 38%.

BC provides stream shading, protection from erosion, and cover for fish. A plant community that is dominated by brush or shrubs with an understory of tall dense forbs and grasses is considered optimum. BC averaged 94%, with 66.7% of the dominant vegetation being shrubs, 27.8% being grass, and 5.6% being exposed. Canopy cover, the percentage of the stream that is covered by riparian vegetation, averaged 67%. A high percentage of canopy cover aides in keeping the water temperature cooler when in the hot summer months it can easily reach or exceed lethal limits for LCT.

Riparian habitat conditions along Winters Creek varied from good to excellent (Table 15). Seral stages consisted of Shrub Potential Natural Community (PNC) and Grass Forb PNC. PNC is the biological community an area can support if given enough time for succession to occur and without the interference of humans. PNC is defined as decreasing riparian plants (riparian plants that decrease with excessive grazing) that are present and regenerating. At the lower two stations, riparian vegetation was very dense.

**Table 15**. Riparian habitat condition seral stages and ratings for stations surveyed along Winters Creek.

| Station | Seral Stage | Ratings |
|---|---|---|
| wnt1 | Shrub PNC | Good |
| wnt2 | Shrub PNC | Excellent |
| wnt3 | Grass Forb PNC | Excellent |

*Fish Population Survey*

Eleven LCT (9 sub adults/adults and 2 YOY) were only captured at wnt1 and occupied about 0.5 miles (Table 16). Excluding YOY, LCT density was estimated as 145 fish/0.5 mi, and the average fork length was 102 mm. Including YOY, three age classes were represented. No other fish species were collected in Winters Creek.

**Table 16**. The total number of and the relative abundance population estimates for LCT in Winters Creek. The adult column includes subadult and adult fish and * indicates stations that were dry.

| Station | Station Length (m) | Number of LCT Captured | | Population Estimate (fish/half mile) | |
|---|---|---|---|---|---|
| | | YOY | adults | With YOY | Without YOY |
| wnt1 | 50 | 2 | 9 | 177 | 145 |
| wnt2 | 50 | 0 | 0 | 0 | 0 |
| wnt3* | 50 | 0 | 0 | 0 | 0 |

*Aquatic Invertebrates*

Aquatic invertebrates documented in Winters Creek included individuals from the orders Decapoda, Trichoptera, Ephemeroptera, and Hemiptera (family Gerridae).

*Land Management*

There was no evidence of livestock grazing at survey stations. Stations wt1 and wnt2 were located in a rocky gorge not accessible to livestock or feral horses. Riparian and aquatic habitats were in good condition, so it is appropriate to continue with current land management actions. The LCT population and habitat conditions should be resurveyed in 2023.

Pole Creek Population and Habitat Survey (HUC 16040109)

A GAWS survey was used to sample seven stations on Pole Creek (Table 17). Stations were in the same locations as in the 1992 survey except for station pol7, which occurred in the same location as the 2010 survey. Stations pol1, pol2, pol3, and pol5 were located on BLM, pol4 and pol6 on private land, and pol7 on State of Nevada Land.

**Table 17.** UTM (NAD 83) coordinates for stations surveyed on Pole Creek.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| pol1 | 511200 | 4574211 | 11T |
| pol2 | 510916 | 4573971 | 11T |
| pol3 | 510572 | 4573744 | 11T |
| pol4 | 510164 | 4573516 | 11T |
| pol5 | 508849 | 4572910 | 11T |
| pol6 | 508684 | 4572840 | 11T |
| pol7 | 506376 | 4572218 | 11T |

*Habitat Conditions*

Of the seven stations surveyed, three had flowing water and four were dry. Water flows averaged 0.24 cfs and water temperatures averaged 16°C. The HCI rating for Pole Creek was 56% (fair) and when dry stations were excluded, the rating was 69% (good).

PM is a rating of the pool-riffle ratio for a stream or stream reach and averaged 39% (poor). When dry stations were excluded, PM averaged 91% (excellent). The low PM rating can be partially attributed to four of the seven stations being dry during the survey.

PS is defined as pools with widths or lengths that are greater or equal to the average stream width, greater or equal to one foot in depth, and have adequate cover. A high PS rating is an important component of fish habitat because good quality pools provide desirable habitat for rearing, resting, and wintering fish. PS for Pole Creek averaged 14% (poor) and when dry stations were excluded, PS averaged 33% (poor).

Undercut banks are an important component of quality pool habitat because they provide shelter for LCT. Across all stations surveyed, 7% of the stream was undercut.

**Table 18**. HCI and parameter ratings for stations surveyed along Pole Creek. Stations with an * were dry during the survey and the highlighted parameters are those that can be improved at each station.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| pol1* | 53 | 0 | 0 | 92 | 83 | 67 | 73 |
| pol2* | 43 | 0 | 0 | 54 | 75 | 79 | 48 |
| pol3* | 48 | 0 | 0 | 67 | 71 | 75 | 77 |
| pol4* | 44 | 0 | 0 | 75 | 71 | 83 | 33 |
| pol5 | 63 | 99 | 0 | 75 | 88 | 63 | 57 |
| pol6 | 66 | 88 | 0 | 71 | 83 | 83 | 70 |
| pol7 | 78 | 86 | 100 | 79 | 58 | 58 | 93 |
| Average | 56 | 39 | 14 | 73 | 76 | 76 | 65 |

BVS relates to the stability of the bank that is covered by vegetation and BSS relates to the resiliency of the bank to eroding. BVS averaged 76% and BSS averaged 71%. Stream banks were in stable condition; however, when walking over an undercut bank at station pol7, it collapsed indicating a lack of riparian plant having root systems that provide robust stabilizing characteristics. Station pol7 was along an older incised channel.

SB is the percent of the station covered by preferred substrates (gravel and rubble), which Pole Creek averaged 65%. Stream substrate consisted of 6% boulder, 33% rubble, 31% gravel, and 30% sand/silt. Embeddedness is the percent of large particle substrate, such as gravels, cobbles, and boulders that are covered by fine sediments (sand/silt). Elevated embeddedness can decrease salmonid spawning success by limiting the amount of clean oxygenated gravel. Embeddedness was moderate, averaging 39%.

BC provides stream shading, protection from erosion, and cover for fish. A plant community that is dominated by brush or shrubs and has an understory of tall dense forbs and grasses is considered optimum. BC averaged 73%, with 33.3% of the dominant vegetation being trees, 31.0% shrubs, 33.3% grass, and 2.4% being exposed. Canopy cover, the percentage of the stream that is covered by riparian vegetation, was rated as good, averaging 69%. A high percentage of canopy cover aides in keeping water temperatures low during hot summer months, when water temperatures may reach or exceed lethal limits for LCT.

Riparian habitat conditions along Pole Creek varied from good to excellent condition (Table 19). Seral stages consisted of Tree Potential Natural Community (PNC), Shrub PNC, and Grass Forb PNC. PNC is the biological community an area could support if given enough time for succession to occur without the interference of humans. PNC is defined as decreasing riparian plants (riparian plants that decrease with excessive grazing) that are present and regenerating. At stations pol2 and pol3, upland plant species were encroaching the riparian area and at stations pol1 and pol7,

large patches of bull and musk thistle were present. It was also noted at station pol7 there was a large amount of stinging nettle covering the banks.

**Table 19.** Riparian habitat condition seral stages and ratings for stations surveyed along Pole Creek.

| Station | Seral Stage | Ratings |
|---|---|---|
| pol1 | Tree PNC | Good |
| pol 2 | Grass Forb PNC | Good |
| pol 3 | Shrub PNC | Good |
| pol 4 | Shrub PNC | Good |
| pol 5 | Tree PNC | Good |
| pol 6 | Tree PNC | Excellent |
| pol 7 | Tree PNC | Good |

*Fish Population Survey*

Nine LCT (all subadults/adults) were captured at one of the seven stations (pol7) surveyed (Table 20). Its abundance was 290 fish/mi, occupying approximately 1.3 mi of Pole Creek. Fish had an average fork length of 142 mm, were in good body condition, and approximately four age classes were represented.

**Table 20.** The total number of and the relative abundance population estimates for LCT in Pole Creek. The adult column includes subadults and adults and * indicates that the station was dry.

| | Station length | Number of LCT Captured | | Population Estimate (fish/mile) | |
|---|---|---|---|---|---|
| Station | (m) | YOY | adult | With YOY | Without YOY |
| pol1* | 50 | 0 | 0 | 0 | 0 |
| pol2* | 50 | 0 | 0 | 0 | 0 |
| pol3* | 50 | 0 | 0 | 0 | 0 |
| pol4* | 50 | 0 | 0 | 0 | 0 |
| pol5 | 50 | 0 | 0 | 0 | 0 |
| pol6 | 50 | 0 | 0 | 0 | 0 |
| pol7 | 50 | 0 | 9 | 290 | 290 |

*Land Management*

At the time of the survey, cattle grazing had not begun along Pole Creek. Past evidence of moderate to heavy cattle use was found at station pol7, with trails running alongside the stream channel and several locations showing loafing. Stations pol1 through pol6 occur in the Bullhead Allotment and station po7 is in the Little Humboldt Allotment. Each has its own grazing plan and guidance document.

*Aquatic Invertebrates*

Aquatic invertebrates documented in Pole Creek included individuals from the Classes Clitellata and Gastropoda and Orders Odonata, Decapoda, Trichoptera, Plecoptera, Coleoptera, Ephemeroptera, Diptera (family Chironomidae), and Hemiptera (family Gerridae).

Feral horses in the Bullhead Allotment must to be managed appropriately at 90 to 140 horses. The next LCT population and habitat survey should be conducted post-grazing season to examine the amount of damage by cattle. LCT population and habitat conditions should be resurveyed in 2023.

Sheep Creek Population and Habitat Survey (HUC 16040109)

A, GAWS survey was used to sample three stations on Sheep Creek (Table 21). Stations shp1, shp2, and shp3 were located on NDOW land, with station shp1 in the Oregon Flat Exclosure. Stations were located in the same place as stations sampled in 1977.

**Table 21**. UTM coordinates (NAD 83) for stations surveyed on Sheep Creek.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| shp1 | 511811 | 4571725 | 11T |
| shp2 | 511012 | 4570959 | 11T |
| shp3 | 510732 | 4570391 | 11T |

*Habitat Conditions*

Of the three stations surveyed, two had flowing water and the upper most station was dry. Because the middle station had a large beaver dam complex, flow was measured at the furthest downstream station (shp1). Water flow was 0.33 cfs and water temperatures averaged 12°C. The water was turbid at station shp2, limiting visibility to 10 to 15 in. The HCI rating for Sheep Creek was 68% (good) and when dry stations were excluded, it was 78% (excellent).

PM is a rating of the pool-riffle ratio for a stream or stream reach and averaged 32% (poor). When dry stations were excluded, PM averaged 47% (poor). PM was the most limiting HCI factor; however, station shp2 was a large beave pond.

**Table 22**. HCI and parameter ratings for stations surveyed along Sheep Creek Stations with an * were dry during the survey and the highlighted parameters are parameters that can be improved at each station.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| shp1 | 92 | 95 | 100 | 100 | 83 | 92 | 83 |
| shp2 | 63 | 0 | 100 | 92 | 96 | 92 | 0 |
| shp3* | 50 | 0 | 0 | 83 | 63 | 75 | 77 |
| Average | 78 | 32 | 67 | 92 | 81 | 86 | 53 |

PS is defined as pools with widths or lengths that are greater or equal to the average stream width, greater or equal to one foot in depth, and have adequate cover. A high PS rating is an important component of fish habitat because good quality pools provide desirable habitat for rearing, resting, and wintering fish. PS for Sheep Creek averaged 67% (good) and when dry stations were excluded, PS averaged 100% (excellent). Undercut banks are an important component of quality pool habitat because they provide shelter for LCT. Across all stations, 5% of stream banks were

undercut.

BVS relates to the stability of the bank covered by vegetative cover and BSS relates to the resiliency of the bank from eroding. BVS averaged 81% and BSS averaged 86%. Stream banks along Sheep Creek were in stable condition.

SB is the percent of the station covered by preferred substrates (gravel and rubble) and, on average, gravel and rubble made up 53% of the substrate. Stream substrate consisted of 12% rubble, 41% gravel, and 47% sand/silt. Embeddedness is the percent of large particle substrate, such as gravels, cobbles, and boulders covered by fine sediments (sand/silt). Elevated embeddedness can decrease salmonid spawning success by limiting the amount of clean oxygenated gravel. Embeddedness was high, averaging 58%.

BC provides stream shading, protection from erosion, and cover for fish. A plant community that is dominated by brush or shrubs, with an understory of tall dense forbs and grasses, is considered optimum. BC averaged 92%, with 83% of the dominant vegetation being shrubs and 17% being grass. Canopy cover averaged 41%. A high percentage of canopy cover aides in keeping water temperatures low during hot summer months, when water temperatures can reach or exceed lethal limits for LCT.

Riparian conditions along Sheep Creek varied from fair to good (Table 23). Seral stages consisted of Tree Early to Late and Shrub Early to Late. Early to Late seral stage is defined as decreasing riparian vegetation (from excessive grazing) that are not present or are present but not regenerating.

**Table 23.** Riparian habitat condition seral stages and ratings for stations surveyed along Sheep Creek. Ratings are based on a scale of very poor to excellent.

| Station | Seral Stage | Ratings |
|---|---|---|
| shp1 | Tree Early to Late | Good |
| shp2 | Tree Early to Late | Good |
| shp3 | Shrub Early to Late | Fair |

*Fish Population Survey*

A total of 19 LCT (14 sub adults/adults and 5 YOY) were captured at one of the three stations (shp1) surveyed (Table 24). It was noted that electroshocking efficiency was poor at shp1 and shp2 and no LCT was captured or observed at shp2. However, it can be extremely difficult to capture LCT in large beaver dam complexes. Water visibility was also low (10 to 15 in), making it difficult to observe LCT. The total amount of occupied habitat in Sheep Creek was one mile. The estimated density at shp1 was 382 fish/mi and when YOY were excluded, the density was 282 fish/mi. The average fork length was 128 mm and approximately three to four age classes were represented. No other fish species were collected in Sheep Creek.

**Table 24**. The total number of and the relative abundance population estimates for LCT in Sheep Creek. The adult column includes subadult and adult fish and [d] indicates stations that were dry.

| Station | Station length (m) | Number of LCT Captured | | Population Estimate (fish/mile) | |
|---|---|---|---|---|---|
| | | YOY | adult | With YOY | Without YOY |
| shp1 | 80 | 5 | 14 | 382 | 282 |
| shp2 | 100 | 0 | 0 | 0 | 0 |
| shp3[d] | 100 | 0 | 0 | 0 | 0 |

*Land Management*

There was no evidence of livestock grazing at stations surveyed in 2018. Station shp1 is located inside Oregon Flat Exclosure and station shp2 is located in a steep canyon with rocky slopes limiting livestock access. Stations shp2 and shp3 are located in the Little Humboldt Allotment in the Basin North Pasture, which is only grazed in odd years.

The spring source located between shp2 and shp3 (UTM 11T E 0510126 N 4570597) and at the headwaters of Sheep Creek (UTM 11T E 0507416 N 4567094) should be investigated to verify that cattle are not causing excessive damage to the springheads. During the next survey of Sheep Creek, the tributary between stations shp2 and shp3 should be surveyed, as it was in 1977. LCT population and habitat conditions should be resurveyed in 2023 after livestock have had the opportunity to graze.

Secret Creek Population and Habitat Survey (HUC 16040109)

A GAWS survey method was used to sample three stations on Secret Creek (Table 25). Stations were located on State of Nevada land. These sites were in the same general location as those sampled in 1977.

**Table 25**. UTM coordinates (NAD 83) for stations surveyed on Secret Creek.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| sct1 | 511158 | 4568610 | 11T |
| sct2 | 511143 | 4567529 | 11T |
| sct3 | 511055 | 4566274 | 11T |

*Habitat Conditions*

All three stations had flowing water, which averaged 0.43 cfs and water temperatures averaged 8°C. The HCI rating for Secret Creek was 63% (good).

PM is a rating of the pool-riffle ratio for a stream or stream reach and averaged 39% (poor). This was the most limiting habitat parameter. PS is defined as pools with widths or lengths that are greater or equal to the average stream width, greater or equal to one foot in depth, and have adequate cover. A high PS rating is an important component of fish habitat because good quality pools provide desirable habitat for

rearing, resting, and wintering fish. PS was rated as poor, averaging 45%; however, at station sct1, several quality pools were created by downed aspen trees. Undercut banks are an important component of quality pool habitat because they provide shelter for LCT. Across all stations surveyed, the stream was comprised of 28% undercut banks. However, it was noted that most of the undercut banks were shallow and would not provide adequate cover to protect LCT.

**Table 26**. HCI and parameter ratings for stations surveyed along Secret Creek. Highlighted parameters are parameters that can be improved at each station.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| sct1 | 49 | 0 | 0 | 79 | 58 | 58 | 85 |
| sct2 | 68 | 28 | 70 | 83 | 67 | 67 | 95 |
| sct3 | 75 | 88 | 64 | 75 | 67 | 67 | 92 |
| Average | 63 | 39 | 45 | 79 | 64 | 64 | 91 |

BVS relates to the stability of the bank that is generated by vegetation cover and BSS relates to the resiliency of the bank from eroding. BVS averaged 64% and BSS averaged 64%. Overall, stream banks were in stable condition.

SB is the percent of the total station covered by preferred substrates (gravel and rubble) and averaged 91% of the substrate. Stream substrate consisted of 43.3% rubble, 47.2% gravel, and 9.4% sand/silt. Embeddedness is the percent of large particle substrate, such as gravels, cobbles, and boulders covered by fine sediments (sand/silt). Elevated embeddedness can decrease salmonid spawning success by limiting the amount of clean oxygenated gravel. Embeddedness was moderate, averaging 42%. Station sct1 had a fine layer of silt covering the substrate.

BC provides stream shading, protection from erosion, and cover for fish. A plant community dominated by brush or shrubs with an understory of tall dense forbs and grasses is considered optimum. BC averaged 79%, with 39% of the dominant vegetation being trees, 39% being shrubs, and 22% being grass. Canopy cover averaged 62%. A high percentage of canopy cover aides in keeping water temperatures low during hot summer months when water temperatures can reach or exceed lethal limits for LCT.

Riparian habitat conditions along Secret Creek varied from fair to good condition (Table 27). Seral stages consisted of Shrub Potential Natural Community (PNC) and Tree PNC. PNC is the biological community an area could support if given enough time for succession to occur and without the interference of humans. PNC is defined as decreasing riparian plants (riparian plants that decrease with excessive grazing) that are present and regenerating.

*Fish Population Survey*

A total of 93 LCT (35 sub adults/adults and 58 YOY) were captured (Table 28) and LCT were estimated to occupy approximately two miles of Secret Creek. When including YOY in the analysis, density was estimated at 998 fish/mi. When YOY were

excluded, the density was 376 fish/mi. The average fork length was 118 mm and approximately three to four age classes were represented. Two LCT mortalities occurred during the survey, but all other LCT were released alive and in good condition. LCT was found approximately 90 m downstream of the upper most spring that supplied water to Secret Creek.

**Table 27**. Riparian habitat seral stages and condition ratings for stations surveyed along Secret Creek. Ratings are based on a scale of very poor to excellent.

| Station | Seral Stage | Ratings |
|---|---|---|
| sct1 | Tree PNC | Good |
| sct2 | Shrub PNC | Good |
| sct3 | Tree PNC | Good |

**Table 28**. The total number of and the relative abundance population estimates for LCT in Secret Creek. The adult column includes subadults and adults.

| | Station length | Number of LCT Captured | | Population Estimate (fish/mile) | |
|---|---|---|---|---|---|
| Station | (m) | yoy | adult | With yoy | Without yoy |
| sct1 | 50 | 39 | 16 | 1,771 | 515 |
| sct2 | 50 | 15 | 14 | 934 | 451 |
| sct3 | 50 | 4 | 5 | 290 | 161 |

*Aquatic Invertebrates*

Aquatic invertebrates documented in Secret Creek included individuals from the Class Gastropoda and the Orders Decapoda (Signal Crayfish), Trichoptera, Plecoptera, Coleoptera, Ephemeroptera, and Hemiptera (family Gerridae).

*Land Management*

Secret Creek lies entirely within the Basin South Pasture of the Little Humboldt Allotment. Currently a USFWS BO and BLM Grazing Decision stipulates what grazing management practices will be implemented to protect LCT and their associated habitats along Secret Creek. During this survey, it was evident that livestock use downstream of station sct3 was light, but upstream of this showed heavy utilization and damage. Cattle have been causing excessive damage to aquatic and riparian habitats, which degrades water quality along downstream reaches of Secret Creek and in the SFLHR. Stream banks and springs were severely trampled causing banks to slough off and increase sedimentation in downstream reaches. Stream bank trampling has also resulted in a reduction of undercut banks that generally provide shelter for LCT. At numerous locations, cattle trails were running through and along the stream resulting in increased sedimentation and reduced canopy cover. In many areas, cattle usage was so high that stream banks were turned to bare dirt, reducing bank stability and increasing water temperatures.

At several locations, cattle loafing has caused growth forms of aspen stands that exhibit signs of excessive livestock utilization. It was evident that cattle primarily foraged along the riparian corridor and were not utilizing the upland areas. In

accordance with the BO and Grazing Decision, cattle are allowed to graze along Secret Creek until July 1. However, trespass cattle were found at station sct2 on September 18, 2018.

Land management strategies within the Secret Creek drainage should be modified to improve aquatic and riparian habitats, particularly upstream of station sct3. Management actions should be developed to relieve livestock pressure on the upper portion of Secret Creek so aquatic and riparian habitats can improve over the entire length of the stream. As required by the Little Humboldt Allotment BO and Grazing Decision, livestock utilization monitoring (stubble height, plant utilization, and stream bank trampling) needs to occur along Secret Creek to prevent cattle from over utilizing the riparian corridor and negatively influencing the stream corridor. The LCT population and habitat conditions should be resurveyed in 2023.

Oregon Canyon Creek Population and Habitat Survey (HUC 16040109)

Thirteen stations were surveyed along Oregon Canyon Creek. These stations were in the same general location as in the 2006 survey, except for the addition of oc13 (Table 29). Stations oc1, oc2, and oc10 through oc12 were located on land owned by the State of Nevada and stations oc3 through oc9 and oc13 are located on BLM land. Two stations (oc9 and oc13) only had photos taken at the first transect, while other stations (oc1 through oc8 and oc10 through oc12) were surveyed using the USFS

**Table 29.** UTM coordinates (NAD 83) for stations surveyed on Oregon Canyon Creek.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| oc1 | 512200 | 4572304 | 11T |
| oc2 | 512601 | 4571805 | 11T |
| oc3 | 512631 | 4571103 | 11T |
| oc4 | 513089 | 4570549 | 11T |
| oc5 | 513720 | 4570630 | 11T |
| oc6 | 514351 | 4570520 | 11T |
| oc7 | 514997 | 4570103 | 11T |
| oc8 | 515645 | 4570387 | 11T |
| oc9 | 516365 | 4570458 | 11T |
| oc10 | 513057 | 4570451 | 11T |
| oc11 | 513098 | 4569800 | 11T |
| oc12 | 513003 | 4569137 | 11T |
| oc13 | 513844 | 4568682 | 11T |

*Habitat Conditions*

Of the 11 stations surveyed, 6 had flowing water and 5 were dry or had flows too low to accurately measure. Excluding stations where flows were not measured, water flows averaged 0.13 cfs and water temperatures averaged 13°C. The HCI rating for Oregon Canyon Creek was 38% (poor), a considerable decline from the 2006 survey when habitat conditions were ocular estimated as being fair.

**Table 30**. HCI and parameter ratings for stations surveyed along the Oregon Canyon Creek. Stations with an * were dry during the survey and the highlighted parameters are those that can be improved at each station.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| oc1* | 46 | 0 | 0 | 58 | 79 | 63 | 75 |
| oc2 | 46 | 88 | 0 | 46 | 67 | 54 | 23 |
| oc3 | 48 | 91 | 0 | 58 | 38 | 42 | 57 |
| oc4* | 26 | 0 | 0 | 58 | 33 | 33 | 32 |
| oc5* | 33 | 0 | 0 | 38 | 38 | 25 | 100 |
| oc6* | 20 | 0 | 0 | 42 | 38 | 33 | 7 |
| oc7 | 36 | 0 | 0 | 63 | 46 | 46 | 60 |
| oc8 | 20 | 0 | 0 | 38 | 29 | 29 | 27 |
| oc10 | 68 | 94 | 100 | 67 | 46 | 38 | 63 |
| oc11 | 48 | 64 | 72 | 58 | 38 | 33 | 22 |
| oc12* | 22 | 0 | 0 | 50 | 50 | 29 | 2 |
| Average | 38 | 31 | 16 | 52 | 45 | 39 | 43 |

PM is a rating of the pool-riffle ratio for a stream or stream reach and averaged 31% (poor). When dry stations were excluded from analysis, PM averaged 56% (fair). PS is defined as pools with widths or lengths that are greater or equal to the average stream width, greater or equal to one foot in depth, and have adequate cover. A high PS rating is an important component of fish habitat because good quality pools provide desirable habitat for rearing, resting, and wintering fish. PS for Oregon Canyon Creek averaged 16% (poor) and when dry stations were excluded, quality pools averaged 29% (poor). PS was the most limiting factor along Oregon Canyon Creek. Undercut banks are an important component of quality pool habitat because they provide shelter for LCT, which increases the quality rating for pools. Excluding dry stations, undercuts made up 2% of the bank at stations surveyed.

BC provides stream shading, protection from erosion, and cover for fish. A plant community that is dominated by brush or shrubs with an understory of tall dense forbs and grasses is considered optimum. BC averaged 52%, with 14% of the dominant vegetation being shrubs, 68% being grass, and 18% being exposed. Oregon Canyon Creek is lacking woody vegetation that provides stream shading (i.e., reduces water temperatures) and increase bank stability. Woody vegetation also provides stream materials (branches and trunks) that assist in the development of pools that can support LCT.

BVS relates to the stability of the bank that is generated by vegetative cover and BSS relates to the resiliency of the bank from eroding. BVS averaged 45%, and BSS averaged 39%. Stream banks along Oregon Canyon Creek were unstable due to extreme utilization by cattle.

SB is the percent of the station covered by preferred substrates and, on average, gravel and rubble made up 43% of the substrate. Stream substrate consisted of 0.9% boulder, 6.8% rubble, 35.7% gravel, and 56.5% sand/silt. Embeddedness is the percentage of large particle substrate, such as gravel, cobble, and boulder that are covered by fine sediments (sand/silt). Elevated embeddedness can decrease salmonid

spawning success by limiting the amount of clean oxygenated gravel. Embeddedness was excessive, averaging 68%.

Overall, riparian habitats were in fair to poor conditions (Table 31), except for two stations (oc1 and oc2) located in the Oregon Flat Exclosure. These stations showed good to excellent riparian conditions (Table 31). Seral stages consisted of Shrub Potential Natural Community (PNC), Grass PNC, Shrub Early to Late, and Grass Early to Late. PNC is the biological community an area can support if given enough time for succession to occur without the interference of humans. Grass Forb Early to Late is defined as decreasing riparian grasses that are not present or are present, but not regenerating. Canopy cover, the percentage of the stream that is covered by riparian vegetation averaged 23%. A high percentage of canopy cover aides in keeping water the temperature low during hot summer months, when it can reach or exceed lethal limits for LCT.

**Table 31.** Riparian habitat condition seral stages and ratings for stations surveyed along Oregon Canyon Creek.

| Station | Seral Stage | Ratings |
|---|---|---|
| oc1 | Shrub PNC | Good |
| oc2 | Grass Forb PNC | Excellent |
| oc3 | Shrub PNC | Fair |
| oc4 | Grass Forb Early to Late | Poor |
| oc5 | Grass Forb PNC | Very Poor |
| oc6 | Grass Forb PNC | Very Poor |
| oc7 | Shrub Early to Late | Poor |
| oc8 | Shrub PNC | Poor |
| oc10 | Shrub PNC | Fair |
| oc11 | Shrub PNC | Fair |
| oc12 | Grass Forb PNC | Fair |

*Fish Population Survey*

No fish were captured or observed during the survey.

*Aquatic Invertebrates*

Aquatic invertebrates documented in Oregon Canyon Creek included individuals from the Class Gastropoda, the orders Hemiptera (family Gerridae), Decapoda, Trichoptera, Plecoptera, Odonata, Coleoptera, and Ephemeroptera.

*Land Management*

Livestock utilization was excessive along Oregon Canyon Creek (within the Basin South Pasture, Rim Pasture, and Castle Ridge Pasture) except near its confluence with the SFLHR in Oregon Flat Exclosure. Overall, ungulate damage was high, averaging 50% and ranging from 0% to 75%. Stations oc1 and oc2 located in the Oregon Flat Exclosure showed no ungulate damage. Stream banks and springs were severely trampled by cattle causing banks to slough off, causing sedimentation downstream. In

addition, trampling also reduces the percentage of undercut banks found along the stream. In many areas, cattle usage was so high that stream banks were turned to bare dirt.

Springheads were also severely trampled causing extensive hummocking and spring caps were sloughing off. Over utilization by cattle has resulted in numerous springs being turned into mud holes. Severe trampling of multiple springheads reduces water flow, which ultimately reduces flows into Oregon Canyon Creek and the SFLHR. Heavy utilization of riparian vegetation along the stream resulted in a lack of vegetation that helps insulate the stream, keeping water temperatures cooler in the summer and preventing anchor ice in the winter. Because cattle overgrazed Oregon Canyon Creek, water temperatures were too high to support LCT. According to the USFWS Services BO and the BLM's Final Decision Effective Upon Issuance Regarding Livestock Grazing in the South Fork Little Humboldt River Basin Portion of the Little Humboldt Allotment, cattle must be removed from the Basin South Pasture by July 1. In 2018, trespass cattle were observed along the stream corridor until September 17. Based on historical photographs of oc10 from 2006 to 2018, aquatic and riparian habitat conditions have not improved significantly. Grazing has resulted in poor riparian and aquatic habitats and has prevented LCT from occupying Oregon Canyon Creek.

Brush Creek is a small tributary to Oregon Canyon Creek near the confluence of the SFLHR. Brush Creek also receives excessive livestock utilization causing massive hummocking and poor water quality (high siltation and increased water temperatures). On June 19, 2018, NDOW constructed a small exclosure fence around Brush Creek Spring to keep cattle from trampling the area and creating hummocking. Although the fenced area was not breached, nearby cattle use remained high resulting in the stream being heavily trampled. Brush Creek produces approximately 2.0 gpm of water to Oregon Canyon Creek (Brush Creek Spring produces approximately 1.0 gpm and water reemerging within the Brush Creek channel upstream of the spring head produces approximately 1.0 gpm). Because of high cattle utilization along Brush Creek, water quality in Oregon Canyon Creek and the SFLHR is severely degraded. If water quality in Brush Creek could be improved, it would provide a cold-water refuge for LCT from Oregon Canyon Creek.

Grazing management along Oregon Canyon Creek has caused extensive damage to riparian and aquatic habitats and has decreased water quality in the SFLHR. Because the natural terrain of South Fork Oregon Canyon Creek allows easy cattle access for loafing, a riparian pasture should be constructed within the State owned property. This pasture should be rested until aquatic and riparian habitats have fully recovered and Oregon Canyon Creek supports a reproducing LCT population. Various willow species should be planted along the banks for shading and production of woody debris for development of quality pools. Livestock grazing needs to be monitored within the South Basin Pasture in accordance with the BO and Grazing Decision, particularly in relation to bank trampling. On the BLM portion, a conservative grazing system that allows for the recovery of riparian and aquatic habitats needs to be implemented. Exclosures should be constructed around springs and an exclosure fence should be

constructed around the wetted portions of Brush Creek and Brush Creek Spring to improve water quality. Oregon Canyon Creek should be resurveyed in 2023.

Gance Creek Population and Habitat Survey (HUC 16040102)

A GAWS survey was used to sample five stations on Gance Creek (Table 32). Stations gcp4, gcf8, and gcf9 were located on private land and gcf6 and gc7 were on USFS land. Stations occurred in the same general locations as those sampled in 1977.

Due to the 2018 Gance Creek Fire, a fish salvage was conducted along severely burned areas. LCT captured were relocated to Pratt Creek and the NFHR to augment their LCT populations. Paiute Sculpin were relocated to the NFHR as part of the post-NFHR treatment reintroduction. Total lengths were measured on all subadult and adult LCT and a subsample of YOY. Genetic samples (fin clips) were taken on all subadult and adult LCT for hybridization analysis. A subsample of Paiute Sculpin was also measured.

**Table 32.** UTM coordinates (NAD 83) for stations surveyed on Gance Creek.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| gcp4 | 0593621 | 4571060 | 11T |
| gcf6 | 0588102 | 4572332 | 11T |
| gcf7 | 0586243 | 4573121 | 11T |
| gcf8 | 0585822 | 4574102 | 11T |
| gcf9 | 0585402 | 4575076 | 11T |

*Habitat Conditions*

Two of five stations had flowing water, which averaged 1.26 cfs. Gance Creek was dry upstream of its confluence with Road Canyon Creek, a major water contributor to Gance Creek. Water temperatures averaged 11°C. The HCI rating for Gance Creek was 42% (fair) and when dry stations were excluded, HCI averaged 59% (fair).

**Table 33**. HCI and parameter ratings for stations surveyed along Gance Creek stations with an * were dry during the survey and the highlighted parameters are parameters that can be improved at each station.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| gcp4* | 22 | 0 | 0 | 50 | 33 | 25 | 25 |
| gcf6 | 51 | 75 | 66 | 63 | 25 | 25 | 53 |
| gcf7 | 66 | 53 | 51 | 83 | 71 | 67 | 72 |
| gcf8* | 42 | 0 | 0 | 79 | 58 | 54 | 58 |
| gcf9* | 29 | 0 | 0 | 58 | 42 | 42 | 32 |
| Average | 42 | 26 | 23 | 67 | 46 | 43 | 48 |

PM is a rating of the pool-riffle ratio for a stream or stream reach. PM averaged 26% (poor) and when dry stations were excluded, PM averaged 64% (fair). The poor PM is partially attributed to three of five stations being dry during the survey.

PS is defined as pools with widths or lengths that are greater or equal to the average stream width, greater or equal to one foot in depth, and have adequate cover. A high PS rating is an important component of fish habitat because good quality pools provide desirable habitat for rearing, resting, and wintering fish. PS averaged 23% (poor) and when dry stations were excluded, it averaged 58% (fair). PS was the most limiting habitat factor for Gance Creek. Undercut banks are an important component of quality pool habitat because they provide shelter for LCT. Across all stations, undercut banks were estimated at 17% of the stream area surveyed.

BVS relates to the stability of the bank that is generated by vegetative cover and BSS relates to the resiliency of the bank from eroding. BVS averaged 43% and BSS averaged 46%. Banks are unstable along Gance Creek, particularly in the areas that burned during the 2018 Fire.

SB is the percent of the station covered by preferred substrates and, on average, gravel and rubble made up 48% of the substrate. Stream substrate consisted of 11% rubble, 37% gravel, and 52% sand/silt. Embeddedness is the percent of large particle substrate, such as gravels, cobbles, and boulders that are covered by fine sediments (sand/silt). Elevated embeddedness can decrease salmonid spawning success by limiting the amount of clean oxygenated gravel needed for spawning. Embeddedness was high, averaging 72%. A large amount of fine silt occurred at stations gcf6 and gcf7.

BC provides stream shading, protection from erosion, and cover for fish. A plant community that is dominated by brush or shrubs with an understory of tall dense forbs and grasses is considered optimum. BC averaged 67%, with 7% of the dominant vegetation being trees, 40% being shrubs, 33% being grass, and 20% being exposed. Canopy cover, the percentage of the stream that is covered by riparian vegetation, was low, averaging 29%.

Riparian habitat conditions along Gance Creek varied from poor to good (Table 34). Seral stages consisted of Shrub Potential Natural Community (PNC) and Grass Forb PNC. PNC is the biological community an area could support if given enough time for succession to occur and without the interference of humans. PNC is defined as decreasing riparian plants (riparian plants that decrease with excessive grazing) that are present and regenerating. Riparian habitat condition at station gcf6 was not measured because the riparian was burned in 2018 and at station gcf8 as an oversight.

**Table 34.** Riparian habitat seral stages and condition ratings for stations surveyed along Gance Creek.

| Station | Seral Stage | Ratings |
|---|---|---|
| gcp4 | Shrub PNC | Poor |
| gcf7 | Shrub PNC | Good |
| gcf9 | Grass Forb PNC | Fair |

*Fish Population Survey*

Seventy-five LCT (34 sub adults/adults and 41 YOY) were captured at two of the five stations surveyed (Table 35). The population density was estimated at 1,207 fish/mi and without YOY, the population density was 547 fish/mile. It was estimated that LCT occupied approximately 3.5 mil of habitat; however, some wetted portions of Gance Creek were not surveyed because landowner permission was not granted. The average fork length was 111 mm, representing approximately five age classes. All LCT were released alive and in good condition.

**Table 35.** The total number and relative abundance population estimates for LCT in Gance Creek. The adult column includes subadults and adults and * indicates that the station was dry.

| | Station | Number of LCT Captured | | Population Estimate (fish/mile) | |
|---|---|---|---|---|---|
| Station | length (m) | YOY | adult | With YOY | Without YOY |
| gcp4* | 50 | 0 | 0 | 0 | 0 |
| gcf6 | 50 | 10 | 10 | 644 | 332 |
| gcf7 | 50 | 31 | 24 | 1,771 | 773 |
| gcf8* | 50 | 0 | 0 | 0 | 0 |
| gcf9* | 50 | 0 | 0 | 0 | 0 |

*Aquatic Invertebrates*

Aquatic invertebrates documented in Gance Creek included individuals from the class Clitellata, the orders Decapoda (Signal Crayfish), Trichoptera, Plecoptera, Ephemeroptera, and Hemiptera (family Gerridae).

*Land Management*

Gance Creek is within the Gance Creek Pasture of the East Independence C&H Allotment that was scheduled for rest in 2018. However, cattle were found trespassing in the pasture on September 14 (5 head), October 2 (several head), and October 11, 2018 (11 head). It was evident that excessive livestock damage occurred during previous grazing seasons. For example, many stream banks showed 90-degree angles (bank shearing caused by the hoof action of cattle), multiple cattle trails ran along and through the stream channel, and loafing areas were found in several meadow areas within 50 m of the stream.

*2018 Gance Creek Fire and Fish Salvage*

The 2018 Gance Creek Fire burned approximately 1.8 mi of Gance Creek. Most of the riparian vegetation downstream of Warm Creek was burned. Due to the intensity of the fire, 376 LCT were removed translocated to the NFHR (204 individuals) and Pratt Creek (172 individuals). The salvage occurred between UTM 11 E 0 588799 N 4572551 and 11 E 0587142 N 4572532 NAD 83. All fish observed downstream of the salvage area in the burned area were dead. Ten YOY LCT died during this salvage. It

is believed that YOY died because larger fish smashed them in the live well as they were collected.

Gance Creek should be surveyed after the grazing season to determine if current management actions are having a negative effect on aquatic and riparian habitats important to LCT. The LCT population and habitat conditions should be resurveyed in 2023.

Road Canyon Creek Population and Habitat Survey (HUC 16040102)

A GAWS survey was used to sample four stations on Road Canyon Creek (Table 36). Stations rod1, rod2, and rodA are located on private land and station rod3 is located USFS land. Stations occurred in the same general locations as those sampled in 1997.

**Table 36**. UTM coordinates (NAD 83) for stations surveyed on Road Canyon Creek.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| rod1 | 0585619 | 4573868 | 11T |
| rod2 | 0584811 | 4574038 | 11T |
| rod3 | 0584016 | 4573720 | 11T |
| rodA | 0584980 | 4574227 | 11T |

*Habitat Conditions*

Water flow in the mainstem of Road Canyon Creek averaged 0.48 cfs and the small tributary was 0.01 cfs. Water temperatures averaged 8°C. The small tributary had flowing water at station rodA, but the tributary dried up before it connected with the mainstem. The HCI rating for Road Canyon Creek was 53% (fair). Table 37 shows a summary of the habitat survey.

**Table 37**. HCI and parameter ratings for stations surveyed along Road Canyon Creek. Highlighted parameters are parameters that can be improved at each station.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| rod1 | 54 | 8 | 0 | 75 | 75 | 67 | 100 |
| rod2 | 56 | 32 | 0 | 83 | 67 | 67 | 86 |
| rod3 | 45 | 0 | 0 | 81 | 54 | 54 | 90 |
| rodA | 56 | 95 | 0 | 50 | 50 | 50 | 93 |
| Average | 53 | 34 | 0 | 70 | 61 | 59 | 92 |

PM is a rating of the pool-riffle ratio for a stream or stream reach. PM averaged 34% (poor), which is due to the lack of pools detected during the survey. PS is defined as pools with widths or lengths that are greater or equal to the average stream width, greater or equal to one foot in depth, and have adequate cover. A high PS rating is an important component of fish habitat because good quality pools provide desirable habitat for rearing, resting, and wintering fish. PS was rated as poor (0%) with no quality pools being detected during the survey. Undercut banks are an important component of quality pool habitat because they provide shelter for LCT. Across all

stations, undercut banks comprised 16% of the stream.

BVS relates to the stability of the bank generated by vegetative cover and BSS relates to the resiliency of the bank from eroding. BVS averaged 61% and BSS averaged 59%. Larger rubble and boulder material that generally improves BSS was lacking. At station rod3, the stream channel was incised approximately 1.2 m deep.

SB is the percentage of the station covered by preferred substrates and, on average, gravel and rubble made up 92% of the substrate. Stream substrate consisted of 28% rubble, 64% gravel, and 8% sand/silt. Embeddedness is the percent of large particle substrate, such as gravels, cobbles, and boulders that are covered by fine sediments (sand/silt). Elevated embeddedness can decrease salmonid spawning success by limiting the amount of clean oxygenated gravel. Embeddedness was low, averaging 27%.

BC provides stream shading, protection from erosion and cover for fish. A plant community that is dominated by brush or shrubs with an understory of tall dense forbs and grasses is considered optimum. BC averaged 70%, with 8% of the dominant vegetation being trees, 38% being shrubs 50% being grass, and 4% being exposed. Canopy cover averaged 39%. A high percentage of canopy cover aides in keeping water temperatures lower during hot summer months, when water temperatures may reach or exceed lethal limits for LCT.

Riparian habitat conditions along Road Canyon Creek varied from fair to good (Table 38). Seral stages consisted of Tree Potential Natural Community (PNC), Shrub PNC, and Grass Forb PNC. PNC is the biological community an area could support if given enough time for succession to occur without the interference of humans. At station rod2 and rod3, several large stands of noxious thistle were present.

**Table 38.** Riparian habitat seral stages and condition ratings for stations surveyed along Road Canyon Creek.

| Station | Seral Stage | Ratings |
|---|---|---|
| rod1 | Tree PNC | Good |
| rod2 | Shrub PNC | Good |
| rod3 | Tree PNC | Good |
| rodA | Grass Forb PNC | Fair |

*Fish Population Survey*

The survey captured 126 LCT (78 sub adults/adults and 48 YOY) at three of the four stations (Table 39). The density estimate for Road Canyon Creek was 1,352 fish/mi and when YOY were excluded, the estimate was 837 fish/mi. It was estimated that LCT occupied 1.8 mi of habitat. The average total length was 97 mm and approximately five age classes were represented. All LCT caught were released alive and in good condition.

*Aquatic Invertebrates*

Aquatic invertebrates documented in Road Canyon Creek included individuals from the orders Trichoptera, Plecoptera, Ephemeroptera, and Coleoptera.

**Table 39.** The total number of and the relative abundance population estimates for LCT in Road Canyon Creek. The adult column includes subadults and adults.

| | Station length | Number of LCT Captured | | Population Estimate (fish/mile) | |
|---|---|---|---|---|---|
| Station | (m) | YOY | adult | With YOY | Without YOY |
| rod1 | 50 | 14 | 23 | 1,191 | 740 |
| rod2 | 50 | 21 | 25 | 1,481 | 805 |
| rod3 | 50 | 13 | 30 | 1,384 | 966 |
| rodA | 50 | 0 | 0 | 0 | 0 |

*Land Management*

Road Canyon Creek is located in the Gance Creek Pasture of the East Independence C&H Allotment. It was scheduled to be rested in 2018, however, cattle were trespassing on September 14 (5 head) and October 11 (11 head). The survey found historical evidence of excessive livestock grazing damage. A large portion of the stream bank was at 90-degree angles (caused by the hoof action of cattle), multiple cattle trails ran along and through the channel, and several meadows showed signs of loafing. At station rod2, habitat conditions were in noticeably better where cattle could not access to the stream. Road Canyon Creek is a tributary to Gance Creek, but none of it was affected by the 2018.

Road Canyon Creek should be surveyed after the grazing season to determine what current management actions are having on aquatic and riparian habitats important to LCT. The LCT population and habitat conditions should be resurveyed in 2023.

Warm Creek Population and Habitat Survey (HUC 16040102)

A GAWS survey was used to sample four stations on Warm Creek (Table 40). Stations wrm1, wrm2, and wrm3 were located on private land and station wrmA was located on USFS land. Stations occurred in the same general locations as those sampled in 1997.

**Table 40.** UTM coordinates (NAD 83) for stations surveyed on Warm Creek.

| Station | Easting | Northing | Zone |
|---|---|---|---|
| wrm1 | 0585859 | 4572558 | 11T |
| wrm2 | 0585436 | 4572223 | 11T |
| wrm3 | 0584676 | 4572083 | 11T |
| wrmA | 0585063 | 4572764 | 11T |

*Habitat Conditions*

Three of four stations had water, but only two stations (wrm1 and wrmA) had enough water to measure flow. Water flow in the mainstem of Warm Creek was 0.70 cfs and the small tributary was 0.07 cfs. Water temperatures averaged 8°C. Most of the water in Warm Creek came from the spring source located at UTM 11T E 0585412 N 4572278. Station wrm3 was ephemeral and probably only flowed during spring runoff. HCI rating for Warm Creek was 50% (fair).

**Table 41**. HCI and parameter ratings for stations surveyed along Warm Creek. Stations with an * were dry during the survey and the highlighted parameters are parameters that can be improved at each station.

| Station | HCI | PM | PS | BC | BVS | BSS | SB |
|---|---|---|---|---|---|---|---|
| wrm1 | 48 | 5 | 97 | 75 | 50 | 50 | 8 |
| wrm2 | 54 | 54 | 0 | 83 | 71 | 71 | 46 |
| wrm3* | 48 | 0 | 0 | 100 | 58 | 54 | 75 |
| wrmA | 49 | 17 | 0 | 75 | 54 | 54 | 94 |
| Average | 50 | 19 | 24 | 83 | 58 | 57 | 56 |

PM is a rating of the pool-riffle ratio for a stream or stream reach and overall PM averaged 19% (poor). When dry stations were excluded, it averaged 26% (poor). PM was the most limiting HCI factor for Warm Creek. PS is defined as pools with widths or lengths that are greater or equal to the average stream width, greater or equal to one foot in depth, and have adequate cover. A high PS rating is an important component of fish habitat because good quality pools provide desirable habitat for rearing, resting, and wintering fish. PS was rated as poor (24%), with quality pools (a product of active beaver dams) only found at station wrm1. Undercut banks are an important component of quality pool habitat because they provide shelter for LCT. Across all stations surveyed, 21% of the stream banks were undercut.

BVS relates to the stability of the bank generated by vegetative cover and BSS relates to the resiliency of the bank from eroding. BVS averaged 58% and BSS averaged 57%. Bank stability had a lower rating due to cutting into a road paralleling the stream (from wrm2 to the confluence of Gance Creek).

SB is the percentage of the station covered by preferred substrates and, on average, gravel and rubble made up 56% of the substrate. Stream substrate consisted of 15% rubble, 41% gravel, and 44% sand/silt. Embeddedness is the percent of large particle substrate, such as gravels, cobbles, and boulders covered by fine sediments (sand/silt). Elevated embeddedness can decrease salmonid spawning success by limiting the amount of clean oxygenated gravel. Embeddedness averaged 63% and there was heavy siltation at wrm1.

BC provides stream shading, protection from erosion, and cover for fish and averaged 78%, with 25.0% of the dominant vegetation being trees, 58.3% being shrubs, 8.3% being grass, and 8.3% being exposed. Canopy cover, averaged 55%. A high percentage of canopy cover aides in keeping water temperatures low during hot

summer months when water temperatures may reach or exceed lethal limits for LCT.

Riparian habitat conditions along Warm Creek varied from fair to good condition (Table 42). Seral stages consisted of Shrub Potential Natural Community (PNC) and Tree PNC. PNC is the biological community an area could support if given enough time for succession to occur without the interference of humans.

**Table 42**. Riparian habitat seral stages and condition ratings for stations surveyed along Warm Creek.

| Station | Seral Stage | Ratings |
|---|---|---|
| wrm1 | Tree PNC | Good |
| wrm2 | Tree PNC | Good |
| wrm3 | Shrub PNC | Good |
| wrmA | Shrub PNC | Fair |

*Fish Population Survey*

The survey found 114 LCT (66 sub adults/adults and 48 YOY) only at station wrm1 (Table 43). The density estimate was 3,670 fish/mi, and when YOY were excluded, density was estimated at 2,125 fish/mi. However, it was likely that LCT only occupied approximately 0.8 mi of Warm Creek. Station wrm1 was part of a large beaver dam complex starting at the confluence of Gance Creek and ending at transect 3 of station wrm1. Upstream of wrm1, the number of beaver dams greatly diminished and the stream formed a single shallow channel that would support fewer fish than in the beaver ponds. The population estimate generated at station wrm1 is not likely to be representative of the LCT population upstream of the station. The average fork length was 129 mm and approximately six age classes were represented from the fish captured. During the survey, one LCT mortality occurred, but all other LCT were released alive and in good condition.

**Table 43.** The total number and relative abundance population estimates for LCT in Warm Creek. The adult column includes subadults and adults and * indicates that the station was dry.

| | Station length | Number of LCT Captured | | Population Estimate (fish/mile) | |
|---|---|---|---|---|---|
| Station | (m) | YOY | adult | With YOY | Without YOY |
| wrm1 | 50 | 48 | 66 | 3,670 | 2,125 |
| wrm2 | 50 | 0 | 0 | 0 | 0 |
| wrm3* | 50 | 0 | 0 | 0 | 0 |
| wrmA | 50 | 0 | 0 | 0 | 0 |

*Aquatic Invertebrates*

Aquatic invertebrates documented in Warm Creek included individuals from the orders Decapoda (Signal Crayfish), Trichoptera, Plecoptera, and Hemiptera (family Gerridae).

*Land Management*

In 2018, the Gance Creek Pasture of the East Independence C&H Allotment was scheduled for rest, however, cattle were found trespassing on September 14 (5 head) and October 11, 2018 (11 head). There was also evidence that cattle walked upstream shearing off banks. It was evident that livestock grazing damage occurred during previous grazing seasons because a large portion of the banks were at a 90-degrees due to the hoof action. There were also several cattle trails running along and through the stream channel indicating high utilization.

In 2018, approximately 0.36 mi of the lower portion of Warm Creek burned in the Gance Creek Fire. The upper most burned area was located a UTM 11T E 0 585999 N 4572623 NAD 83 and portions of the uplands burned up to the confluence of the main tributary that flows into Warm Creek. The fire burned the riparian, but only at several small locations instead of the entire corridor. Since only a few small areas burned, this fire should not have a negative effect on the LCT population.

Warm Creek should be surveyed after the grazing season to determine what effects the current management actions are having on aquatic and riparian habitats important to LCT. The road paralleling Warm Creek should be stabilized to reduce siltation in Warm and Gance creeks. The main spring located between station wrm1 and wrm2 should be fenced with pipe rail to prevent cattle trampling of the spring, which reduces water discharge into Warm Creek. The LCT population and habitat conditions should be resurveyed in 2023.

Hanks Creek Population Survey (HUC 16040101)

A Smith Root LR-20B Backpack Electrofisher was used to spot electroshock approximately 1.6 mi of Hanks Creek, with no LCT being observed or captured. Cattle damage was excessive in the middle and upper portion of Hanks Creek.

Grazing management must be changed on Hanks Creek to allow for the recovery of riparian and aquatic habitats important to LCT. Other sections of Hanks Creek should to be electroshocked to determine if LCT still exist. The LCT population and habitat conditions should be resurveyed in 2021.

Pratt Creek LCT Population Augmentation (HUC 16040102)

A salvage in Gance Creek from the burned area captured 172 LCT (89 subadults/adults and 83 YOY). Approximately, six to seven age classes, including YOY, were present (Figure 6). Fish were then transported to Pratt Creek in an aerated livewell and released at three locations. Genetic analysis indicated that these LCT were pure. Currently, 354 LCT from Foreman Creek and Gance Creek have been used to reestablish LCT in Pratt Creek.

The LCT population in Pratt Creek should be augmented again in 2019 and a population survey should be conducted to examine for recruitment.

Beaver Creek Temperature Monitoring (HUC 16040102)

Three HOBO thermographs were placed in Beaver Creek from July 1 to August 31 and a temperature was collected every two hours. One was placed in the east fork, one was placed in the west fork, and one was placed in the main stem of Beaver Creek (Table 44). Thermographs were staked to the stream bottom with a T-post and fence wire.

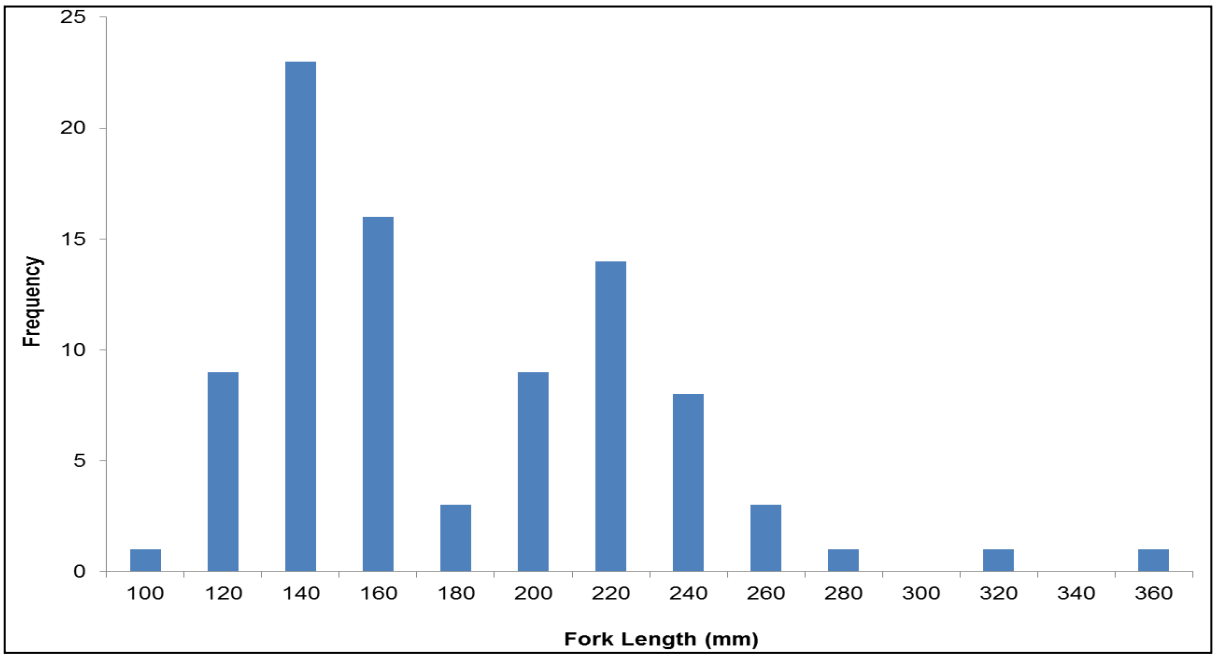


**Figure 6**. Absolute length frequency histogram for LCT that were released into Pratt Creek.

**Table 44**: UTM coordinates (NAD 83) for the locations of the thermographs in Beaver Creek.

| Location | Easting | Northing | Zone |
|---|---|---|---|
| Main Stem Beaver Creek | 0618337 | 4579481 | 11T |
| East Fork Beaver Creek | 0622845 | 4593202 | 11T |
| West Fork Beaver Creek | 0612763 | 4591031 | 11T |

The maximum water temperatures from all temperature loggers ranged from 21 to 24°C (Table 45). According to the USFWS 1995 LCT Recovery Plan, the optimal average maximum summer water temperature for LCT must be less than 22°C and have a relatively stable summer temperature regime averaging 13°C ± 4°C. The average maximum summer water temperature in Beaver Creek ranged from 18 to 21°C, which is just below the lethal limit for LCT (Table 45). However, the average summer temperatures ranged from 17 to 19°C, which is at the upper temperature range and exceeds what is believed to be a water temperature that can support LCT (Table 45).

Based on water temperature data, it is reasonable to believe that LCT can be reintroduced into Beaver Creek if riparian and aquatic habitats can be improved, and water temperatures are reduced.

Riparian and aquatic habitats need to be surveyed on the main stem Beaver Creek, the West Fork of Beaver Creek, and the East Fork of Beaver Creek to examine if LCT can be successfully reintroduced in the system.

**Table 45.** Maximum and average water temperatures for the main stem of Beaver Creek, the East of Fork Beaver Creek, and the West Fork of Beaver Creek.

| Stream | Average maximum summer water temp (° C) | Average summer water temp (° C) | Maximum water temp (° C) |
|---|---|---|---|
| East Fork of Beaver Creek | 20 | 18 | 22 |
| West Fork of Beaver Creek | 18 | 17 | 21 |
| Main Stem Beaver Creek | 21 | 19 | 24 |

## MANAGEMENT REVIEW

All objectives were completed except for the following: Brown Creek (SFHR) was not treated to remove nonnative fish; LCT were not transplanted into Stewart Creek (RR) as the treatment was postponed; electroshocking surveys were not conducted on the NFHR, Winters Creek (NFHR), California Creek (NFHR), Mahala Creek (NFHR), Jim Creek (NFHR), Pie Creek (NFHR), Pratt Creek (NFHR), and Rattlesnake Creek (SFHR) due to other priorities; and assessment of nonnative trout distribution using eDNA sampling was not conducted on the main stem Marys River and T Creek since it will be assessed in 2019. Additionally, reintroduction of LCT and native non-game fish species into T Creek was postponed because post-treatment surveys were put on hold until eDNA sampling and genetic analysis is completed in 2019. Projects that were not listed as objectives but were completed included the Gance Creek fish salvage and the Marys River hybrid survey.

## RECOMMENDATIONS

- Continue to identify potential LCT recovery streams/systems in conjunction with the Upper Humboldt GMU team. Remain involved with the development of BLM and USFS allotment evaluations, grazing decisions, and cooperative development of grazing systems.
- Implement the Upper Humboldt River Basin LCT Species Management Plan during the 2019 field season.
- Continue to monitor LCT populations within the Upper Humboldt River Basin to assess reproduction and population distribution.
- Enroll willing landowners under the umbrella Safe Harbor Agreement to facilitate LCT recovery activities on private lands and public waters upstream.
- The construction of fish migration barriers should be evaluated on proposed treatment waters. Temporary barriers may help for allowing treatment of specific segments within metapopulation systems where entire drainage treatments are not feasible at one time.

- LCT populations that share drainages with nonnative salmonids should continue to be monitored to ensure they are not threatened through competition or hybridization. Documented threats should be discussed within the GMU team and appropriate actions taken.
- Genetic sampling of LCT should continue, as the updated information will help with source stock evaluations for reintroductions as well as recognizing hybridization.

**Project Participants**

Nevada Department of Wildlife, U.S. Forest Service, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, and Trout Unlimited.

**Project Duration (All Past, Present, and Planned Segments)**

Beginning July 1, 1995 and continuing until the species is delisted.

Prepared by: Michael Starr and Jacob Stoller
Fisheries Biologists, Eastern Region

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