BONNEVILLE CUTTHROAT TROUT RESTORATION IN THE MAMMOTH CREEK DRAINAGE: 2019 ACTIVITIES

Michael J. Hadley
Aquatic Biologist

Michael E. Golden
Dixie National Forest Fisheries Biologist

February 2020

Utah Division of Wildlife Resources
Southern Region

Introduction

Native Bonneville cutthroat trout (BCT) were confirmed 98% pure in Mammoth Creek in 2012. The Mammoth Creek BCT Restoration Project was subsequently formulated with the goal of removing non native trout – primarily brook trout – from the Mammoth Creek drainage upstream of Mammoth Spring (Figure 1). Description of the drainage, history of fish management, details of the project, and progress through 2018 can be found in Hadley, et al. 2015, Hadley and Golden 2016a and b, and Hadley and Golden 2019.

2019 project activities focused on nonnative trout removal in Reed Valley Creek, Dead Lake, Porcupine Lake, and the unnamed tributary that feeds the two lakes. Hereafter, this tributary will be referred to as John L Flat Creek. The other primary activity that was scheduled for 2019 was collection of eggs from remnant BCT in Mammoth Creek. High runoff flows resulting from the record 2019 snowpack prevented the streamside egg collection, however.

Dead Lake and Porcupine Lake are two small waterbodies located downstream of John L Flat (Fig. 2). Dead Lake is also known as Scout Lake or Lost Lake. The creek runs through Porcupine Lake, while Dead Lake is filled by a secondary spillover from Porcupine Lake as well as localized runoff. Previous observations also assumed that Dead Lake may be filled by springs, though none are evident at this time. The sport fishery in Dead Lake is sustained by stocking catchable-sized fish in early summer. This quota was changed from rainbow trout to tiger trout in 2017 in preparation for BCT restoration in the Mammoth Creek drainage. Overwinter survival has always been assumed to be nonexistent or negligible in Dead Lake, so it was assumed that rainbow trout were no longer present in the lake in 2019. Porcupine Lake was historically stocked with fingerling brook trout, though this quota was cancelled after 2013. Connection from Porcupine Lake to Dead Lake is seasonally possible, however, so it became necessary to survey Dead Lake in 2019 for potential occupation by brook trout. Porcupine Lake was also surveyed to assess the current population of brook trout.

Trend Net Surveys

Methods

One gill net was set in each of Dead Lake and Porcupine Lake on August 7, 2019, and allowed to fish overnight. Nets measured 6 ft x 80 ft, with eight panels of randomly-arranged mesh size (1.5”, 2.25”, 1”, 0.75”, 2.5”, 1.25”, 2”). Fish caught were removed from nets on the morning of August 8, measured to the nearest millimeter (total length [TL]), and weighed to the nearest gram. Trout body condition was measured by the calculation of Fulton’s K_{TL} (generated from total length):

$$K_{TL} = (Weight/Length^3) \times 100{,}000$$

No previous trend net surveys have been conducted in these lakes, precluding historic comparison.

Results

The gill net set on the east shore of Dead Lake caught a total of 24 tiger trout and three brook trout on August 8, 2019. The tiger trout were stocked just one week prior to the survey, so they were not included in netting analysis (Table 1). The brook trout measured 258 to 297 mm (10-12 in) in TL. The presence of these brook trout in Dead Lake dictated that the lake be treated with rotenone to ensure that fertile nonnative fish be entirely removed from the system.

The gill net set on the southeast shore of Porcupine Lake caught 11 brook trout that spanned two size classes and averaged 220 mm (8.7 in), 100 g, with a mean condition of 0.91 (Table 2). It is presumed that the brook trout caught in Dead Lake washed downstream from Porcupine Lake during spring runoff of 2019. In fact, brook trout were observed in the channel between the lakes during reconnaissance surveys in August, though the channel was dry at the time of the treatment. It is notable, however, that the brook trout in Dead Lake were larger than all those caught in Porcupine Lake. It is possible that those fish experienced accelerated growth in Dead Lake due to little competition between the time of their invasion and stocking of tiger trout on August 1.

Pathogen Surveys

A sample of 30 brook trout was collected by electrofishing in Reed Valley Creek in July, 2019, and submitted to the Fisheries Experiment Station (FES) for testing of infection by *Myxobolus cerebralis*, the parasite that causes whirling disease. Such testing is regularly conducted prior to native trout restoration. Testing was also desired for the John L Flat system though, due to low brook trout density, the 30-fish sample was filled by netting in Porcupine Lake, electrofishing in John L Flat Creek, and the rotenone treatment. FES reported no evidence of *M. cerebralis* in the brook trout collected from Reed Valley Creek. Results from John L Flat Creek were not yet available as of February 2020.

Rotenone Treatments

Reconnaissance surveys were conducted in Reed Valley Creek and John L Flat Creek during July and August 2019 to document brook trout distribution, as well as locations of springs, tributaries, seeps, and potential problem areas for rotenone application.

Reed Valley Creek

Liquid rotenone was applied to target waters in Reed Valley Creek on July 29 and 30, 2019, using three 35-gal (7-hr charge) drip barrels, one 7-gal (4-hr charge) drip barrel, and four micro (32-oz bottle) drips. The 35-gal barrels were set in the stream in upper Reed Valley (Drip 1) (Fig. 3), the main Reed Valley spring (Drip 2), and a spring (Drip 3) 0.65 mi downstream of the top drip. Drip 3 was close enough to the treatment midpoint that it was run as a booster. The 7-gal barrel (Drip 4) was set in another spring next to Drip 3. Micro drips were set on small seeps with less than 0.25 cfs in flow (Fig. 3, 4), including the inflow from Big Spring. Charges for drip stations were calculated to apply the liquid rotenone (5% active ingredient) at a concentration of 1.5 parts per million (ppm). Spray crews were assigned to inspect the entire treatment area for potential refugia and areas of low mixing. Crews worked their way downstream and applied rotenone to these sites with backpack sprayers. Travel of rotenone through the treatment area was monitored by observation of sentinel fish set in live cages at Drip 3, the Jensen Sawmill Road, and just above the confluence with Mammoth Creek. A detox station was set up at the Mammoth Creek campground for potential rotenone deactivation with potassium permanganate ($KMnO_4$). This station was about 0.25 mi downstream of Reed Valley Creek. A live cage with sentinel fish was set at the lower Mammoth Creek fish barrier, which is 0.14 mi downstream of Reed Valley Creek. Detox operations were to commence if or when the sentinel fish at the barrier showed effects of rotenone.

Table 3 lists personnel that participated in the treatments of Reed Valley Creek, John L Flat Creek, Porcupine Lake, and Dead Lake, with assigned tasks. Drips 1-3 were set in Reed

Valley Creek at 11:00 pm on July 29 (Fig. 3). Although all of these drips were set for one 7-hr charge, Drips 1 and 2 emptied more slowly than anticipated and ran for about 11 hours before being pulled. The rotenone concentration resulting from this slow application rate still proved sufficiently lethal, as sentinel fish set above Drip 3 were dead at 6:00 am (Table 4). Drip 3 was pulled after running 7 hours. Drip 4 was run for a single 4-hr charge on the morning of July 30. Four of the six potential micro drips were also set (Fig. 3, 4). Rotenone arrived at the Jensen Sawmill Road at 8:30 am, traveling twice as fast as in the reach upstream of Drip 3 (Table 4). A total of 0.78 gal (2.96 L) of rotenone was applied to Reed Valley Creek on July 29 and 30 (Table 5) – 0.52 gal by drip stations and 0.26 gal by sprayers. Approximately 2.76 miles (4.44 km) of stream were treated with rotenone (Table 6). Brook trout were observed in limited numbers throughout the treatment area. Rotenone reached Mammoth Creek at about 10:00 am on July 30. Sentinel fish at the barrier were observed for the next three hours and showed no effects of rotenone, indicating that the volume of Mammoth Creek was sufficient to dilute rotenone to a nonlethal concentration. Application of $KMnO_4$ was not necessary.

John L Flat Creek, Porcupine Lake, Dead Lake

Rotenone was applied to target waters in John L Flat Creek upstream of Porcupine Lake on September 9, 2019, using two 7-hr (35-gal) drips and two 4-hr (7-gal) drips. The 7-hr drips were set at a spring (Drip 4) in John L Flat (Fig. 5), as well as in a spring at the midway point of the treatment, which was set as a booster. The 4-hr drips were set as boosters (0.5 and 2) in the latter stages of the treatment. Spray crews were assigned to inspect the entire treatment area for potential refugia and areas of low mixing and applied rotenone to these sites with backpack sprayers. Travel of rotenone through the treatment area was monitored by observation of sentinel fish set in live cages 0.33 mi downstream of Drip 4 and at Booster 1. Rotenone was applied to John L Flat Creek below Porcupine Lake on September 10, 2019. A 7-hr drip was set below the lake outlet (Fig. 6) and a spray crew walked the stream from this point to a series of cascades near the confluence with Mammoth Creek. Rotenone was also applied to Porcupine and Dead lakes on September 10 with back sprayers from both shore and a raft, as well as water pump aspirator system.

Drip 4 and Booster 1 were set in John L Flat Creek at 12:00 pm on Sep 9, 2019 (Fig. 5). Three 4-hr drips that had been planned for the spring sources upstream of Drip 4 were not set because Drip 4 was already treating the entire stream flow, habitat was very limited upstream of that drip, and only one brook trout was observed during pre-treatment electrofishing. Instead, the spray crew applied rotenone to those channels, including the single pool where a fish was previously observed and removed. Rotenone was traveling slower than anticipated after about four hours of application (Table 4), so two 7-gal drip jugs were set as boosters (0.5 and 2) (Fig. 5) at 4:00 pm and 4:40 pm. Rotenone reached the sentinel fish at Booster 0.5 at 4:35 pm, so that booster was moved about 0.7 mi downstream. All four drips were pulled at 7:00 pm. Brook trout were observed in very low numbers through the upper reaches of the treatment area. Some fish had already been removed before the treatment during reconnaissance surveys and pathogen sample collection. Rotenone from the upper stream treatment was allowed to flow into Porcupine Lake after application. Drip 5 was set just below Porcupine Lake at 11:00 pm on Sep 9 and was refilled for a half charge at 6:50 am on Sep 10. Application in Porcupine and Dead lakes was completed by late afternoon. Limited numbers of brook trout were observed in Porcupine Lake. Tiger trout were abundant in Dead Lake, while a few brook trout were also observed. A total of 1.77 gal (6.71 L) of rotenone was applied to John L Flat Creek on Sep 9 and 10 (Table 5) – 1.12

gal by drip stations and 0.65 gal by sprayers. 1.5 gal (5.68 L) were applied to Porcupine Lake and 5.0 gal (18.9 L) were applied to Dead Lake. Approximately 2.52 miles (4.06 km) of stream and 3.0 acres (1.22 ha) of lakes were treated with rotenone (Table 6). Because the Reed Valley Creek treatment displayed no need to deactivate rotenone in Mammoth Creek a detox station was not set up for the John L Flat Creek treatment.

Discussion

Other than minor issues with slower than anticipated travel time, 2019 rotenone applications in the Mammoth Creek drainage were accomplished with no complications. Treatment personnel were able to effectively address the travel time in John L Flat Creek with additional boosters. It is recommended that boosters be set at the locations of the additional drips (lower site of Booster 0.5) during the second rotenone treatment in 2020 to ensure full coverage of the stream during the seven-hour drip window. 2019's Booster 1 can be replaced with a 4-hr or micro drip. Treatment of John L Flat Creek, Porcupine Lake, and Dead Lake should be targeted for June 2020 so that sport fish stocking can be resumed in the lakes during early summer. Reed Valley Creek should be treated in July 2020 with the same design as 2019. The remainder of the Mammoth Creek drainage is scheduled for treatment in August 2020.

Another attempt will be made to collect eggs from the remnant Mammoth Creek BCT in spring 2020. If successful, resulting fry should be stocked in Reed Valley Creek. Consideration should also be given to stocking these BCT fry in Porcupine Lake and John L Flat Creek if enough are available, as this lake has the potential to sustain a wild brood later if desired. It is also proposed that a variance from state health protocol be requested from the Utah Fish Health Board, which would allow for salvaging the Mammoth Creek BCT during the final treatment phase. These fish would be collected prior to rotenone application and held next to the stream in transport tanks or a hatchery truck until rotenone concentration has dissipated (2-3 days), then would be returned to the same vicinity in the stream. This salvaging would allow for continued efforts to collect eggs after brook trout are removed from Mammoth Creek. At the very least, this would allow for Mammoth Creek BCT genes to persist and mix with the Manning Meadow fish stocked after completion of the project. The variance should be requested for treatments in 2020 and 2021.

Literature Cited

Hadley, M. J., M. E. Golden, and J. E. Whelan. 2015. 2014 survey of Bonneville cutthroat trout in the upper Sevier River drainage, Utah. Publication Number 15-04. Utah Department of Natural Resources, Division of Wildlife Resources, Salt Lake City. 32 pp.

Hadley, M. J, and M. E. Golden. 2016a. 2015 rotenone treatments in the Mammoth Creek drainage. Utah Department of Natural Resources, Division of Wildlife Resources, Cedar City.

Hadley, M. J, and M. E. Golden. 2016b. 2016 rotenone treatments in the Mammoth Creek drainage. Utah Department of Natural Resources, Division of Wildlife Resources, Cedar City.

Hadley, M. J, and M. E. Golden. 2019. Bonneville cutthroat trout restoration in the Mammoth Creek drainage: 2018 Castle Creek rotenone treatment. Utah Department of Natural Resources, Division of Wildlife Resources, Cedar City.

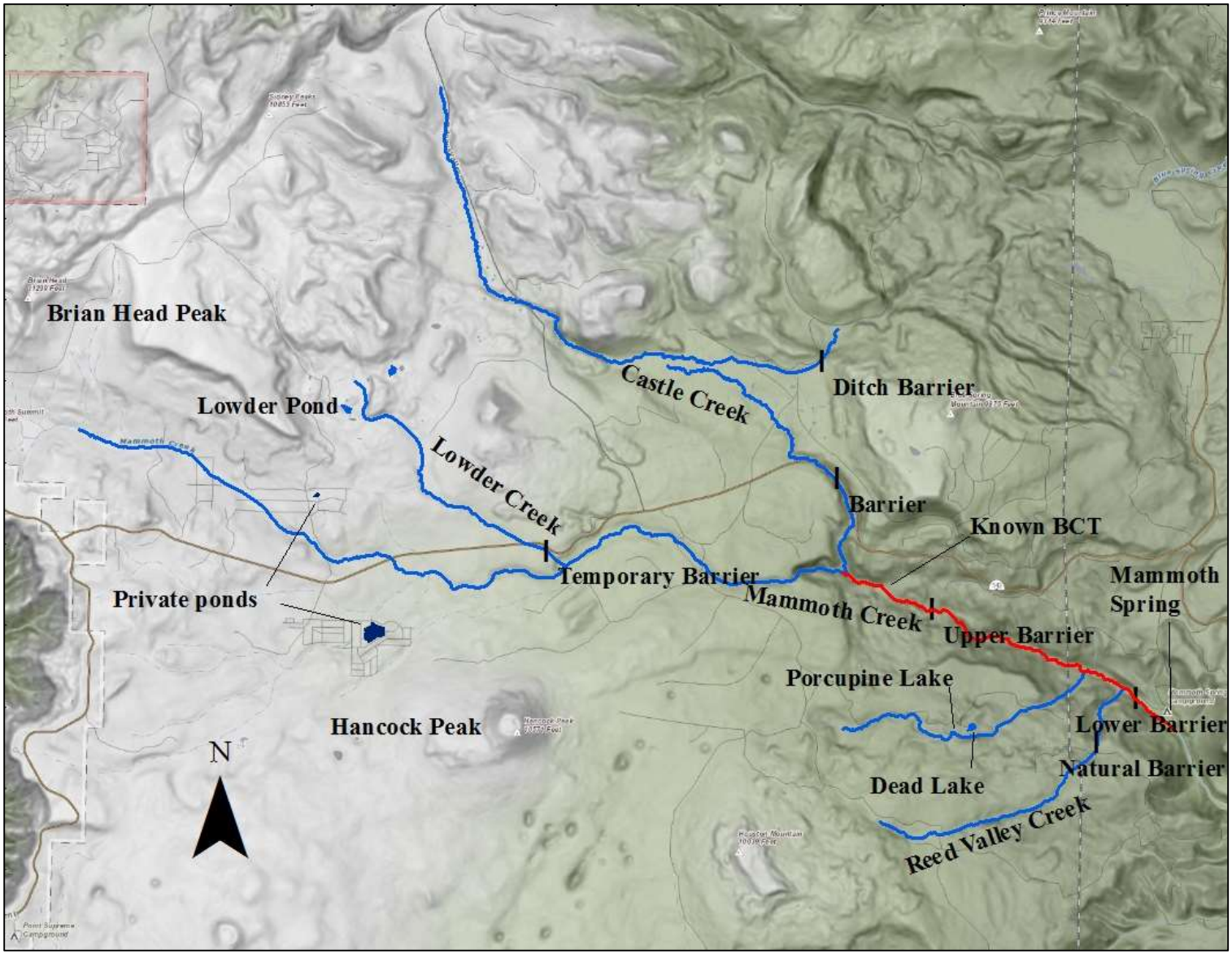

Figure 1. Upper Mammoth Creek drainage.

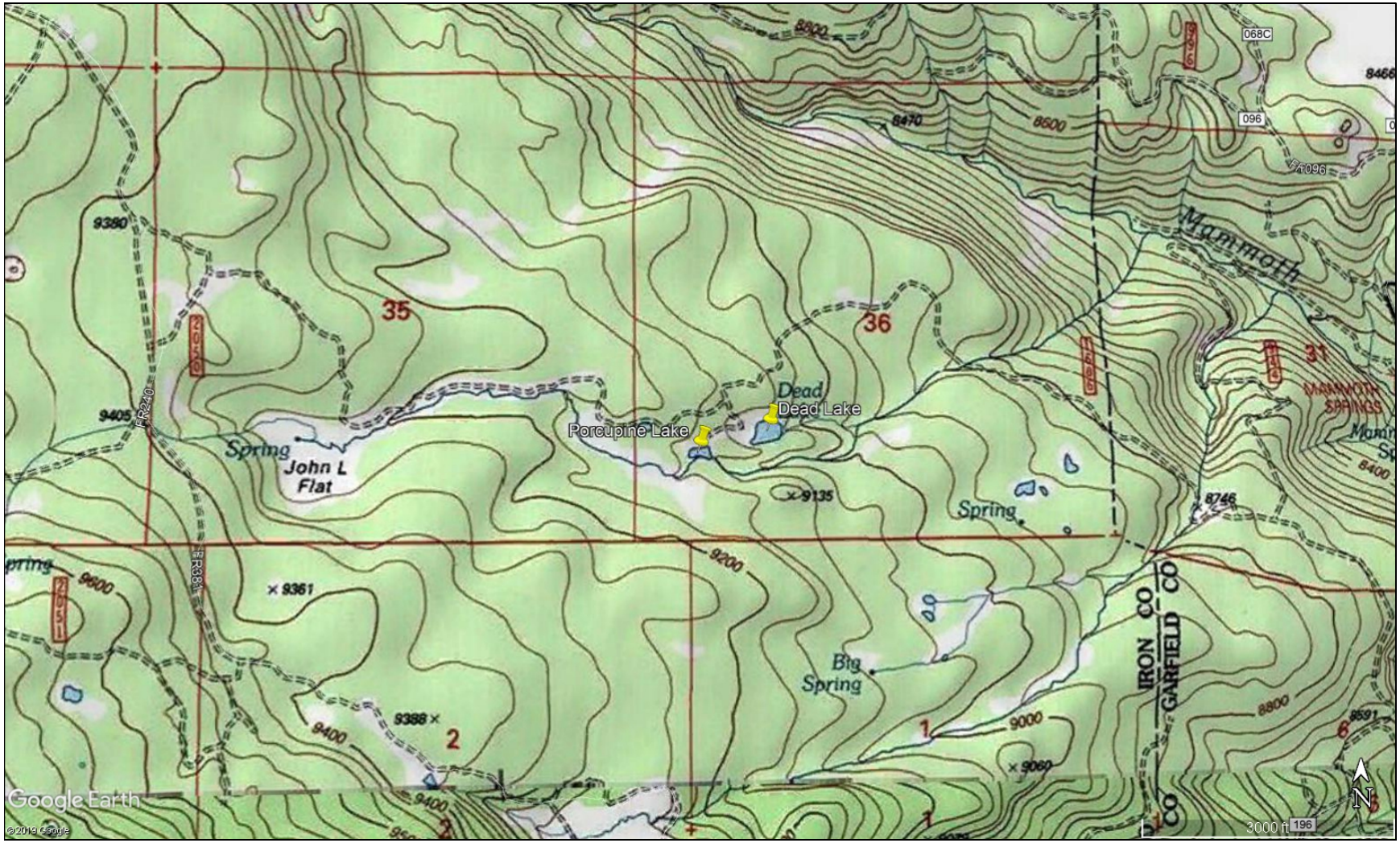

Figure 2. Dead Lake, Porcupine Lake, and John L Flat Creek.

Figure 3. Locations of rotenone drip stations in upper Reed Valley Creek.

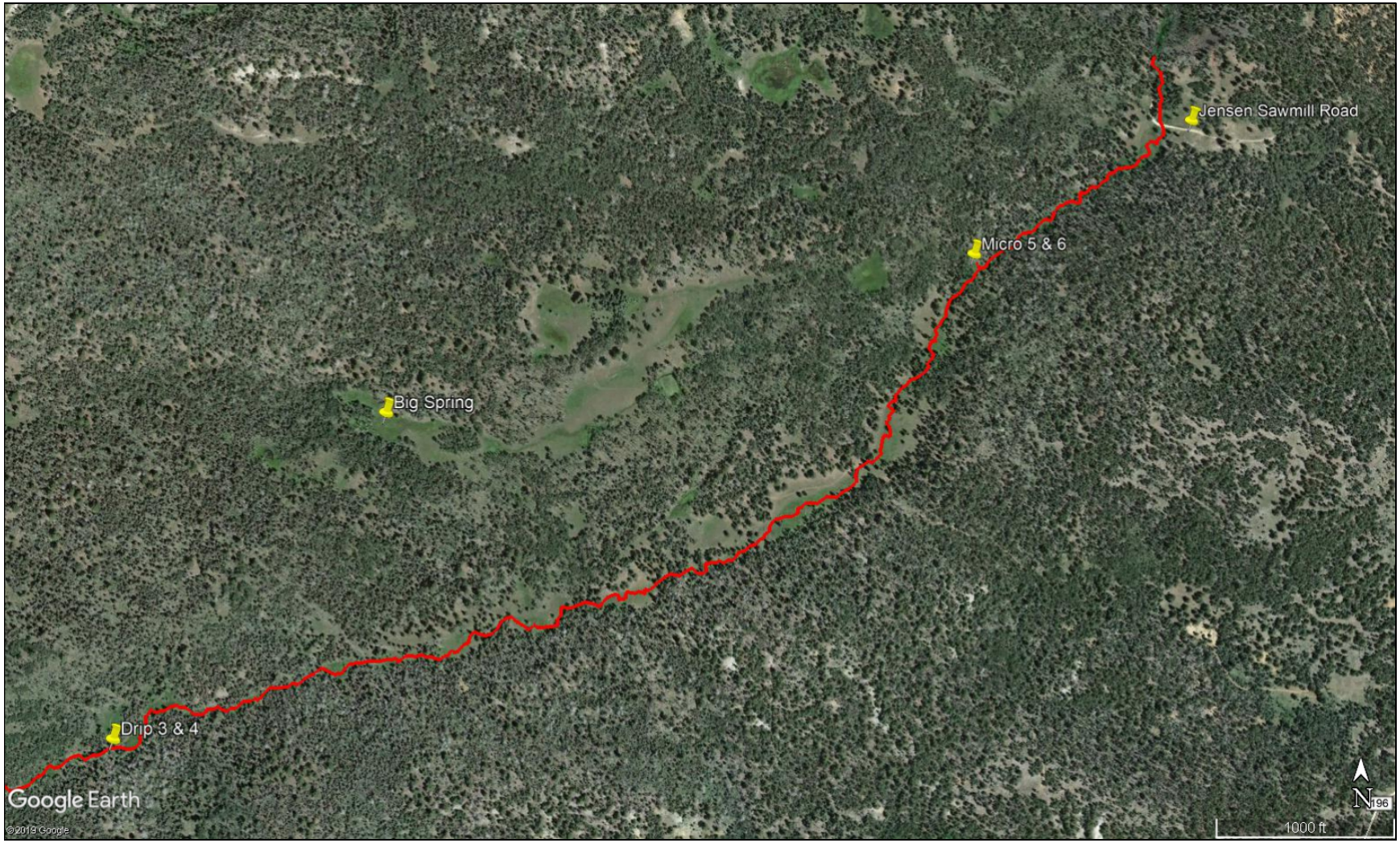

Figure 4. Locations of rotenone drip stations in lower Reed Valley Creek.

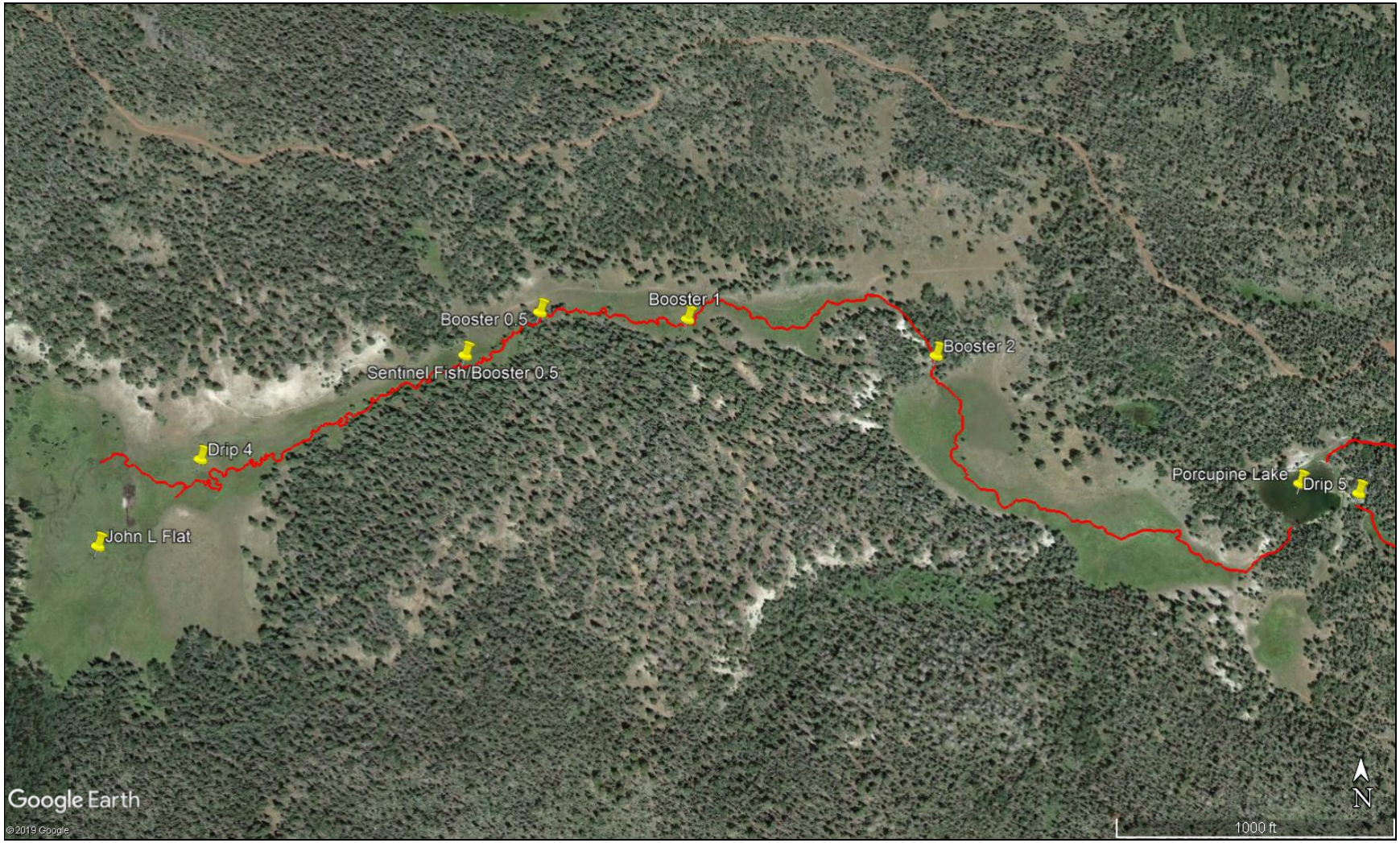

Figure 5. Locations of rotenone drip stations set between John L Flat and Porcupine Lake.

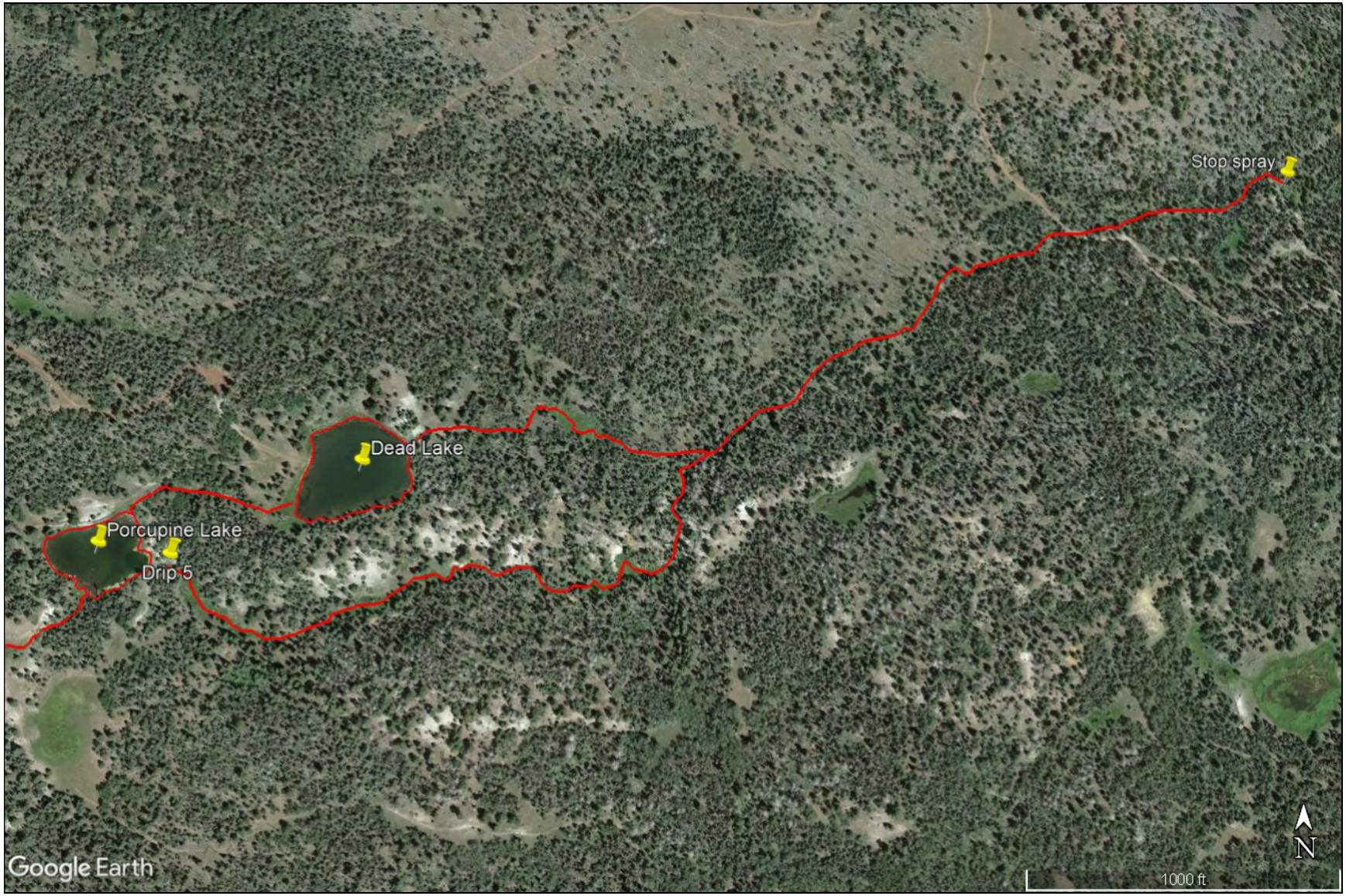

Figure 6. John L Flat Creek below Porcupine and Dead lakes.

Table 1. Summary of the results from the 2019 trend net survey at Dead Lake.

Water:	Dead Lake (Lost Lake, Scout Lake)					**Catalog #:**	VI 374C					
Date Set:	8/7/2019		**Time:**	15:00		**Weather:**						
Date Pulled:	8/8/2019		**Time:**	9:00		**Water Temp:**						
# Nets:	1 Diver; AFS design					**Collectors:**	M. Roundy, H. Gilson, A. Van Valkenburg					
Summary for Sport Fish												
		Total	**fish per**	**Total Length (mm)**			**Weight (g)**			**Condition (Ktl)**		
Species	**N**	**Weight (kg)**	**net/night**	**Mean**	**SE**	**Range**	**Mean**	**SE**	**Range**	**Mean**	**SE**	**Range**
Brook Trout	3	0.71	3.00	278	11.30	258-297	237	39.00	169-304	1.08	0.05	0.98-1.16
Comment:	Also caught 24 tiger trout stocked one week prior to netting.											

Table 2. Summary of the results from the 2019 trend net survey at Porcupine Lake.

Water:	Porcupine Lake					**Catalog #:**	VI 337B					
Date Set:	8/7/2019		**Time:**	15:00		**Weather:**						
Date Pulled:	8/8/2019		**Time:**	9:00		**Water Temp:**						
# Nets:	1 Diver; AFS design					**Collectors:**	M. Roundy, H. Gilson, A. Van Valkenburg					
Summary for Sport Fish												
		Total	**fish per**	**Total Length (mm)**			**Weight (g)**			**Condition (Ktl)**		
Species	**N**	**Weight (kg)**	**net/night**	**Mean**	**SE**	**Range**	**Mean**	**SE**	**Range**	**Mean**	**SE**	**Range**
Brook Trout	11	1.10	11.00	220	7.59	170-244	100	10.2	11-169	0.91	0.05	0.68-1.35

Table 3. Project personnel and assignments for chemical treatments in the Mammoth Creek drainage in 2019.

Personnel	Assignment
Reed Valley Creek: July 30, 2019	
Mike Hadley, UDWR SRO	Planning, recon, supervise, drips
MaKayla Roundy, UDWR SRO	Drips
Hunter Gilson, UDWR SRO	Spray
Nick Dastrup, UDWR SRO	Spray
Clay Tyler, DNF	Spray
Kalli Tyler, DNF	Spray
Nic Braithwaite, UDWR SRO	Detox
John L Flat, Porcupine Lake, Dead Lake: Sep 9-10, 2019	
Mike Hadley, UDWR SRO	Planning, recon, supervise, drips, lake pump application
Mike Golden, DNF	Planning, drips, spray lakes
Clay Tyler, UDWR SRO	Spray streams
Kalli Tyler, UDWR SRO	Spray streams
Nic Braithwaite, UDWR SRO	Spray lakes
Jens Swensen, FNF	Spray lakes
Kevin Wheeler, UDWR WCFO	Spray lakes
Erik Woodhouse, UDWR WCFO	Spray lakes
Kody Callister, UDWR WCFO	Spray lakes
Izzie Speer, UDWR WCFO	Spray lakes

Table 4. Rotenone travel time and rate in selected treated sections.

Stream	**Reach**	**Distance (mi)**	**Travel Time (hrs)**	**Rate (mi/hr)**
Reed Valley Cr	Drip 1/2 to Drip 3	0.50	7.0	0.071
Reed Valley Cr	Drip 3 to Jensen Sawmill Rd	1.48	9.5	0.156
John L Flat Cr	Drip 4 to sentinel fish	0.33	4.5	0.073

Table 5. Chemical used during 2019 treatments in the Mammoth Creek drainage.

Date and location	**Chemical and formulation**	**Application method**	**Amount of chemical used**	**Concentration / rate**
July 30, 2019 Reed Valley Creek	Liquid rotenone, 5% active ingredient	Drip barrels and back pack sprayers	0.78 gal (2.96 L)	~1.5 ppm total ingredient
Sept 9-10, 2019 John L Flat Creek	Liquid rotenone, 5% active ingredient	Drip barrels and back pack sprayers	1.77 gal (6.71 L)	~1.5 ppm total ingredient
Sept 10, 2019 Porcupine Lake	Liquid rotenone, 5% active ingredient	Back pack sprayers	1.50 gal (5.68 L)	~1.5 ppm total ingredient
Sept 10, 2019 Dead Lake	Liquid rotenone, 5% active ingredient	Back pack sprayers and pump	5.0 gal (18.93 L)	~1.5 ppm total ingredient

Table 6. Length of stream and area of lakes treated with rotenone in the Mammoth Creek drainage in 2019.

Stream	**Length (mi)**	**Length (km)**
Reed Valley Creek	2.76	4.44
John L Flat Creek	2.52	4.06
Total	**5.28**	**8.50**
Lake	**Area (ac)**	**Area (ha)**
Porcupine Lake	1.15	0.47
Dead Lake	1.85	0.75
Total	**3.00**	**1.22**