

**TRAPPING, SPAWNING, AND TREND NETTING OF BONNEVILLE CUTTHROAT
TROUT AT MANNING MEADOW RESERVOIR, 2019**

A Sport Fish and Native Cutthroat Trout Restoration Project



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Introduction

A brood stock of Bonneville cutthroat trout (BCT) was established at Manning Meadow Reservoir in Piute County with transfers of fish from Pine Creek (UDWR Catalog No. VI AB 010 B) in 1990 and 1991. The population of BCT in Pine Creek had been established previously by transfers of fish from remnant populations in Birch Creek (VI AB 050 A 02) in the upper Beaver River drainage, as well as Water Canyon (I AA 020 C 01) and Reservoir Canyon (I AA 020 C 02 A) in the upper Virgin River drainage. Eggs were collected from spawning BCT at Manning Meadow Reservoir for the first time in 1992 and every year since then. Fish produced from the Manning Meadow brood have been used to establish conservation populations and maintain sport fisheries in southern Utah for more than 25 years. The brood population is maintained by annual stocking of BCT fingerlings in the fall, with the most recent quota being set at 15,000 (Table 1). Annual trend net surveys are combined with data from trapping and egg takes to monitor the brood population and evaluate changes that may occur over time. This report details results of those efforts in 2019.

For many years, restrictive fishing regulations have been in place at Manning Meadow Reservoir, designed to protect the BCT brood from angling exploitation. These restrictions included a seasonal fishing closure, tackle restriction (ie. “artificial only”), and harvest limit of one BCT over 22 inches in length. Due to decreasing annual egg needs and increasing abundance of BCT observed in trend net surveys, it was determined in 2015 that such a level of restriction was not likely needed to protect the brood. The harvest limit, in particular, was over protective since no BCT over 22 inches have been observed in years, making this an effective catch-and-release restriction. Anglers had also frequently expressed displeasure with the harvest limit. In fall 2015, a daily limit of two trout with no size restriction was submitted to and approved by the Wildlife Board. The new limit went into effect in 2016 and has been effective at increasing angler satisfaction. Future trend net surveys and trapping results will indicate the overall population effect of the new limit.

The creation of triploid (sterile) BCT was initiated in 2016, with the intent of providing fish for stocking in streams where BCT restoration is in progress. The goal in these streams is to establish self-sustaining replicates of nearest neighbor populations; however, the time requisite to accomplish this establishment is often longer than is conducive to sport fishing interest. Sterile tiger trout have been used in the past to meet sport fishing demand in the interim of native cutthroat trout restoration, but can be difficult to procure in the short term and may create an expectation among anglers of continued stocking. BCT resulting from the Manning Meadow brood are readily available and abundant each year, but mixing of the “generic” brood genetics is not desired when a nearest neighbor remnant is available for replication. The creation of triploid BCT was attempted to resolve these conflicting concerns. Mixed results were observed during the first couple years of triploid BCT egg production, as egg survival was poor but triploidy success was always over the acceptable threshold of 90%. Improvements to on-site protocol, including shading and icing the pressure chamber, have improved triploid egg survival. In 2018, there was no noticeable difference in survival and eye-up between diploid and triploid eggs.

Regional and aquaculture staff determined in 2017 that needs for holdover BCT had become obsolete and that the space required to hold those fish in the hatchery could be better served in raising other fish for sport fish purposes. In most cases, holdover BCT have shown to be less desirable to anglers due to persistent fin wear. In addition, holdover BCT have not demonstrated greater survival at stocking over fingerlings. All BCT quotas were converted to fall fingerling stocks in 2017.

Methods

Trend Net Survey

Two experimental gill nets (one floating and one diving) were set in Manning Meadow Reservoir on July 1, 2019, and were allowed to fish overnight. Nets measured 6 ft x 125 ft, with five panels of increasing mesh size (0.75", 1", 1.25", 1.5", 2"). Both nets were set with the smallest mesh size in to shore. Net locations have been consistent for several years of sampling (Figure 1). Fish caught were removed from nets on the morning of July 2 and all fish were measured to the nearest millimeter (total length) and weighed to the nearest gram.

Trapping and Egg Take

Spawning BCT were collected from Manning Meadow Reservoir in 2019 in a constructed fish trap in Timber Creek, a small perennial tributary to the reservoir. Trapping and spawning dates are summarized in Table 2. The inlet trap included compartmentalized pens where fish could be collected, sorted, and held until spawning (title page). Utah Division of Wildlife Resources (UDWR) personnel or other government agency volunteers visited the site daily while the inflow trap was in operation.

Egg collections were conducted on July 2 and 8. The egg take operation was supervised by Glenwood Fish Hatchery personnel. Spawning was conducted by personnel from Egan Fish Hatchery. All BCT were sorted and ripe fish were spawned using standard state methods (Figure 2). Females were generally paired with males at a ratio of 2:1 in spawn groups; eggs and milt were generally pooled from 10 females and 5 males at a time. Ovarian fluid was collected for disease testing from 60 females on July 2. Fluid was pooled from 5 females at a time, per standard pathogen protocol. Eggs were water hardened for at least one hour and then transported to the Fountain Green Hatchery isolation station for incubation. The eyed eggs were then moved to the Glenwood Fish Hatchery for further rearing. All BCT were stocked as fingerlings in fall 2019.

Disease certification was completed as required by standard protocol, including a 60-fish lethal sample and ovarian fluid from 60 females. Disease work was conducted by personnel from the Fisheries Experiment Station, Logan, Utah. The lethal sample for disease certification was obtained from the trend net survey conducted concurrently with spawning activities. Timber Creek and Manning Creek below the spillway were inspected for New Zealand mudsnails and other AIS as per UDWR protocols.

Results from the spawn operation and trend net survey were compared with trends observed since 1992.

Triploid Eggs

Due to the late timing of spawn operations and a lack of need, the triploid operation was not conducted at Manning Meadow in 2019.

Results and Discussion

Trend Net Survey

123 BCT were collected in two nets at Manning Meadow Reservoir on July 2, 2019, for an overall catch rate of 62 trout per net-night (Table 3). This rate was nearly identical to the long-term mean (Table 4). Catch rate has fluctuated from 60 to 80 trout per net-night since the harvest limit was increased in 2016 (Fig. 3), yielding no clear pattern by which to evaluate the

change in potential harvest. The BCT catch spanned four cohorts, with a significant contribution from Age 1+ fish stocked in 2017 (Fig. 4). BCT averaged 285 mm in total length (TL), 328 g in weight, with an average condition (K_{TL}) of 1.20 (Table 3). Mean length and weight were the lowest values recorded since 2012 (Table 4), reflecting the high contribution from the 2017 cohort. Abundance of young fish has led to a decreasing trend in mean length during the last two years (Fig. 5). Mean condition in 2019 was the highest observed since 2011, the last time that southern Utah experienced an exceptional snowpack.

Trapping and Egg Take

The timing of the Manning Meadow trap set up, first spawn, last spawn, and trap take down have been very similar in recent years (Table 2). High snowpack and a late spring thaw in 2019 delayed trap setup about two weeks and egg take about three weeks. Since 2014, the first egg take has been conducted within two days of set up due to the high number of ripe female BCT collected during trap installation. It has been common for personnel to sort 500-1,000 fish on the day of set up. Coupled with the need for only two spawn days, trap operation was completed in only one week's time during 2014-2018, saving both time and effort. In 2019, however, sufficient numbers of BCT were not captured during trap set up and the first egg take was conducted one week later. The full trap operation was completed in two weeks' time.

Results from the 2019 Manning Meadow egg take are summarized in Table 5. Total number of eggs collected continued to decrease in 2019 as egg needs have decreased and efforts have been made to avoid collecting a large excess of eggs (Fig. 6). In addition, triploid eggs were not collected in 2019. Continued decreases are less likely to occur in the future, since the number of eggs collected in recent years (160,000-200,000) has been deemed sufficient to cover current requested stocking quotas. The number of eggs per fluid ounce declined again in 2019 – meaning that eggs were larger on average than those collected in the last ten years (Table 7). This is a beneficial trend as larger eggs typically experience improved survival. Following a stall from 2017 to 2018, mean length of male and female BCT spawned continued an overall increasing trend observed since 2014 (Fig. 7). Despite the increase in size, the mean number of eggs collected from each females has been decreasing since 2015, though the decrease has not been dramatic. Male and female BCT spawned had similar size distributions in 2018, though males were slightly larger on average (Fig. 8).

Percentages of green BCT eggs successfully eyed and converted to stocked fish in 2019 nearly matched the highest levels observed at the Manning Meadow brood (Table 7, Fig. 9). A total of 114,418 BCT fingerlings was stocked in 15 waters in fall 2019. This total included 4,000 stocked in North Fork Corn Creek to bolster a struggling conservation population, as well as nearly 27,000 sent to the Lee Kay Hatchery to feed warm water brood fish. Due to the late egg take dates, growth at Glenwood Hatchery was also delayed and fingerlings were smaller than normal at the scheduled time of stocking. Quotas were increased by 30-40% in order to compensate for any reduced survival of smaller fish.

Regular quotas for BCT in the southern region are anticipated to be between 60,000 to 80,000 diploid fish going forward. Based on trends in rates of egg survival to stocked fish (Table 7), collection should target 170,000-250,000 eggs annually in order to meet these requests. The long-term mean measure of eggs per female dictates that 190-280 female BCT could provide enough eggs to fill these quotas. Requests for triploid BCT eggs will increase these targets accordingly.

The annual stocking quota of 15,000 BCT fingerlings has successfully maintained a sufficient population of adult fish for the brood operation. Current potential egg production is outpacing regional stocking needs by a large factor and the population level supported by the current quota of 15,000 fish produces more spawners than needed. However, it is anticipated that liberalization of the angling harvest limit may remove some of these excess spawners each year. If future surveys show that such reduction does not occur, a reduction of the stocking quota or increase in harvest limit may be considered in order to improve growth, mean size, and maximum size. Satisfying angling interests at Manning Meadow Reservoir through both improved fish quality and harvest opportunity may help to further build public support for native cutthroat trout conservation and such interests should be carefully considered in the management of the fishery.

2019 pathogen testing detected *Myxobolus cerebralis*, the parasite that causes whirling disease, for the first time in BCT collected at Manning Meadow Reservoir. While this finding does not prevent the collection of gametes, it will preclude further transfers of adult spawners to other waters. Current spawning protocol at Manning Meadow already employs precautions to minimize the threat of pathogen movement and will continue to be followed carefully into the future. Because BCT are stocked annually in Manning Meadow Reservoir, the presence of whirling disease should not effect the abundance or availability of spawning BCT for the egg take operation. The conservation population located downstream in Manning Creek may be impacted, however, as the pathogen can reduce survival and recruitment of BCT young-of-the-year.

Recommendations

1. Work with aquaculture coordinators, Glenwood Hatchery, and Fountain Green Hatchery to continue improvements in native trout culture.
2. Collect eggs from 200-300 female BCT, spread over two spawn dates. Adjust targets for successive egg takes based on results of the previous take.
3. Avoid collecting eggs or milt from BCT captured in the spillway.
4. Continue to monitor the effect of the increase in angling harvest limit on BCT population demographics. Adjust stocking rate, if necessary, to meet goals of both brood production and to meet angler satisfaction.
5. Identify potential needs for triploid BCT prior to egg take operations. Consider stocking triploid BCT in targeted waters where survival and growth can be evaluated.
6. Take precautions to minimize the threat of whirling disease spread from Manning Meadow Reservoir.

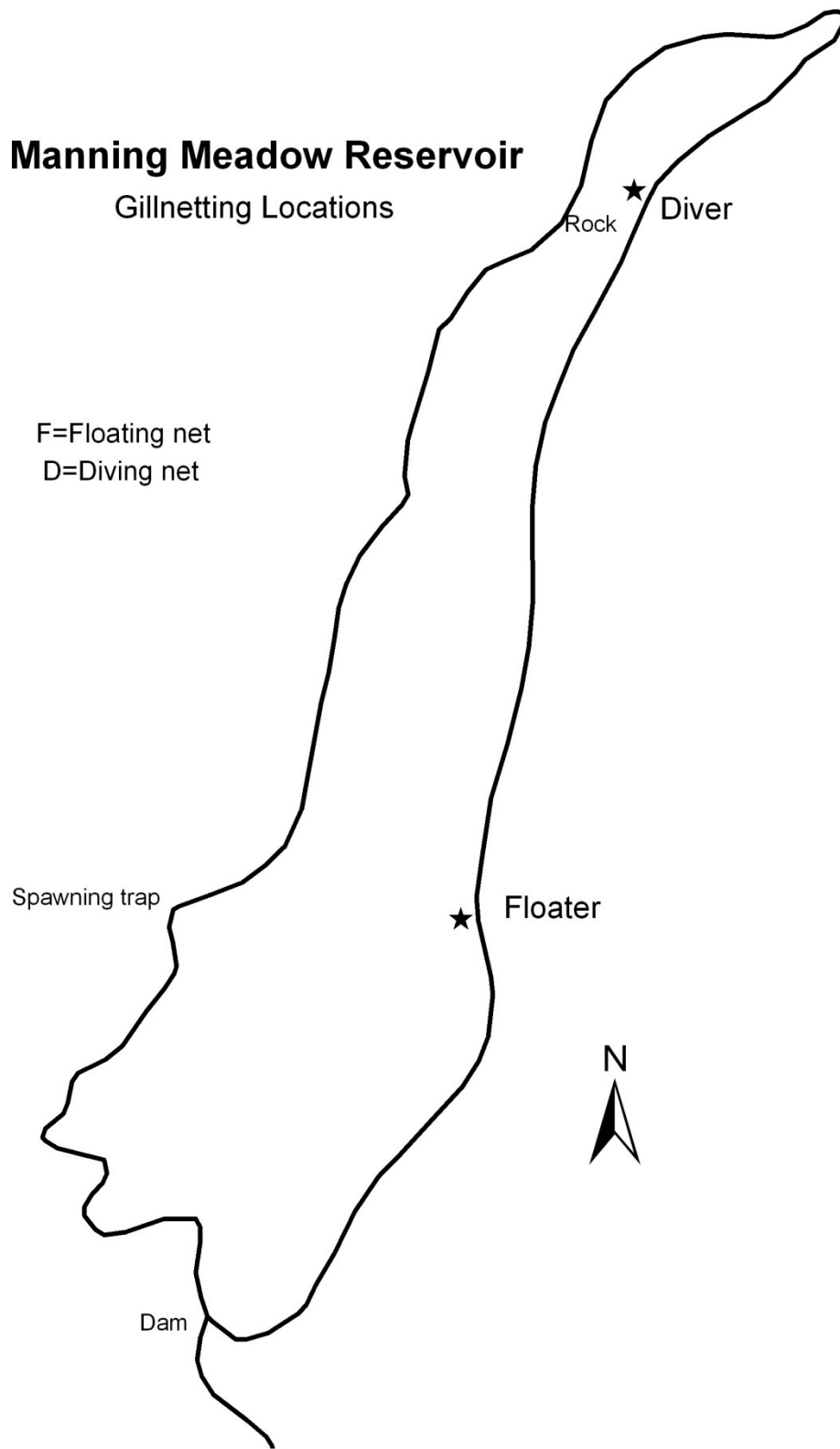


Figure 1. Locations of gill nets set at Manning Meadow Reservoir during the 2018 trend net survey.



Figure 2. Eggs are stripped from a female Bonneville cutthroat trout at Manning Meadow Reservoir.

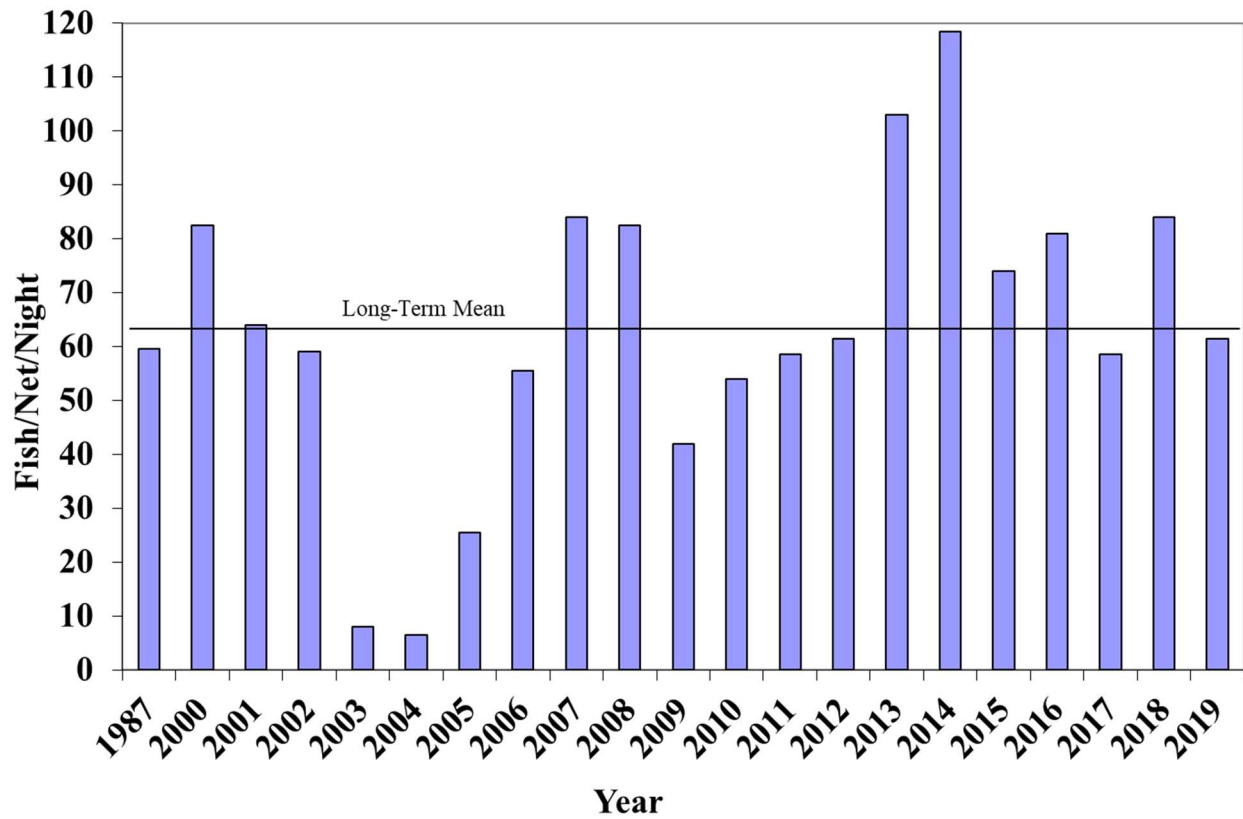


Figure 3. Cutthroat trout catch rate during trend net surveys at Manning Meadow Reservoir, 1987-2019.

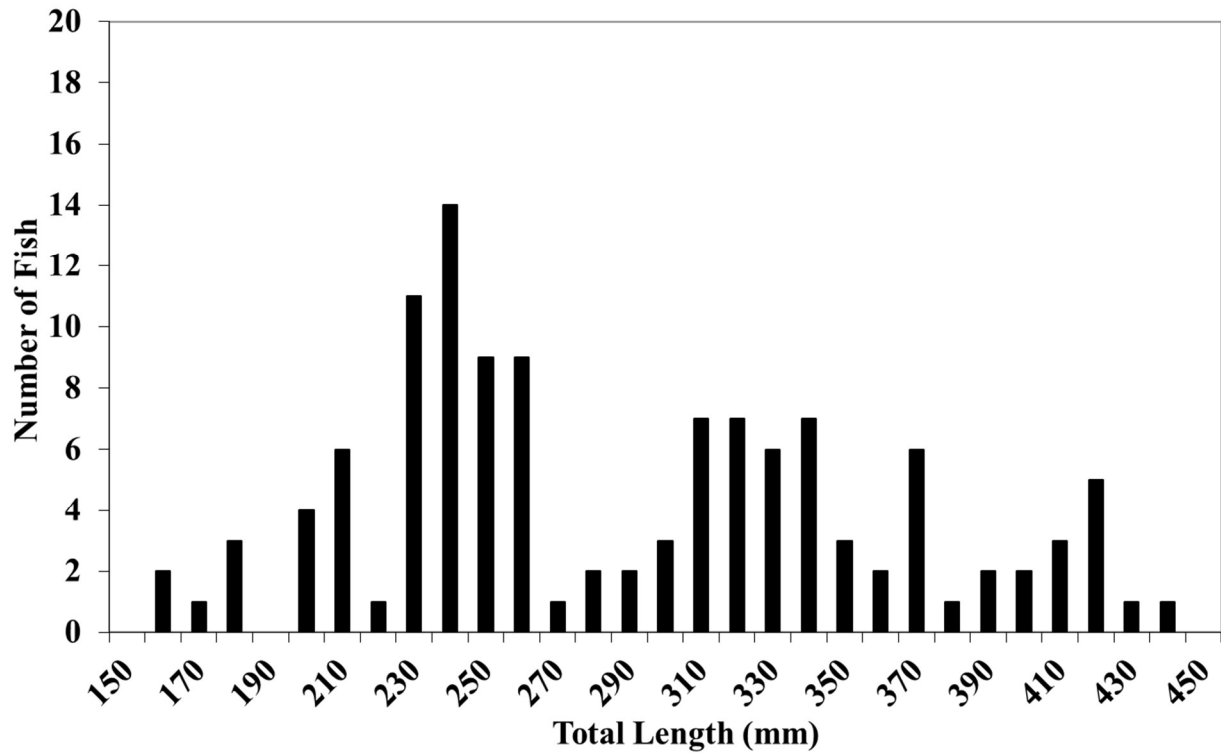


Figure 4. Length distribution of Bonneville cutthroat trout collected during the trend net survey at Manning Meadow Reservoir on July 2, 2019.

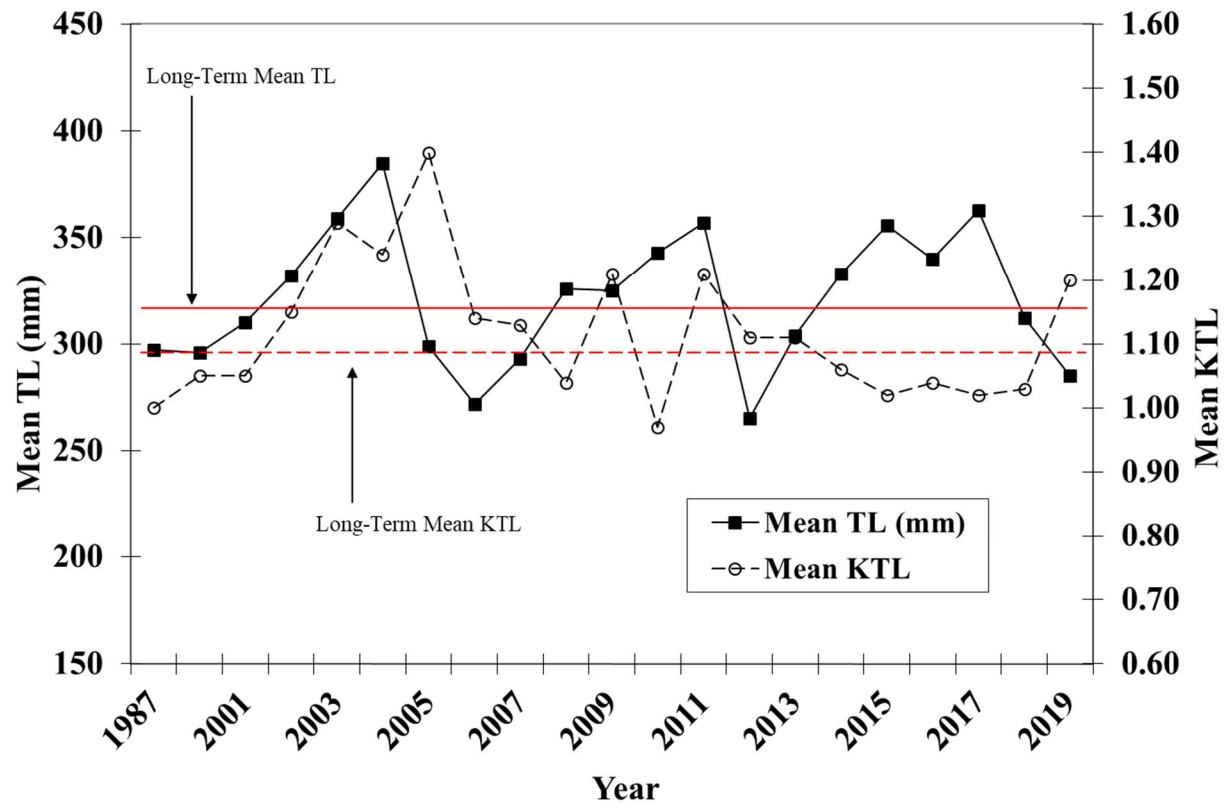


Figure 5. Mean total length (TL) and condition (K_{TL}) of Bonneville cutthroat trout collected during trend net surveys at Manning Meadow Reservoir, 1987-2019.

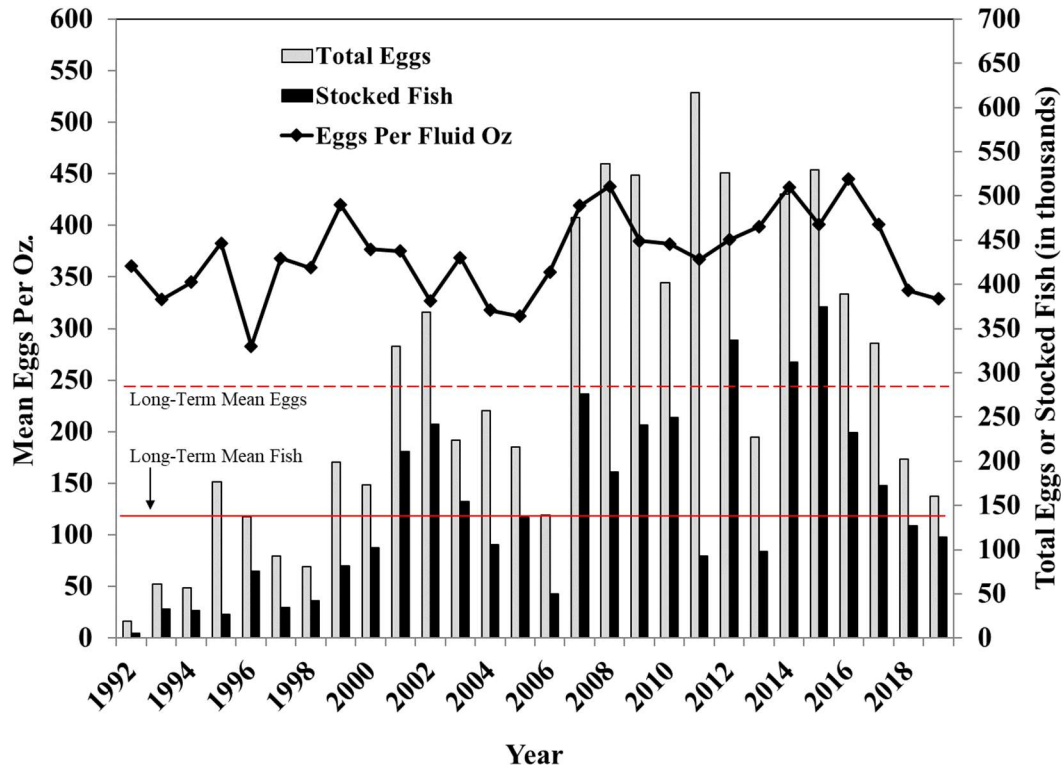


Figure 6. Total number of Bonneville cutthroat trout eggs collected during the brood operation at Manning Meadow Reservoir, 1992-2019, as well as measures of eggs per fluid ounce and numbers of fish stocked from the egg collection.

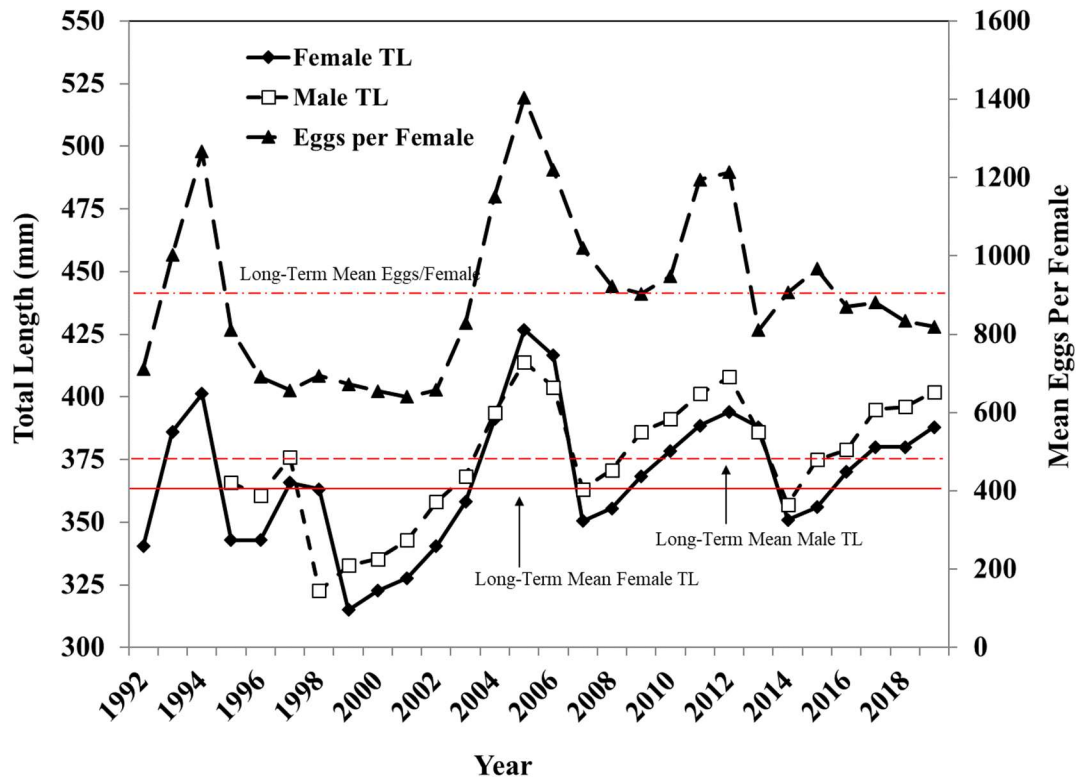


Figure 7. Mean total length (mm) of male and female Bonneville cutthroat trout spawned at Manning Meadow Reservoir, 1992-2019, as well as mean number of eggs collected per female.

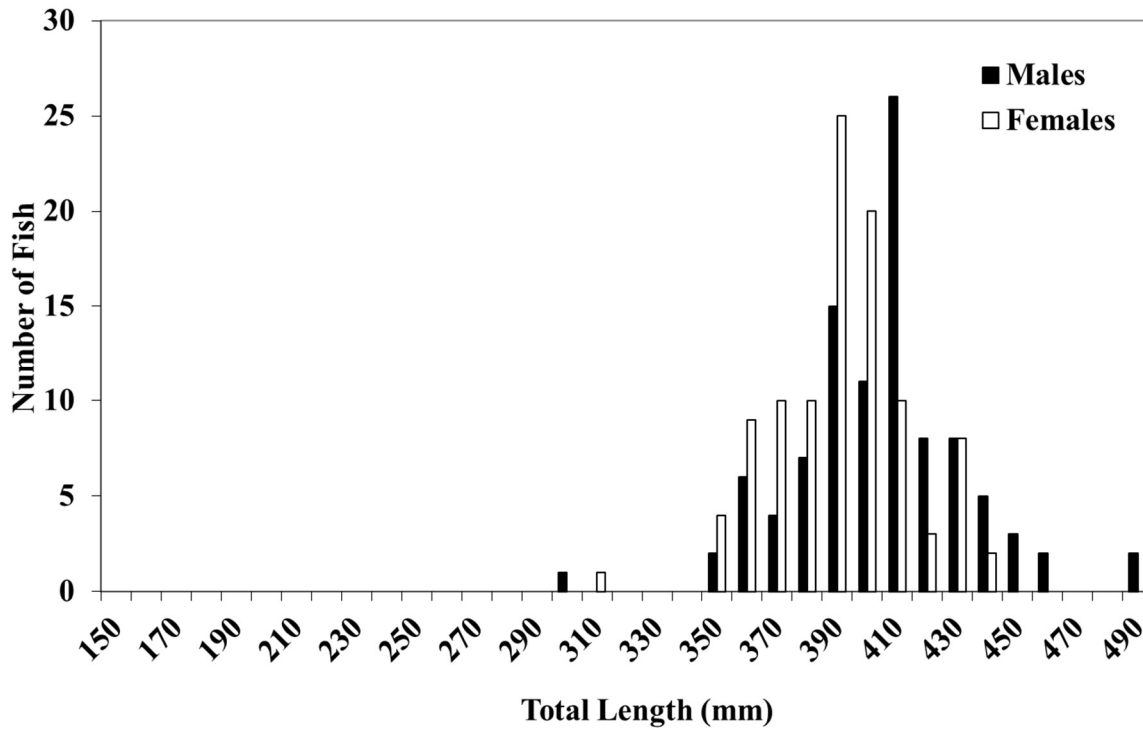


Figure 8. Size distribution of male and female Bonneville cutthroat trout spawned at Manning Meadow Reservoir in 2019.

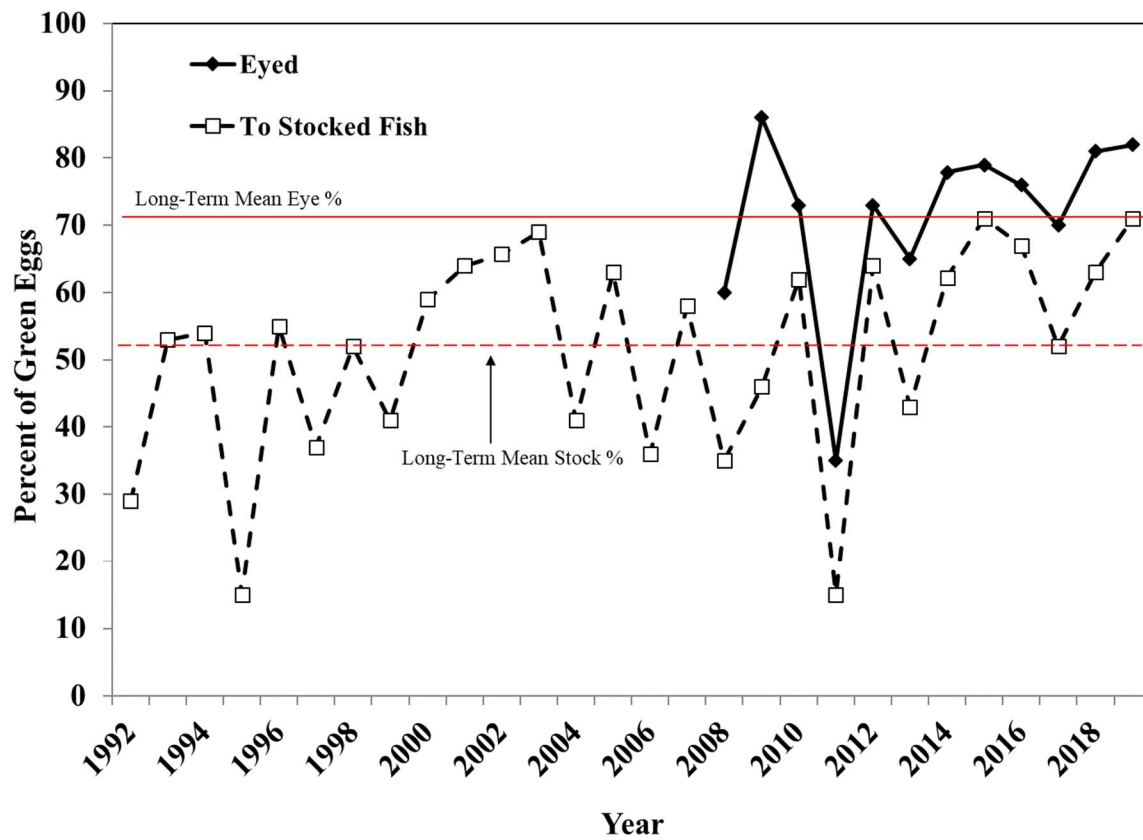


Figure 9. Percent of Bonneville cutthroat trout eggs collected at Manning Meadow Reservoir, 1992-2019, which reached the eye-up and stocking stages. Percentages from 2016 do not include triploid eggs.

Table 1. Total number, as well as size, age, or source of Bonneville cutthroat trout stocked in Manning Meadow Reservoir as brood stock replacement, 1990-2018. Transplants were of various sizes and ages, holdovers were age 1 (5-8 inches mean total length), and fingerlings were age 0 (1.5-2.5 inches mean total length). Holdovers were stocked in June and July. Fingerlings were stocked in September/October.

Year	BCT Stocked		
	Transplants	Holdovers	Fingerling
1990	469	–	–
1991	245	–	–
1992	–	–	–
1993	–	1,995	–
1994	–	1,999	4,648
1995	–	–	6,024
1996	–	–	5,060
1997	–	1,499	8,202
1998	–	2,008	9,506
1999	–	–	12,428
2000	–	–	12,001
2001	–	–	10,729
2002	–	–	–
2003	–	–	20,000
2004	–	–	24,515
2005	–	–	20,017
2006	–	–	15,037
2007	–	–	15,060
2008	–	–	15,651
2009	–	–	15,240
2010	–	–	16,000
2011	–	–	15,000
2012	–	–	16,500
2013	–	–	15,134
2014	–	–	15,088
2015	–	–	15,336
2016	–	–	15,411
2017	–	–	15,520
2018	–	–	16,190

Table 2. Bonneville cutthroat trout spawning times at Manning Meadow Reservoir, Utah 1992-2019.

Year	Trap operation dates		Dates spawned		Number days spawned	Lake water temperature (Fahrenheit)	
	Begin	End	First	Last		First spawn	Last spawn
1992	2 June	30 June	16 June	30 June	3	55	62
1993	21 June	6 July	22 June	6 July	3	62	62
1994	14 June	22 June	16 June	22 June	2	56	60
1995	3 July	11 July	5 July	11 July	2	60	62
1996	24 June	2 July	26 June	2 July	2	58	60
1997	23 June	8 July	25 June	8 July	3	59	62
1998	29 June	13 July	1 July	13 July	3	58	63
1999	18 June	6 July	22 June	6 July	3	58	62
2000	5 June	13 June	6 June	13 June	3	58	59
2001	12 June	20 June	14 June	20 June	2	58	61
2002	7 June	18 June	11 June	18 June	2	58	61
2003	13 June	25 June	18 June	25 June	2	55	57
2004	10 June	23 June	16 June	23 June	2	59	59
2005	18 June	5 July	21 June	5 July	3	53	64
2006	9 June	23 June	13 June	23 June	3	60	64
2007	8 June	19 June	13 June	19 June	2	62	65
2008	18 June	27 June	23 June	27 June	2	60	65
2009	18 June	29 June	22 June	29 June	2	56	64
2010	17 June	29 June	22 June	29 June	2	56	62
2011	5 July	11 July	6 July	11 July	2	60	66
2012	31 May	11 June	5 June	11 June	2	56	54
2013	5 June	21 June	11 June	21 June	3	60	60
2014	10 June	17 June	12 June	17 June	2		
2015	9 June	16 June	10 June	16 June	2	59	
2016	14 June	21 June	16 June	21 June	2		60
2017	13 June	19 June	15 June	19 June	2	54	
2018	12 June	18 June	13 June	18 June	2	64	59
2019	25 June	8 July	2 July	8 July	2		
Means	15 June	26 June	18 June	26 June		58	61

Table 3. Summary of the results from the 2019 trend net survey at Manning Meadow Reservoir.

Water:	Manning Meadow Reservoir	Catalog #:	VI 402												
Date Set:	7/1/2019	Weather:													
Date Pulled:	7/2/2019	Water Temp:													
# Nets:	1 floater, 1 diver	Collectors:	M. Hadley, etc.												
Summary for Sport Fish															
Species	N	Total	fish per	Total Length (mm)			Weight (g)			Condition (Ktl)			% total catch	% total biomass	Age 0 growth (mm/day)
		Weight (kg)	net/night	Mean	SE	Range	Mean	SE	Range	Mean	SE	Range			
Bonn. Cutt. Trout	123	39.70	61.5	285	6.31	158-432	328	20.8	47-918	1.20	0.01	0.67-1.46	100	100	0.39

Table 4. Trend net survey results at Manning Meadow Reservoir, 1987-2019.

Date	Net Sets		Total Trout	Trout per Net-Night	All cutthroat trout		Mean K	Comments
	Flo	Div			Mean TL (mm)	Mean W (g)		
2-Jun-87	2	1	179	60	297	306	1.00	BCT introduced 1990
12-Jun-00	1	1	165	83	296	280	1.05	Quota: 12,000
19-Jun-01	1	1	128	64	310	320	1.05	
10-Jun-02	1	1	118	59	332	427	1.15	
10-Jun-03	1	1	16	8	359	596	1.29	Quota inc to 20,000
15-Jun-04	1	1	13	7	385	709	1.24	
21-Jun-05	1	1	51	26	299	375	1.40	
13-Jun-06	1	1	111	56	272	261	1.14	Quota dec to 15,000
13-Jun-07	1	1	168	84	293	306	1.13	
16-Jun-08	1	1	165	83	326	387	1.04	
22-Jun-09	1	1	84	42	325	448	1.21	
22-Jun-10	1	1	108	54	343	422	0.97	
19-Jul-11	1	1	117	59	357	575	1.21	
5-Jun-12	1	1	123	62	265	251	1.11	
11-Jun-13	1	1	206	103	304	336	1.11	
17-Jun-14	1	1	237	119	333	408	1.06	
16-Jun-15	1	1	148	74	356	476	1.02	
21-Jun-16	1	1	162	81	340	445	1.04	
16-Jun-17	1	1	117	59	363	498	1.02	
13-Jun-18	1	1	168	84	312	375	1.03	
2-Jul-19	1	1	123	62	285	328	1.20	
Long-term mean			63	317	379	1.09		

Table 5. Spawning totals at Manning Meadow Reservoir during 2019.

Date	Lake water temp (F)	Number females spawned	Number males spawned	Total eggs collected	Eggs per ounce	Eggs per female	Percent green eggs eyed
July 2		104	54	92,120	329	886	91%
July 8		92	45	68,432	329	744	69%
Total	–	196	99	160,552	329	819	82%

Table 6. Bonneville cutthroat trout spawning totals at Manning Meadow Reservoir, 1992-2019.

Year	Number of females spawned	Mean length (mm) Female	Mean length (mm) Male	Total eggs	Eggs per fluid ounce	Eggs per female	Number of trout trapped	Percent of green eggs eyed	Percent of green eggs to stocked fish
1992	27	340	–	19,218	361	712			29%
1993	61	386	–	61,148	328	1,002			53%
1994	45	401	–	57,000	345	1,267			54%
1995	218	343	366	176,896	383	811			15%
1996	198	343	361	136,980	283	691	485		55%
1997	141	366	376	92,603	368	657	271		37%
1998	116	363	323	80,514	359	694	330		52%
1999	296	315	333	198,895	420	672	744		41%
2000	265	323	335	173,484	377	655	1,099		59%
2001	516	328	343	330,129	375	640	1,809		64%
2002	560	340	358	368,688	327	658	1,310		98%
2003	270	358	368	223,614	369	828	753		69%
2004	223	391	394	256,984	318	1,152	546		41%
2005	154	427	414	216,438	312	1,405	352		63%
2006	114	417	404	139,104	355	1,220	339		36%
2007	466	351	363	475,488	419	1,020	1,076		58%
2008	540	356	371	536,112	438	923	1,451	60%	35%
2009	580	368	386	523,776	385	903	1,681	86%	46%
2010	338	378	391	402,254	382	948	1,299	73%	62%
2011	516	389	401	616,512	367	1,195	1,166	35%	15%
2012	433	394	408	525,764	386	1,214	1,392	73%	64%
2013	281	388	386	227,534	399	810	867	65%	43%
2014	554	351	357	501,824	437	906		78%	62%
2015	547	356	375	529,160	401	967		79%	71%
2016	447	370	379	389,020	445	870		76%	67%
2017	378	380	395	333,002	401	881		70%	52%
2018	242	380	396	201,936	337	834		81%	63%
2019	196	388	402	160,552	329	819		82%	71%
Means	312	363	375	284,094	372	906	943	71%	52%

