

**TRAPPING, SPAWNING, AND TREND NETTING OF BONNEVILLE CUTTHROAT
TROUT AT MANNING MEADOW RESERVOIR, 2021**

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 (Beaver River drainage) 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 in the Beaver River drainage, as well as Water Canyon and Reservoir Canyon in the Virgin River drainage. Eggs have been collected from spawning BCT at Manning Meadow Reservoir every year since 1992. Fish produced by the brood have been used to establish conservation populations and maintain sport fisheries in southern Utah for 30 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 2021.

For many years, restrictive fishing regulations have been in place at Manning Meadow Reservoir, designed to protect the BCT brood from angling exploitation. Those restrictions include a seasonal fishing closure, tackle restriction (i.e. “artificial only”), harvest limit, and – for many years – a minimum harvest length of 22 inches. 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 had 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 anecdotally effective at increasing angler satisfaction.

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. BCT resulting from the Manning Meadow brood are readily available and abundant each year, but mixing of the “generic” brood genetics is not desired in a conservation population 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. By 2018, there was no noticeable difference in survival and eye-up between diploid and triploid eggs.

Methods

Trend Net Survey

Two experimental gill nets (one floating and one diving) were set in Manning Meadow Reservoir on June 13, 2021, 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 many years of sampling (Figure 1). Fish caught were removed from nets on the morning of June 14 and all fish were measured to the nearest millimeter (total length) and weighed to the nearest gram. Trout body condition was measured by the calculation of Fulton’s K_{TL} (generated from total length [TL]):

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

Trapping and Egg Take

Spawning BCT were collected from Manning Meadow Reservoir in 2021 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 (DWR) personnel or other government agency volunteers visited the site daily while the inflow trap was in operation.

Eggs were collected from trapped BCT on June 8 and 14, 2021. Trapping was supervised by Glenwood Hatchery personnel, while spawning was conducted by personnel from Egan 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 June 14. 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. All eggs collected on June 14 were made triploid. The eyed eggs were later moved to the Glenwood Hatchery for hatching and rearing. All BCT were stocked as fingerlings in fall 2021.

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. 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 aquatic invasive species as per DWR protocols.

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

Results and Discussion

Trend Net Survey

191 BCT were collected in two nets at Manning Meadow Reservoir on June 14, 2021, for an overall catch rate of 96 trout per net-night (Table 3). This was the highest catch observed since the harvest limit was increased in 2016 (Fig. 3). While BCT catch rate has been lower in recent years than the extremely high catches observed in 2013 and 2014, netting rate remains relatively high. The 2021 BCT catch spanned at least three cohorts, with a significant contribution from larger cohorts, presumably three-years-old and older (Fig. 4). This pattern followed that observed in 2020, when age-2 and -3 fish (stocked in 2017 and 2018) were markedly abundant. BCT averaged 322 mm in total length (TL), 402 g in weight, with an average condition (K_{TL}) of 1.10 (Table 3). All of these values were slightly higher than long-term means (Table 4). Length and weight were markedly higher than those observed during the previous two years, while condition was lower than high values measured in 2019 and 2020 (Fig. 5). Increases in mean length and weight can be attributed to the continued maturing of abundant 2017 and 2018 cohorts.

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), except during 2019 when a record snowpack and late spring thaw delayed the operation by two weeks. Since 2014, the first egg

take has generally 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 has usually been completed in only one week's time during 2014-2021, saving both time and effort.

Results from the 2021 Manning Meadow egg take are summarized in Table 5. The number of eggs collected has decreased since 2015 as stocking needs have decreased and efforts have been made to avoid collecting a large excess of eggs (Fig. 6). Currently, annual fluctuations in the numbers of eggs collected are dictated by the changing needs of restoration projects for both diploid and triploid BCT. Anticipated needs for triploid BCT stocking in the Mammoth Creek drainage increased the 2021 egg take (284,460) to almost equal to the long-term mean. The number of eggs per fluid ounce was similar in 2021 to the long-term mean (Table 7). Mean length of male and female BCT spawned in 2021 were higher than long-term means, while the mean number of eggs per female was the highest observed since 2012 (Fig. 7). Male and female BCT spawned had similar size distributions in 2021, though males were slightly larger on average (Fig. 8).

The percentage of green BCT eggs successfully eyed up in 2021 (85%) nearly matched the highest level observed at the Manning Meadow brood (Table 7). Eye-up percentage for just diploid BCT was even higher, however, at 94% (Table 5). Unlike what was observed in 2018, the last year that eggs were made triploid, triploid eggs in 2021 showed a much lower eye-up percentage, at 55%. These differences in survival persisted through rearing (diploid: 71% eyed eggs to stocked fish; triploid: 55%). The proportion of green eggs successfully converted to stocked fish in 2021 was higher than the long-term mean (Fig. 9), but survival of just diploid BCT (67%) would have been closer the highest observed in the last ten years. A total of 144,452 diploid BCT fingerlings was stocked in 19 waters in fall 2021, while 20,518 triploid BCT were stocked in four waters. In addition to regular sport fish stocking quotas, 31,000 diploid BCT were stocked throughout the Mammoth Creek drainage in an effort to restore BCT. Another 32,000 diploids were stocked in Fish Creek (Clear Creek drainage) following a rotenone treatment to remove rainbow trout and hybridized BCT. 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 Manning Meadow 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. The liberalization of the harvest limit has not yielded any significant effect on the BCT population or the availability of sufficient spawners during egg takes. In fact, netting results in 2020 and 2021 indicate that the population could potentially sustain more harvest. However, these high catch rates are likely bolstered by high survival of the 2017 and 2018 cohorts. BCT abundance has remained relatively high since 2015, with occasional, single-year decreases below the long-term mean (Fig. 3). This pattern appears to be dictated by survival of individual cohorts and, although five of the last seven years have experienced a high survival of BCT, further changes to the stocking quota or harvest limit are not recommended at this time. Satisfying angling interests at

Manning Meadow Reservoir through both improved fish quality and harvest opportunity are essential to building public support for native cutthroat trout conservation, so such interests should be carefully considered in tandem with the brood operation in the management of the Manning Meadow Reservoir fishery. Conducting a creel survey would provide additional data for evaluating angler use, harvest, and satisfaction.

Pathogen testing in 2020 detected *Myxobolus cerebralis*, the parasite that causes whirling disease, for the first time in BCT collected at Manning Meadow Reservoir. The spawning protocol already in use for years at Manning Meadow employs precautions to minimize the threat of pathogen movement and will continue to be followed carefully into the future. Because BCT brood are replaced through annual stocking 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. Conduct an angler (i.e. creel) survey during July-September 2022. 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. Evaluate survival and growth of stocked triploid BCT when possible.
6. Take precautions to minimize the threat of whirling disease spread from Manning Meadow Reservoir.

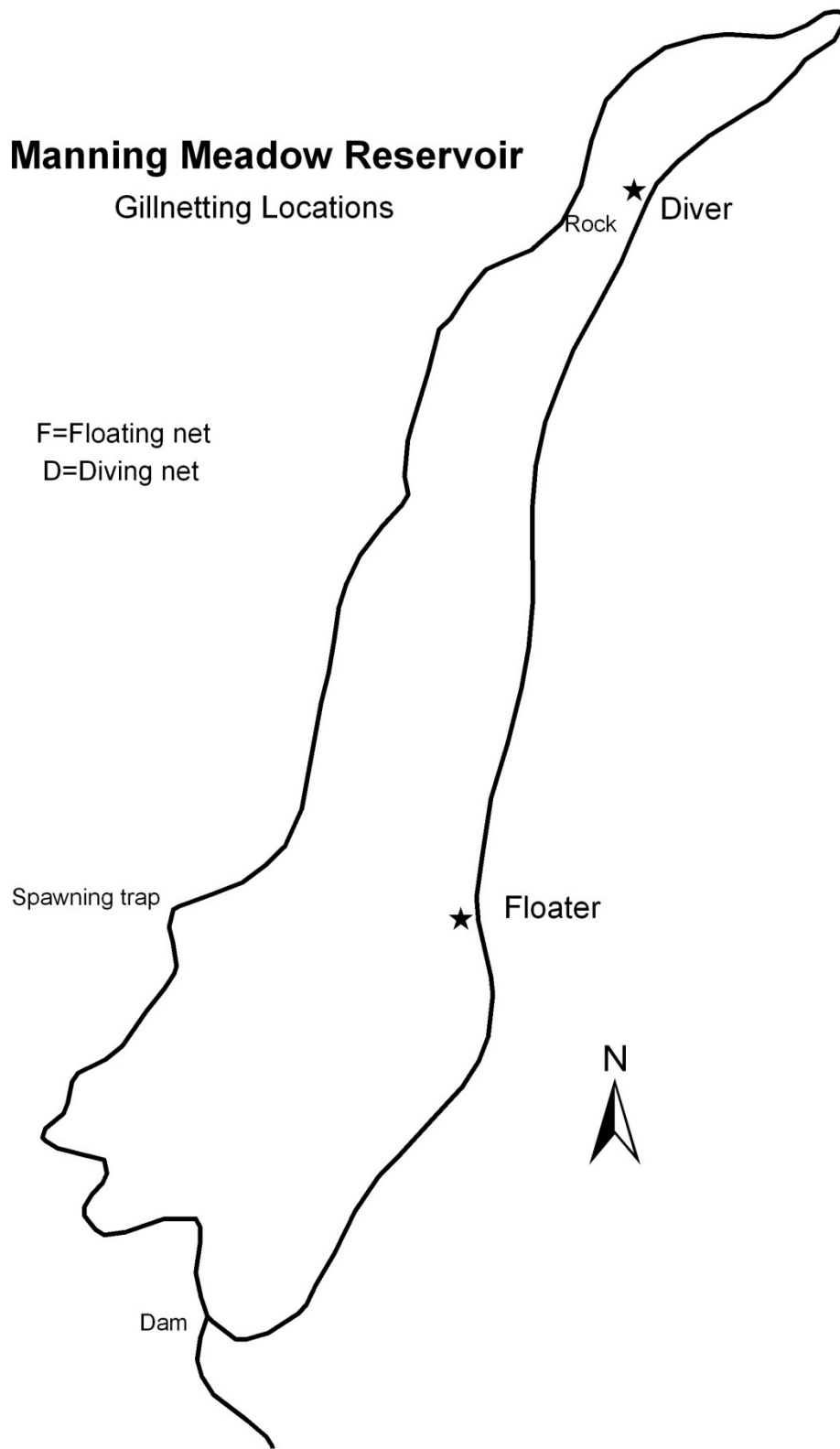


Figure 1. Locations of gill nets set at Manning Meadow Reservoir during trend net surveys.



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

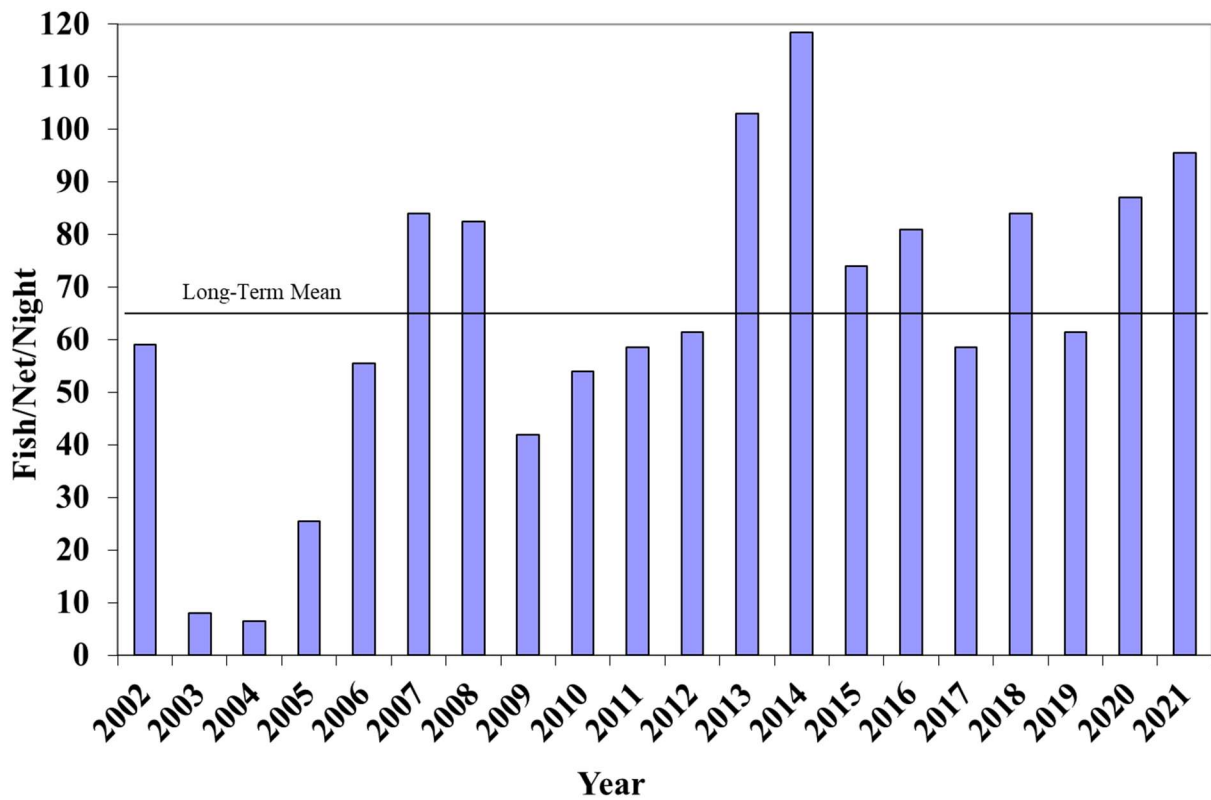


Figure 3. Cutthroat trout catch rate during trend net surveys at Manning Meadow Reservoir, 2002-2021.

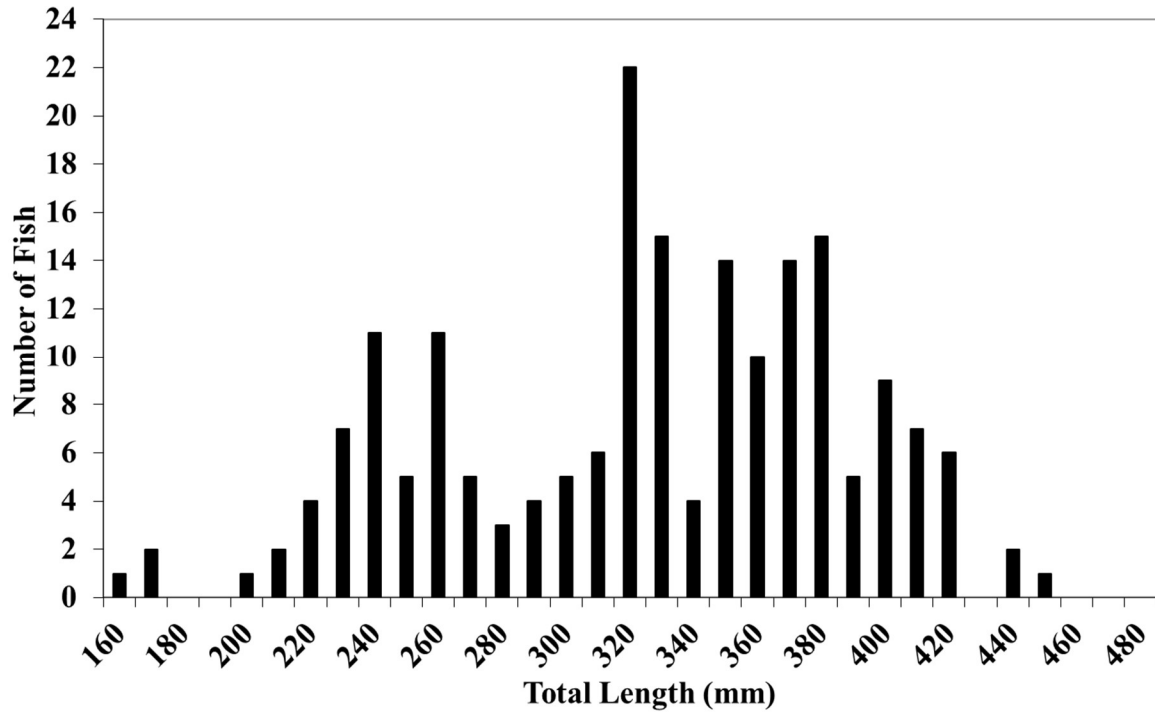


Figure 4. Length distribution of Bonneville cutthroat trout collected during the trend net survey at Manning Meadow Reservoir on June 14, 2021.

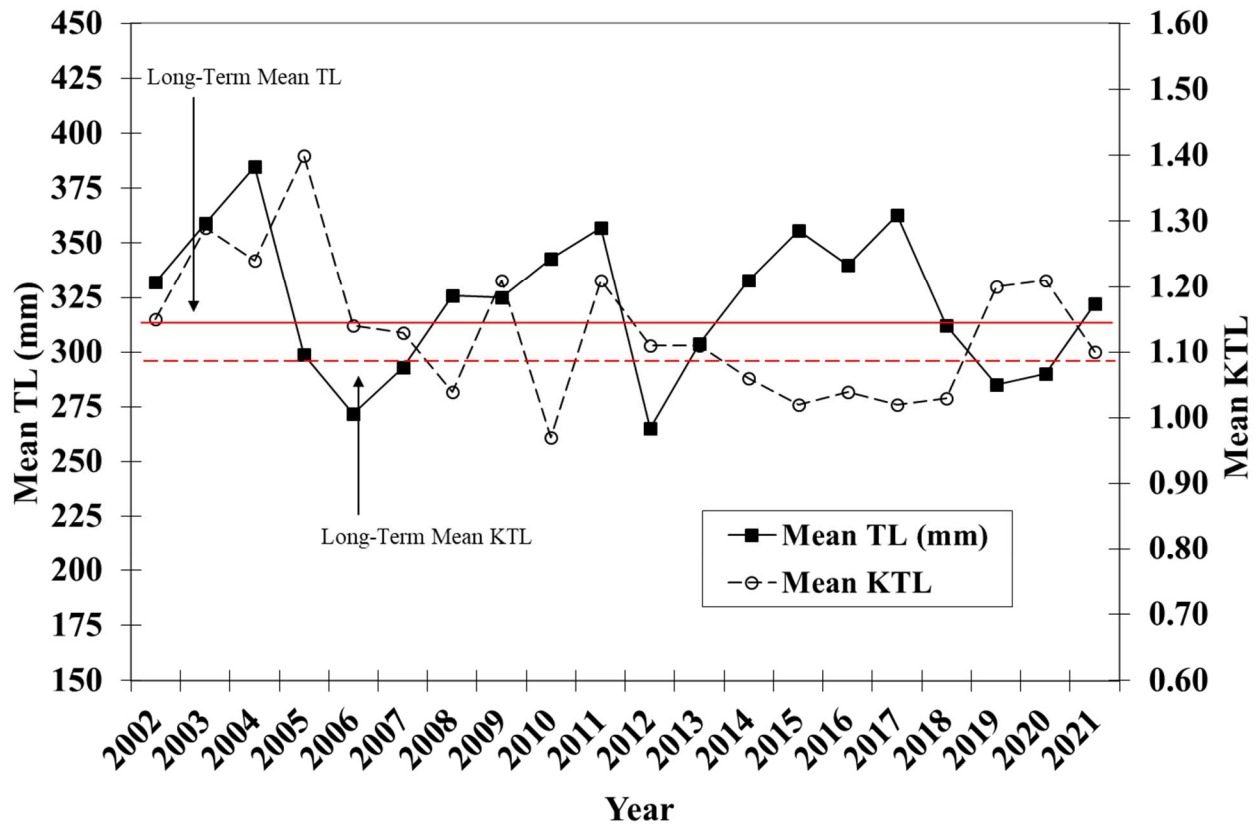


Figure 5. Mean total length (TL) and condition (K_{TL}) of Bonneville cutthroat trout collected during trend net surveys at Manning Meadow Reservoir, 2002-2021.

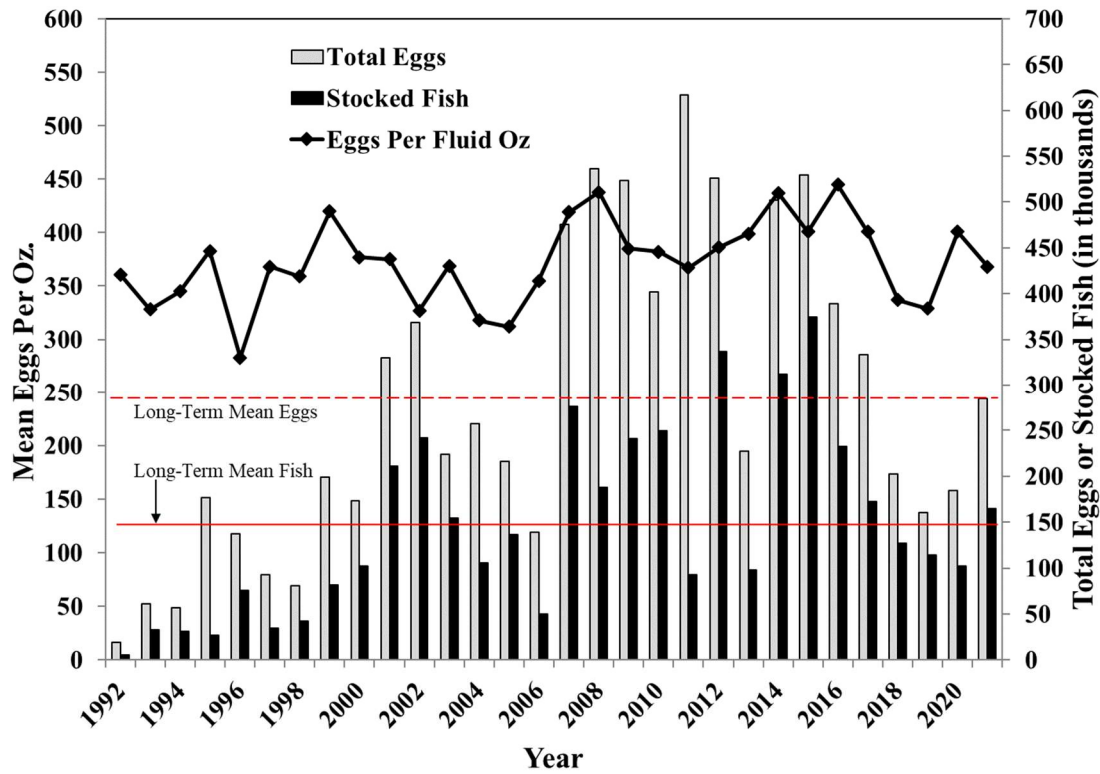


Figure 6. Total number of Bonneville cutthroat trout eggs collected during the brood operation at Manning Meadow Reservoir, 1992-2021, as well as measures of eggs per fluid ounce and numbers of fish stocked from the egg collection.

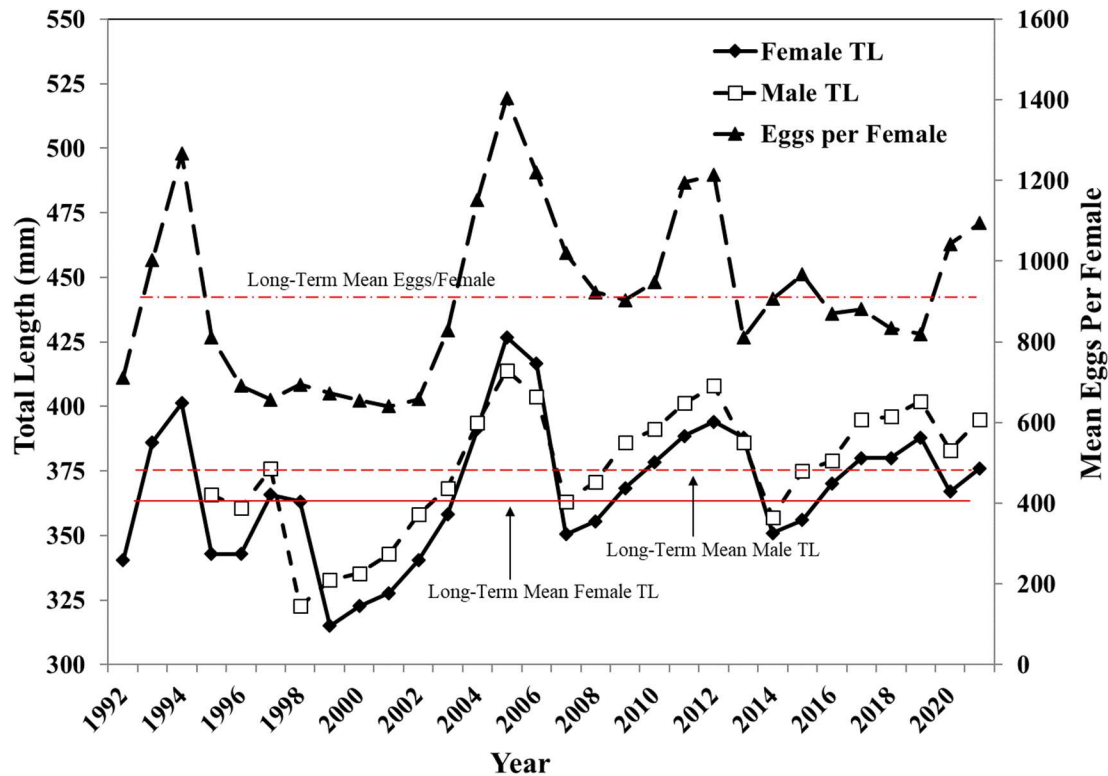


Figure 7. Mean total length (mm) of male and female Bonneville cutthroat trout spawned at Manning Meadow Reservoir, 1992-2021, as well as mean number of eggs collected per female.

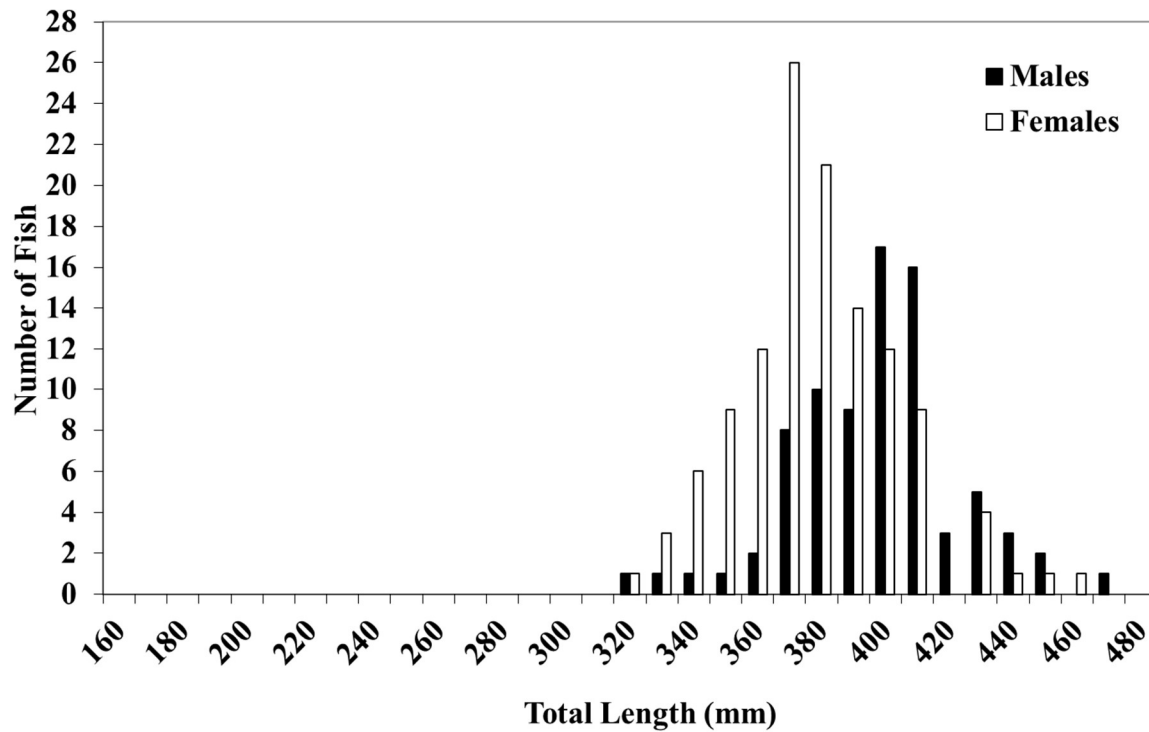


Figure 8. Size distribution of male and female Bonneville cutthroat trout spawned at Manning Meadow Reservoir in 2021.

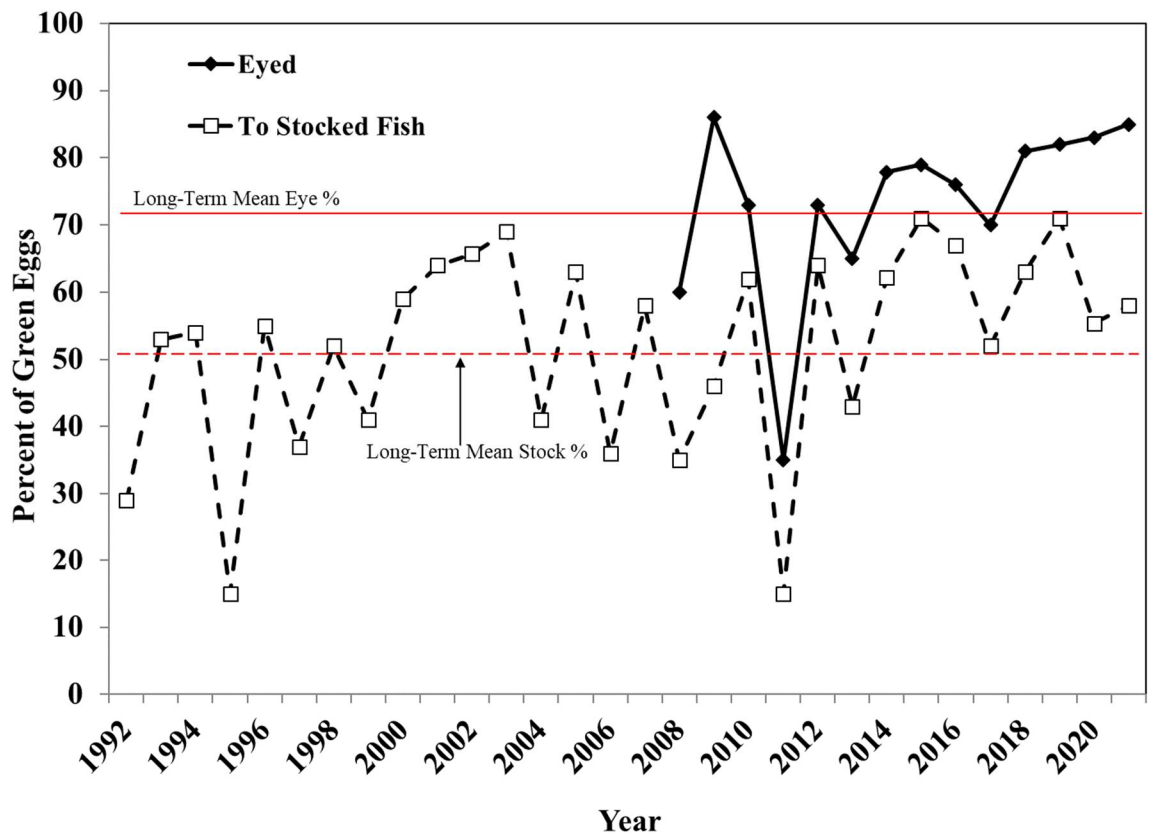


Figure 9. Percent of Bonneville cutthroat trout eggs collected at Manning Meadow Reservoir, 1992-2021, which reached the eye-up and stocking stages.

Table 1. Total number, as well as size, age, or source of Bonneville cutthroat trout stocked in Manning Meadow Reservoir as brood stock replacement, 1990-2020. 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			Year	BCT Stocked
	Transplants	Holdovers	Fingerling		Fingerling
1990	469	–	–	2006	15,037
1991	245	–	–	2007	15,060
1992	–	–	–	2008	15,651
1993	–	1,995	–	2009	15,240
1994	–	1,999	4,648	2010	16,000
1995	–	–	6,024	2011	15,000
1996	–	–	5,060	2012	16,500
1997	–	1,499	8,202	2013	15,134
1998	–	2,008	9,506	2014	15,088
1999	–	–	12,428	2015	15,336
2000	–	–	12,001	2016	15,411
2001	–	–	10,729	2017	15,520
2002	–	–	–	2018	16,190
2003	–	–	20,000	2019	19,622 ^a
2004	–	–	24,515	2020	17,820
2005	–	–	20,017		

^a – BCT were smaller than normal at time of stocking due to a late spawn, so the quota was increased in case of reduced survival.

Table 2. Bonneville cutthroat trout spawning times at Manning Meadow Reservoir, 1992-2021.

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		
2020	12 June	16 June	16 June	16 June	1		
2021	7 June	14 June	8 June	14 June	2	54	56
Mean	14 June	25 June	18 June	26 June		58	61

Table 3. Summary of the results from the 2021 trend net survey at Manning Meadow Reservoir.

Water:	Manning Meadow Reservoir	Catalog #:	VI 402												
Date Set:	6/13/2021	Weather:													
Date Pulled:	6/14/2021	Water Temp:	56 F												
# 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	191	76.86	95.50	322	4.46	160-450	402	14.7	40-1003	1.10	0.01	0.84-1.36	100	100	0.41

Table 4. Trend net survey results at Manning Meadow Reservoir, 1987-2021.

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	Harvest limit increased
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	
16-Jun-20	1	1	174	87	290	328	1.21	
14-Jun-21	1	1	191	96	322	402	1.10	
Long-term mean				66	316	378	1.09	

Table 5. Spawning totals at Manning Meadow Reservoir during 2021.

Date	Lake water temp (F)	Number females spawned	Number males spawned	Total eggs collected	Eggs per ounce	Eggs per female	Percent green eggs eyed
June 8	54	200	100	216,348	363	1,082	94
June 14	56	60	31	68,112	387	1,135	55 ^a
Total	–	260	131	284,460	368	1,094	85

^a – All eggs collected on June 14 were made triploid.

Table 6. Bonneville cutthroat trout spawning totals at Manning Meadow Reservoir, 1992-2021.

Year	Number of females spawned	Mean length (mm) Female	Mean length (mm) Male	Total eggs	Eggs per fluid ounce	Eggs per female	% green eggs eyed	% green eggs to stocked
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		55%
1997	141	366	376	92,603	368	657		37%
1998	116	363	323	80,514	359	694		52%
1999	296	315	333	198,895	420	672		41%
2000	265	323	335	173,484	377	655		59%
2001	516	328	343	330,129	375	640		64%
2002	560	340	358	368,688	327	658		98%
2003	270	358	368	223,614	369	828		69%
2004	223	391	394	256,984	318	1,152		41%
2005	154	427	414	216,438	312	1,405		63%
2006	114	417	404	139,104	355	1,220		36%
2007	466	351	363	475,488	419	1,020		58%
2008	540	356	371	536,112	438	923	60%	35%
2009	580	368	386	523,776	385	903	86%	46%
2010	338	378	391	402,254	382	948	73%	62%
2011	516	389	401	616,512	367	1,195	35%	15%
2012	433	394	408	525,764	386	1,214	73%	64%
2013	281	388	386	227,534	399	810	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%
2020	177	367	383	184,460	401	1,042	83%	55%
2021	200	376	395	284,460	368	1,094	85%	58%
Means	305	363	376	280,785	373	916	73%	52%