# COLORADO RIVER CUTTHROAT TROUT SPAWNING OPERATIONS AT DOUGHERTY BASIN LAKE IN 2021

***A Sport Fish and Native Cutthroat Trout Restoration Project***

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## INTRODUCTION

A wild brood stock of Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) (CRCT) was developed as a cooperative effort between the Utah Division of Wildlife Resources (DWR) and Dixie National Forest at Dougherty Basin Lake in the late 1990s. Dougherty Basin Lake covers 3.7 acres at an elevation of 9,720 ft (2,963 m) and is located on the southwest slope of Boulder Mountain (Figure 1). Access is gained by a 0.75-mile foot trail from Barker Reservoir at the end of the North Creek Road. The inlet spring is about 0.25 mile upstream from the lake and rarely exceeds a temperature of 46° F (8° C) during the year. The outlet from Dougherty Basin flows for about 0.25 mile before entering Tall Four Reservoir (0.67 acres) and then from Tall Four into a sink hole. The two lakes are thus isolated from other systems containing wild trout. Springs below Tall Four originate from the sink hole and flow into other headwater lakes, eventually becoming part of North Creek, an Escalante River tributary. The canals feeding Dougherty Basin Lake and Tall Four Reservoir were constructed prior to 1960 and are maintained by DWR to provide stable water levels in the lakes for fish habitat. The brood population has been maintained with annual stocking of 1,000 CRCT in Dougherty Basin Lake (Table 1) and 100 CRCT in Tall Four Reservoir.

The brood project began in 1997-99 when wild CRCT were transplanted to Dougherty Basin Lake from the east and west forks of Boulder Creek. (Approximately 80% of the original transplanted fish came from the east fork.) Both Boulder Creek and Dougherty Basin Lake are located in the Escalante River drainage, where remnant CRCT were first discovered in the mid-1980s (Behnke 1992). By 2013, a total of seven remnant populations of native cutthroat trout had been found throughout this drainage (Hepworth et al. 2001, Hadley et al. 2008, Hadley et al. 2014). The CRCT brood stock is part of a native trout conservation program outlined in cooperative agreements (CRCT Conservation Team 2020) and strategies (CRCT Coordination Team 2020, Utah CRCT Team 2020). The Dougherty Basin brood was originally intended to provide a source of fish to establish new CRCT conservation populations and augment flat-water sport fisheries associated with those populations. In addition, it was hoped that enough CRCT could be produced to increase sport fishing opportunities for native trout within the historic range of CRCT in the Lower Colorado River Geographic Management Unit (GMU).

Eggs have been collected from CRCT in Dougherty Basin Lake since 1999. Annual production of the brood has ranged from less than 2,000 to nearly 20,000 fish stocked out in the Southern Region. In an effort to produce additional eggs, a brood was also established at Kolob Reservoir and spawning was conducted there from 2010 to 2014. Egg-take logistics were difficult and variable at Kolob, however, leading to returns much lower than what was anticipated and the brood operation was abandoned. Also beginning in 2014, improvements made to the trap at Duck Fork Reservoir in the Southeastern Region (Lower Green River GMU) allowed for the collection of an excess of CRCT eggs. The resulting fry were offered to help fill sport fish quotas in the Southern Region. For the first time, all cutthroat sport fish needs in the Colorado River drainage in the region were filled by CRCT. Previously, shortages were met by excess Bonneville cutthroat trout produced at Manning Meadow Reservoir. A new sport fish management plan developed for Boulder Mountain lakes in 2014 recommended that only CRCT be stocked in Colorado River basin waters (Boulder Mountain Sport Fish Advisory Committee 2014). The stocking of CRCT from Duck Fork was instrumental in addressing all of these concerns and has provided more than 50% of the total CRCT stocking in the southern region during most years since 2014.

A spawning protocol developed in 2018 identifies the purpose of the progeny from egg

takes at Dougherty Basin under five scenarios:

- **Scenario 1: Wild broodstock are used to produce sport fish (attached to conservation populations)**
    - These fish are considered conservation because the waters they are stocked in are connected to streams with conservation populations and the stocked fish could intermix with those conservation populations.
    - Currently constitutes approximately 26% of egg production needs.
- **Scenario 2: Wild broodstock are used to produce sport fish (separate from conservations populations)**
    - These fish are not used for conservation purposes.
    - These lakes are not connected to current CRCT stream populations and may be stocked with CRCT from other brood sources outside the GMU (eg. Duck Fork).
    - This scenario comprises 71% of typical annual CRCT quotas.
- **Scenario 3: Wild broodstock are used in Fish Restoration Projects**
    - The goal is to produce fish for repopulating or restoring conservation populations.
    - Requirements for this scenario are short-term and irregular, though they may comprise a significant portion of any year's brood production. In addition, transfer of adult CRCT from remnant stream populations is combined with brood production to ensure genetic diversity in newly restored conservation stream populations.
- **Scenario 4: Wild broodstock are used to develop captive brood program**
    - The goal is to produce fish to be used for hatchery propagation, future restoration projects, and sport fish stocking purposes (scenarios 1-3).
- **Scenario 5: Wild broodstock maintenance**
    - The goal is to produce fish to be used to replace fish in the wild broodstock at Dougherty Basin Lake and Tall Four Reservoir (3% of total brood requests).

Egg take prioritization is identified as follows:

- 20,000 eggs collected for Scenarios 1, 3, and 5.
- 2,000-3,000 eggs collected for Scenario 4.
- All additional egg production collected for Scenario 2

For many years, CRCT eggs collected at Dougherty Basin have experienced fluctuating levels of survival through eye-up, hatching, and rearing. Inbreeding stress caused by years of collecting eggs from small groups of fish – compounded by an original founding by less than 300 individuals – was identified as a potential factor contributing to poor egg survival by staff at the Fisheries Experiment Station (FES) (Wagner and Oplinger 2012). They recommended that gametes be collected from single-mated pairings (ie. one female to one male) at brood locations where less than 200 fish were spawned in a given year. This practice was implemented at Dougherty Basin from 2015 to 2017. Beginning in 2018, a modified factorial spawn design was prescribed, where eggs from five females are pooled, mixed, then split into five equal lots, which are then fertilized by five individual males. In addition to altering fertilization strategy, CRCT from remnant populations not previously represented in the brood – primarily Pine Creek – have been periodically introduced to Dougherty Basin since 2014 (Table 1). These wild fish have contributed gametes to egg take operations during most of those years and have likely increased the genetic diversity of the brood satisfactorily.

Improvements to fish collection and handling at the trap, egg collection and transport, and infrastructure at the Fountain Green isolation facility have generally improved eyeing success for Dougherty Basin eggs in recent years. Eyeing rate fell to less than 50% in 2017, 2018, and 2020 however. It is presumed that logistical issues during egg collection contributed to the poor rates in 2017 and 2018, since eye-up percentage varied between egg takes and specific problems were identified during those takes (Hadley 2017, 2018). The potential causes of poor egg survival varied from delayed fertilization, to physical damage during mixing, to dripping water on the eggs before fertilization. Implementation of the factorial spawn likely contributed to poor survival as trap personnel tried to adjust to the new design, but failed to maintain all conditions necessary for favorable egg survival. Efforts to address these identified issues at the trap yielded improved eye-up again in 2019. Eyeing percentage dropped below 50% again in 2020, though no causative factor for the decrease could be determined.

For many years, Dougherty Basin CRCT fry repeatedly experienced high rates of mortality during rearing due to encephalitis (inflammation in and around the brain). Previous spawning reports discussed in detail factors that may have contributed to these outbreaks (Hadley 2020). Because there is no direct treatment for encephalitis, mitigation has focused on reducing stress during outbreaks and ensuring that water temperatures remain at or below 55° F (13° C) as much as possible. Thanks to these mitigation efforts and infrastructure improvement, Fountain Green Hatchery achieved improved rearing success from 2018 to 2020, with 57-77% of eyed eggs reaching stocking. These were the highest rearing rates observed since they started raising Dougherty Basin CRCT in 2013.

Captive brood development dictated that a portion of eyed eggs was shipped to FES each year from 2018 to 2020 for quarantine during testing for bacterial kidney disease (BKD). Installation of a water chilling system there improved egg survival over extremely poor returns of the 2016 and 2017 cohorts. However, rearing success was still much lower than that at Fountain Green, with 23-25% of eyed eggs surviving until they could be transferred to Mammoth Creek Hatchery during the subsequent spring. Improvements in infrastructure (i.e. water chiller) and protocol (feed conversion) yielded increased hatching and rearing success for the 2020 cohort (48%) by fall of that year. Unfortunately, approximately 1,300 of the estimated 1,600+ fry were lost during well maintenance work in January 2021, yielding a total rearing success of only 10%. 322 CRCT were sent to Mammoth Creek Hatchery in late February 2021. After reviewing the incident, as well as the rearing data for the previous years, DWR administrative staff decided that Dougherty Basin CRCT brood needed to be isolated for BKD testing at a facility other than FES. A new isolation facility specifically designed to isolate small lots of fish was built at Fountain Green Hatchery in summer 2021. This new facility provided the opportunity to keep Dougherty Basin CRCT at the same installation until delivery to the Mammoth Creek Hatchery in spring 2022.

While CRCT eggs and fry have experienced improving trends in eye-up and rearing survival, brood production has been limited by reduced CRCT brooder catch during trapping – and, therefore, reduced egg take – since 2017. Record high trapping catches from 2014 to 2016 yielded the only egg collection totals (60,000-75,000) in the history of the brood that could have reasonably fulfilled all requested stocking quotas for southern Utah. Variabilities in egg and fry survival, however, yielded a final stocking production that was not much greater than any other of the best years at Dougherty Basin. While egg and fry survival improved in the ensuing years, catch results dropped precipitously. Continual adjustments to trapping strategy and techniques were made to improve catch success, but these yielded only temporary and minor increases. It is not entirely clear why so many more adult CRCT were trapped during 2014 to 2017. All trapping

methods caught more fish during those years, indicating that CRCT may have simply been more abundant and are experiencing lower survival since that time. While overall catch has decreased, catch and contribution of wild Pine Creek CRCT has maintained, indicating that a decrease in abundance may have resulted from lower survival of CRCT fingerlings after stocking.

One factor that may have contributed to reduced CRCT survival and abundance in Dougherty Basin Lake was the increase in brook trout abundance observed in recent years. For many years, the brook trout population remained at a low density, producing a small number of fish that experienced accelerated growth but didn't exert overt competition pressure on CRCT. Since 2018, however, the number of brook trout caught during the spawning operation has increased and those fish have exhibited poorer body condition and slower growth than what has been generally observed in the past. The increased density and reduced condition and growth suggested that the brook trout population may have increased to a point where it could be having a negative impact on CRCT growth and/or survival.

## METHODS

Fish traps (Fig. 2) were installed on May 24, 2021, in the inlet and outlet at Dougherty Basin Lake, as well as in the inlet at Tall Four Reservoir, to capture out-migrating CRCT. Traps consisted of portable aluminum frames with removable rods spaced 0.5 inches apart. These frames could be adjusted to various stream widths and depths and were set to funnel trout into holding compartments. In addition to the traps, two small fyke nets were set in Dougherty Basin Lake, and one set in Tall Four Reservoir (Fig. 3). These nets were allowed to fish through the entirety of the operation. DWR and/or DNF personnel were stationed at Barker Reservoir (trailhead to Dougherty Basin Lake) for 24 hours per day while traps were in operation. Traps and fyke nets were checked once or twice a day from May 24 through June 7 and fish captured were transported to live cages. CRCT were held in live cages in the lake until they were ready to spawn or until the project ended. Aging holding cages that had consistently allowed escapement during previous years were replaced with larger, more functional cages.

Egg collection was conducted on June 1 and 7, 2021 (Table 2) and was supervised by personnel from the Egan brood station. On spawning dates, all captive fish were sorted and ripe CRCT were spawned using standard state methods. The modified factorial spawning strategy was implemented during both egg takes: eggs were collected from five females on a cloth screen, with ovarian fluid being collected underneath for pathogen testing. The eggs were then gently mixed with a rubber spatula and separated evenly into five bowls. Milt from a single male was filtered across a metal screen to remove feces, then combined with diluent and a single lot of eggs, and allowed to fertilize for 5-10 minutes. Eggs were rinsed with clean hatchery water and water-hardened for one hour, then transported to Fountain Green Fish Hatchery for eyeing. Eggs were treated with an iodine solution prior to loading for transport to Fountain Green and again at the hatchery. Following eye-up, all eggs remained at Fountain Green for hatching and rearing.

Disease certification was completed as required by standard protocol. A total of 60 trout (including CRCT and brook trout) collected during trapping were used in disease testing. Samples of ovarian fluid were taken from all females spawned (samples were combined from groups of five females). All samples were analyzed at FES. The inlet and outlet were also inspected for the presence of aquatic invasive species per UDWR protocols.

## RESULTS & DISCUSSION

Trap and spawn operation dates were slightly earlier in 2021 than what has been typically experienced at Dougherty Basin Lake (Table 2) due to the early melt of a reduced snowpack. Table 3 summarizes results of the spawning operation in 2021. The first spawn on June 1 yielded 64% of the total eggs collected. The total number of CRCT trapped remained low in 2021, while the number of females spawned was the lowest since 2005 (Table 4). Despite these lows, 23,702 eggs were collected in 2021, which was only slightly lower than collection totals in recent years (Fig. 4). The disparity was explained by the mean number of eggs per female, which was among the highest ever observed at Dougherty Basin. Most spawners measured between 260 mm and 380 mm (Fig. 5). A concerted effort to avoid spawning very small, but mature, fish yielded an increase in mean female spawner length (Fig. 6) and likely contributed to the elevated level of mean eggs per female. For the first time since 2008, female CRCT spawned were larger on average than males. Mean female and male length tend to follow similar trends over time and the difference in mean size between sexes has typically been relatively low. Twenty-three CRCT (10 female, 13 male) introduced from Pine Creek contributed gametes to the 2021 egg take (Table 5). Pine Creek fish made up 26% off all female CRCT spawned and 31% of the males, similar to that observed in 2019 and 2020. Pine Creek fish contributed gametes to every lot of eggs.

Eye-up rate for eggs collected during 2021 was 72%, which ranks among the highest values observed during the brood operation (Table 4, Fig. 7). Eye-up rates for each egg take were similar, at 66% and 73% (Table 3). CRCT also experienced exceptional rearing success at Fountain Green Hatchery (Fig. 8), yielding 10,400 fingerlings for stocking in fall 2021, as well as 3,050 held in the new isolation facility for brood quarantine. The combined survival of these groups (80% of eyed eggs converted to "stocked" fish) is the highest measure achieved at Fountain Green and continues a trend of increased success observed since 2018 (Fig. 8). The Duck Fork Trap returned to full operation in 2021, though egg needs in the Southeast Region also increased, leaving only 10,905 fingerling CRCT available for stocking in the Southern Region (Table 6). A total of 21,305 CRCT were stocked in 16 waters, filling only 53% of the requested 2021 quota.

Contribution of "wild" gametes to the brood from Pine Creek CRCT has increased to nearly one third of all spawners in 2021 (Table 5). The genetic diversity provided by these fish will greatly benefit the captive brood program. BYU geneticist Paul Evans (personal comm.) previously stated that even a 5% proportion of wild fish annually could provide enough diversity to avoid a genetic bottle neck. The cohorts from 2018 to 2021 met and surpassed that rough threshold.

A total of 31 brook trout were captured in fyke nets set in Dougherty Basin Lake during the 2021 brood operation, while one was caught in Tall Four Reservoir. While brook trout catch continued to decline from the high observed in 2019 (Table 7), it still remained higher than what was anecdotally caught in years past. As was also the case in 2019 and 2020, most brook trout caught in 2021 appeared to be similar in size, indicating that the increased abundance may have resulted from one very successful cohort. As this cohort continues to age and die off, it is possible that a natural population decline may occur again in the near future. On the other hand, a more abundant pool of adult brook trout may also yield greater overall spawning success and tip the balance in the fishery away from CRCT. Careful documentation of brook trout caught during the spring CRCT trapping should continue, while targeted removal efforts should also be conducted in the fall, when brook trout are more vulnerable to catch.

During the past five years (2017-2021), the Dougherty Basin brood operation has

experienced a high amount of variability in a number of factors that influence egg and fish production, including numbers of female CRCT trapped and spawned, percentage of trapped females that contributed eggs, and number of eggs produced per female (Table 4). Despite all this variability among multiple factors, the total number of eggs produced has been surprisingly consistent, at 23,000 to 26,000 (Fig. 4). Variability has been the only constant during the more than 20 years of operation at Dougherty Basin. Mean CRCT production over that time (less than 9,000 fish) fills only 22% of the annual requested stocking quota and even the best years in 2013 to 2017 did not meet half of the request. Even with improved levels of eye-up and rearing experienced since 2018, the current trend in reduced egg collection keeps final production at less than 35% of what is requested. Such mediocre results, yielded from such a significant investment of time and resources, demonstrate that the Dougherty Basin wild brood will likely never come close to meeting egg needs, and magnify the crucial need to develop an alternative source for CRCT production in southern Utah. The current effort to establish a captive brood at the Mammoth Creek Hatchery holds great potential to meet and exceed those production needs, as evidenced by the success that the Little Dell Bonneville cutthroat trout brood has already experienced there. Other brood groups have not fared so well yet at Mammoth Creek, however, so success in the Dougherty Basin group is not guaranteed. The oldest groups of captive Dougherty Basin CRCT were not quite ready to give eggs in 2021, but the next few years will likely demonstrate whether that brood can achieve conservation and production goals. Regardless of the success of the captive brood, long-term maintenance of the Dougherty Basin brood is highly unfavorable due to its lack of production potential and continually prohibitive operational logistics. Even if the captive brood is successful, a wild brood must be maintained to provide replacement brood fish every two generations or so (see Captive Brood Strategy below). Regional personnel intend to investigate potential alternatives for developing a new wild brood to replace Dougherty Basin, one that will better meet the future needs for replacement brood, or for full production in case the captive brood is less successful than hoped.

It is imperative that regional, aquaculture, and administrative staff continue to work toward improving the success of the Lower Colorado CRCT brood by maintaining communication and exploring all potential avenues for enhancement of protocol, infrastructure, equipment, etc. The ultimate goal of the brood should be to efficiently and consistently meet the needs of both conservation and sport fish stocking in the Lower Colorado GMU. Until that time, the production of the Duck Fork brood has been and will continue to be instrumental in meeting sport fish needs.

## CAPTIVE BROOD STRATEGY

As the development of the captive CRCT brood has continued, administrative and regional staff coordinated to devise a strategy for maintaining the captive brood into the future. The primary concerns that this strategy is intended to address are: 1) to ensure that genetic diversity is maintained, 2) threat of hatchery domestication is reduced, and 3) workload to maintain pathogen testing is not excessive. While the specific schedule of work is still being determined and will depend on the pending success of the captive brood, the strategy will prescribe a cycle where collection of eggs at the wild brood can be suspended for nine years (about two “generations”) at a time. This means that three to four cohorts of CRCT produced by the wild brood would support stocking and brood replacement, followed by three or more cohorts of fish produced by the captive brood. It is felt that this cycle will not yield a significant increase in domestication. Following this cycle, the entire brood would be replaced by spawn

from three or more cohorts at the wild brood. Regional staff has requested that collection at Dougherty Basin continue until after the captive brood begins producing eggs and the combined production exceeds all requested stocking needs.

The captive brood strategy should help to significantly reduce the amount of time and effort employed in trapping fish, collecting eggs, and maintaining pathogen clearance for gamete production. In addition, wild gene infusion will be conducted from another population (ie. Pine Creek, forks of Boulder Creek) to the wild brood each 10 to 12 years to continually ensure genetic diversity. It would be best to schedule this transfer for the year prior to the first collection of the three-year wild brood cycle. As possible and feasible, pathogen clearance for the captive brood, wild brood, and wild gene sources will be scheduled to avoid overlap. The "off" cycle for the wild brood will also provide the opportunity to permanently address the threat of brook trout in Dougherty Basin Lake, and/or explore other opportunities for wild brood development.

## RECOMMENDATIONS FOR BROOD OPERATION

1. Efforts should continue to maintain improved egg and fry survival during every step of brood operation: trapping, spawning, transport, eyeing, and rearing. Full and unimpeded communication among regional, administrative, and hatchery personnel will be critical in ensuring that the best practices are being implemented.
2. Set fyke nets near the beginning of the brood operation and run through the final egg take. Net locations and orientation (floating vs diving) should be altered frequently to avoid depressed catch due to net avoidance and localized depletion. Catch and length data of brook trout should be recorded.
3. Maintain the current stocking rate of 1,000 CRCT at Dougherty Basin and 100 CRCT at Tall Four.
4. Continue use of larger cages for holding trapped CRCT. These cages should be meticulously inspected for holes and repaired. Immature fish, spent females, and excess males may be retained in these larger live cages to prevent recapture. A few well-maintained small cages should also be used to hold brook trout for inclusion in the pathogen sample.
5. Egg-take protocols at Dougherty Basin should be reviewed and modified as necessary to comply with approved statewide protocols and ensure that best methods are employed.
6. During egg take, hold CRCT in oxygenated live wells next to the egg take table to reduce excessive handling and delayed fertilization. Set up a tarp over the table to prevent sun exposure.
7. The canal between Dougherty Basin and Tall Four should be monitored and improved as needed to maintain water level at Tall Four. The sinkhole in Tall Four should also be monitored.
8. Survey brook trout spawning activity in the fall and conduct removal when possible.
9. CRCT from Duck Fork brood production should be stocked only in sport fish waters.
10. Continue coordinated development of the captive Lower Colorado CRCT brood, along with its protocol and strategy.
11. Investigate opportunities to develop a new wild CRCT brood to replace Dougherty Basin.

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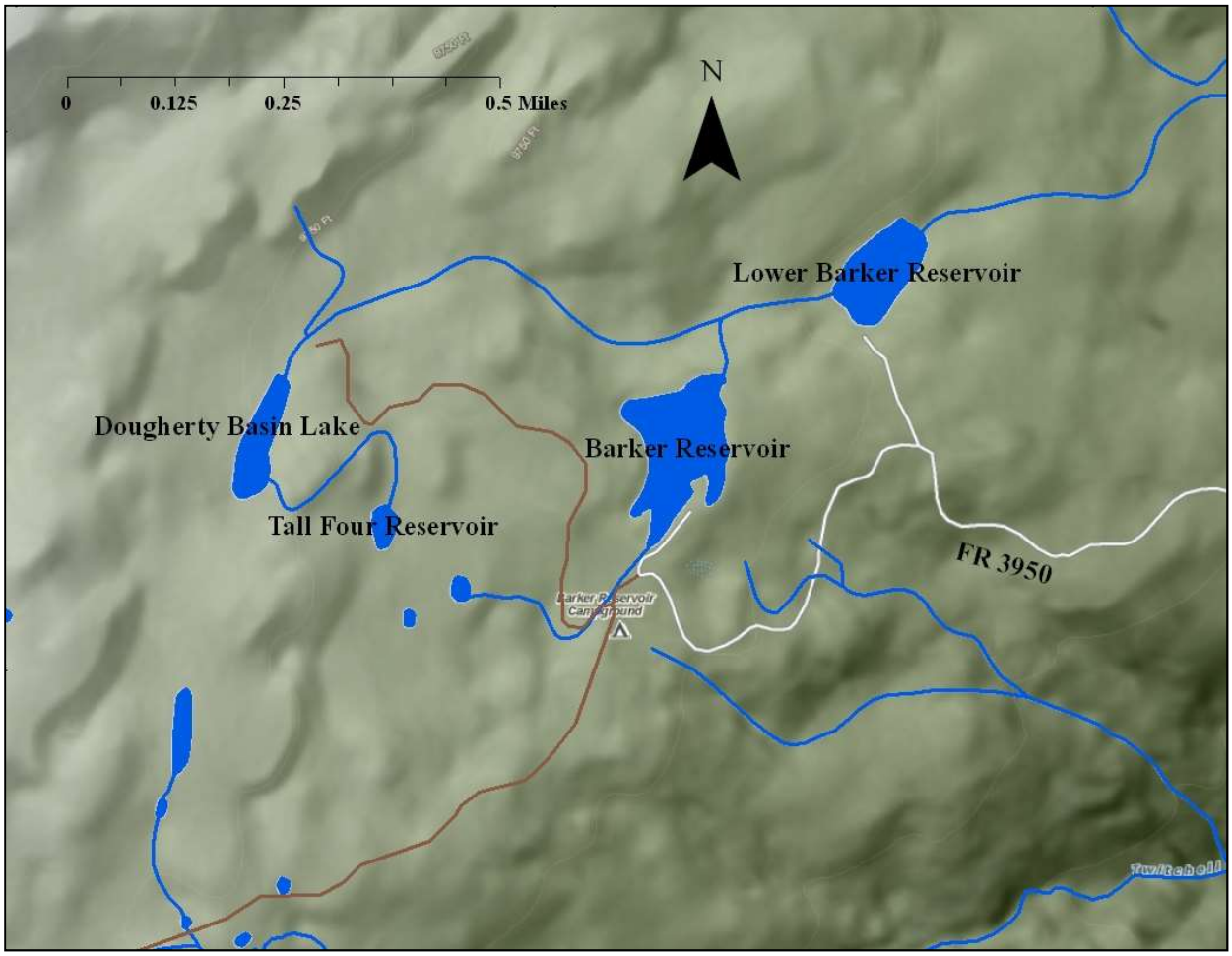


Figure 1. Map of Dougherty Basin Lake, Tall Four Reservoir, and the surrounding area.

Figure 2. Portable fish traps installed in the Dougherty Basin Lake inlet (top) and outlet (bottom).

Figure 3. Fyke net used to collect spawning Colorado River cutthroat trout at Dougherty Basin Lake.

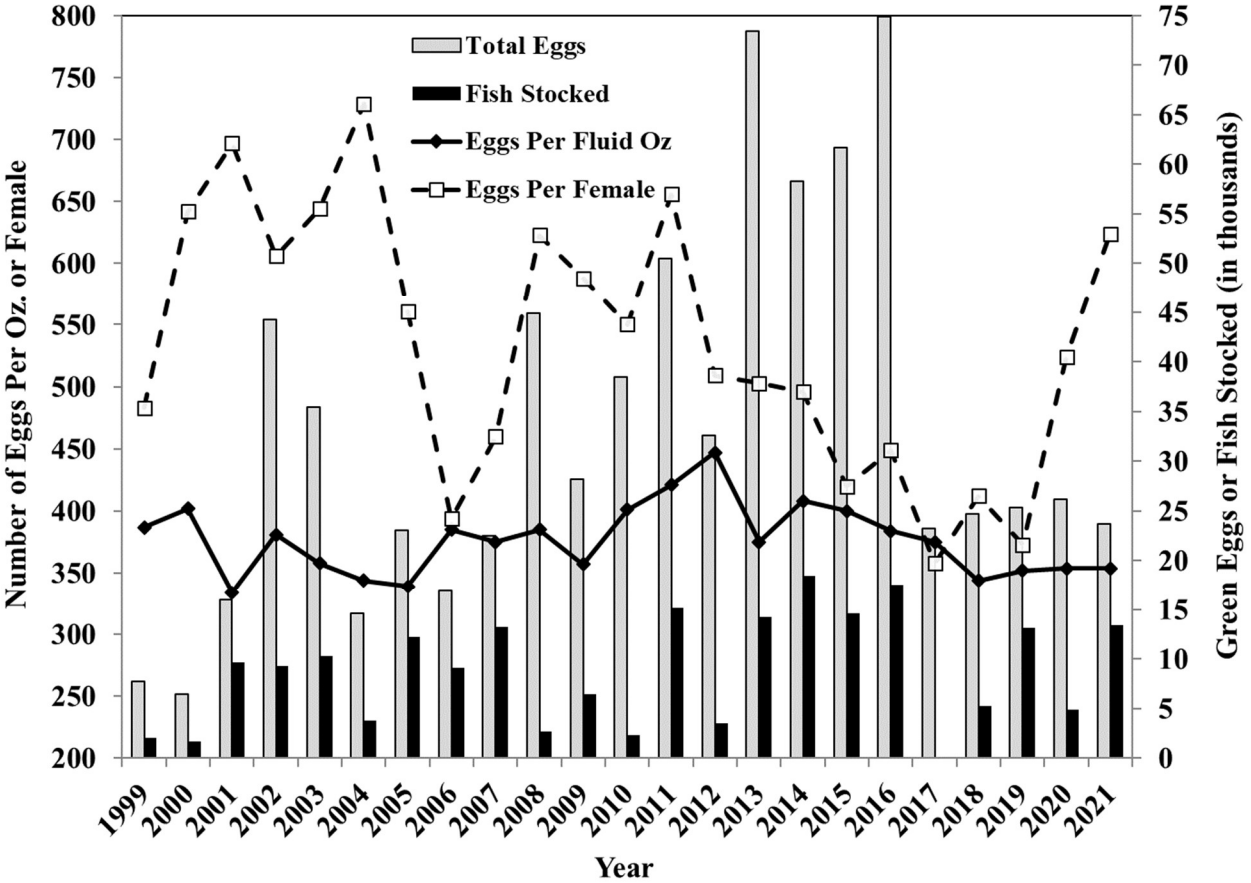


Figure 4. Total number of Colorado River cutthroat trout eggs collected during the brood operation at Dougherty Basin Lake, 1999-2021, as well as measures of eggs per fluid ounce, eggs per female, and numbers of fish stocked from the egg collection.

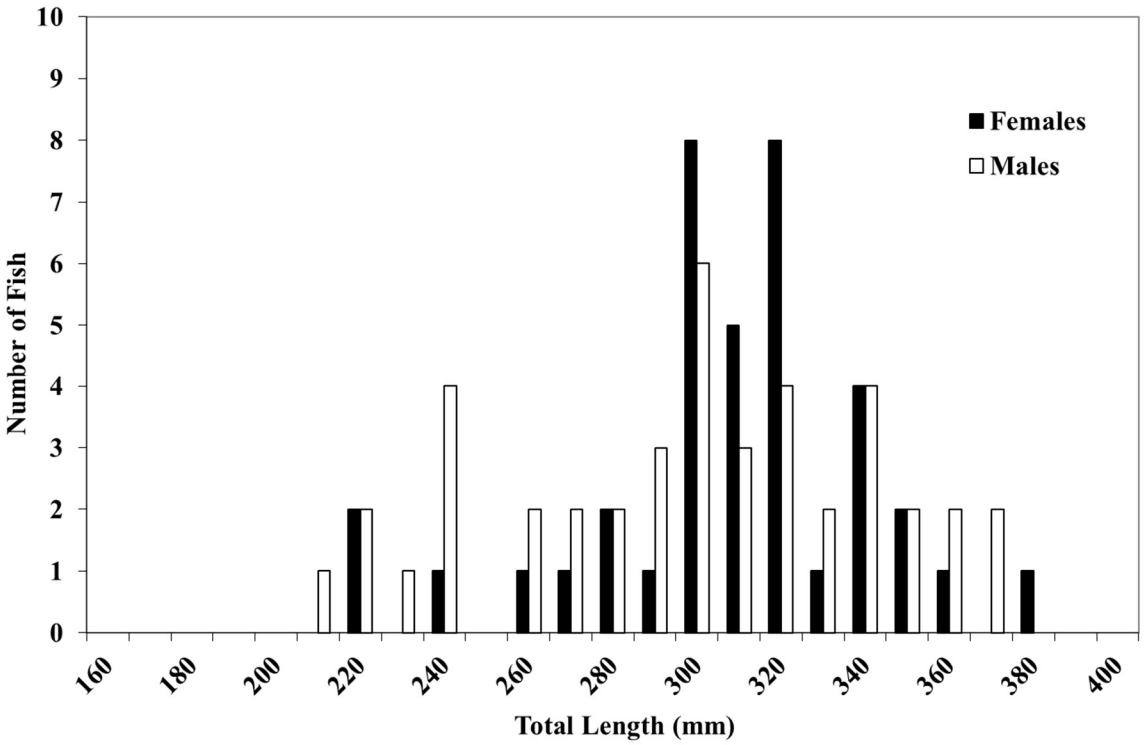


Figure 5. Distribution of total length (mm) of female and male Colorado River cutthroat trout spawned at Dougherty Basin Lake in 2021.

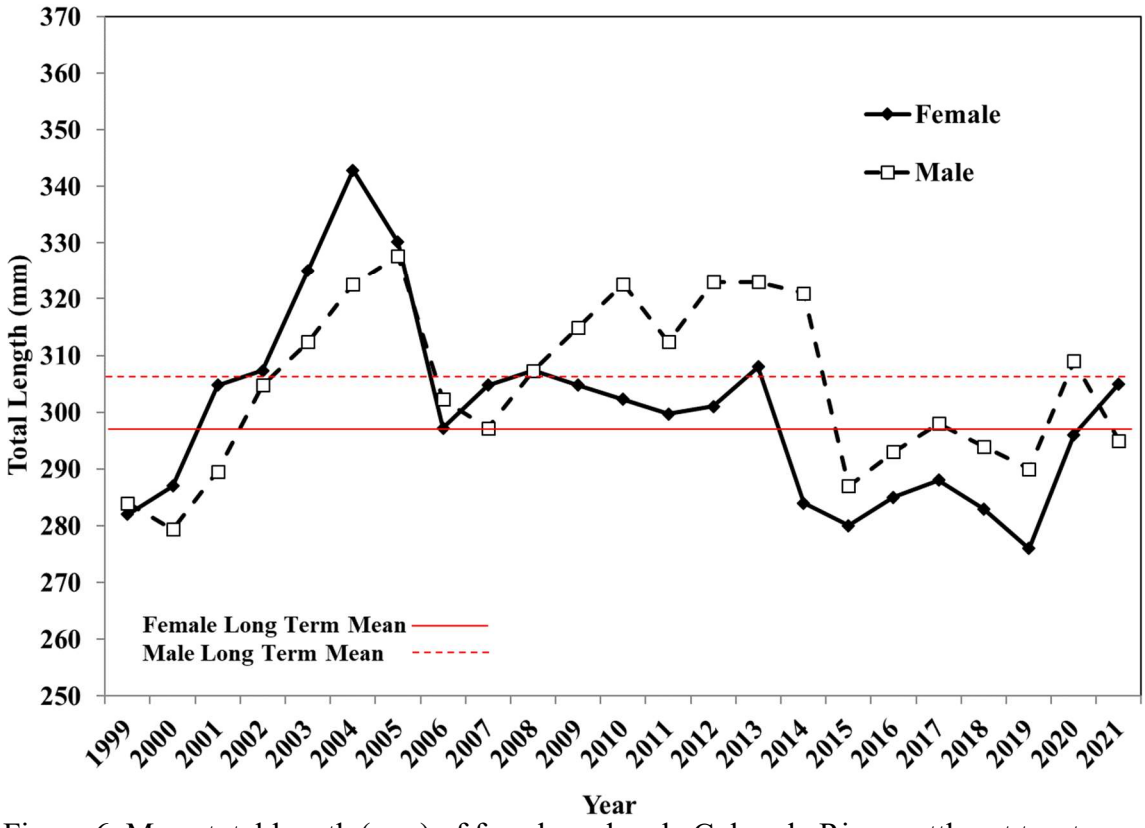


Figure 6. Mean total length (mm) of female and male Colorado River cutthroat trout spawned at Dougherty Basin Lake, 1999-2021.

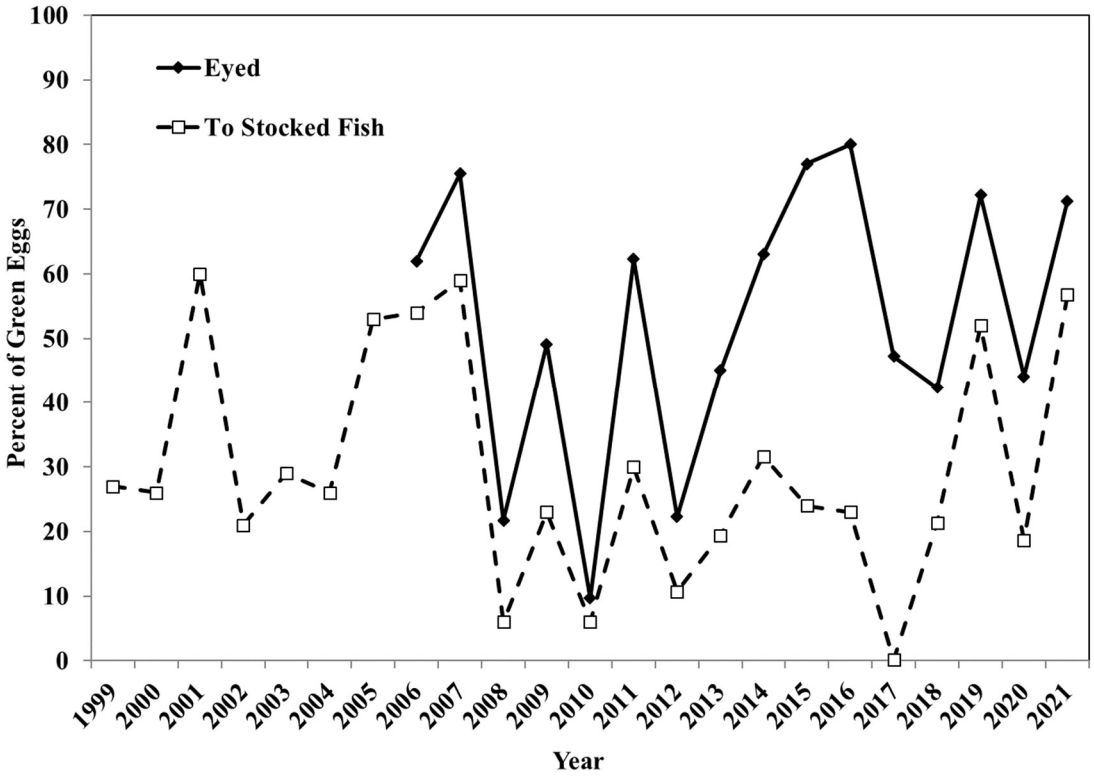


Figure 7. Percent of green eggs collected at Dougherty Basin Lake, 1999-2021, which reached the eye-up and stocking stages.

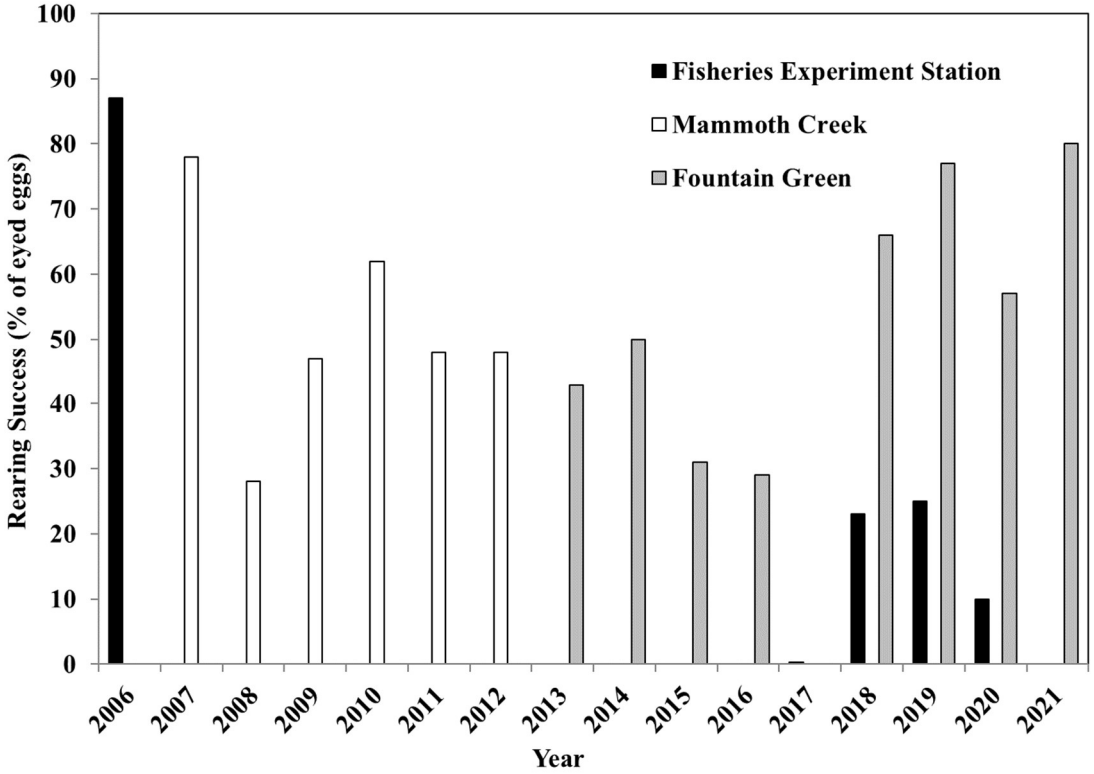


Figure 8. CRCT rearing success (percent of eyed eggs converted to stocked fish) yielded by various hatcheries, 2006-2021. (All eggs were sent to FES in 2017. Fountain Green kept all eggs in 2021.)

Table 1. Total number, size, and/or source of Colorado River cutthroat trout stocked in Dougherty Basin Lake, Utah, as brood stock, 1997-2021. Transplants were of various sizes and ages, holdovers were age 1 (approximately 5-6 inches in mean total length), and fry were age 0 (approximately 2 inches mean total length). Holdovers were stocked in May and fry were stocked in September/October.

| | Number of fish stocked | | |
|---|---|---|---|
| | Transplants | Holdovers | Fry |
| 1997 | 105[1] | -- | -- |
| 1998 | 107[1] | -- | -- |
| 1999 | 45[2] | -- | -- |
| 2000 | -- | 250 | -- |
| 2001 | -- | 350 | 699 |
| 2002 | -- | -- | 226 |
| 2003 | -- | -- | 831 |
| 2004 | -- | -- | 1,032 |
| 2005 | -- | 250 | 1,000 |
| 2006 | -- | -- | 1,000 |
| 2007 | -- | -- | 1,009 |
| 2008 | -- | -- | 1,003 |
| 2009 | -- | -- | 1,002 |
| 2010 | -- | -- | 1,014 |
| 2011 | -- | -- | 1,001 |
| 2012 | -- | -- | 999 |
| 2013 | -- | -- | 1,023 |
| 2014 | 170[3] | -- | 997 |
| 2015 | -- | -- | 1,015 |
| 2016 | -- | -- | 1,045 |
| 2017 | 234[4] | -- | -- |
| 2018 | 115[4] | -- | 1,000 |
| 2019 | -- | -- | 986 |
| 2020 | 171[4] | -- | 987 |
| 2021 | -- | -- | 1,000 |

[1] – Transferred from East Fork Boulder Creek.
[2] – Transferred from West Fork Boulder Creek.
[3] – 120 transferred from Pine Creek (right pelvic clip), 50 from White Creek (left pelvic clip).
[4] – Transferred from Pine Creek (adipose clip).

Table 2. Colorado River cutthroat trout spawning times at Dougherty Basin Lake, Utah 1999-2021.

| Year | Trap operation dates | | Dates spawned | | Number of days spawned | Lake water temp (F) | |
|---|---|---|---|---|---|---|---|
| | Begin | End | First | Last | | First spawn | Last spawn |
| 1999 | 15 June | 23 June | 17 June | 23 June | 2 | 55 | 58 |
| 2000 | 1 June | 12 June | 5 June | 12 June | 2 | 58 | 52 |
| 2001 | 25 May | 13 June | 6 June | 13 June | 2 | 58 | 60 |
| 2002 | 21 May | 12 June | 30 May | 12 June | 3 | 61 | 60 |
| 2003 | 29 May | 24 June | 10 June | 24 June | 3 | 58 | 57 |
| 2004 | 28 May | 22 June | 8 June | 22 June | 3 | 60 | 58 |
| 2005 | 8 June | 28 June | 20 June | 28 June | 3 | 55 | 54 |
| 2006 | 26 May | 14 June | 8 June | 13 June | 2 | 55 | 58 |
| 2007 | 29 May | 12 June | 5 June | 12 June | 2 | 52 | 54 |
| 2008 | 6 June | 17 June | 12 June | 17 June | 2 | 50 | 55 |
| 2009 | 2 June | 16 June | 8 June | 16 June | 3 | 50 | 50 |
| 2010 | 7 June | 14 June | 9 June | 14 June | 2 | 58 | 54 |
| 2011 | 8 June | 20 June | 14 June | 23 June | 3 | 56 | 56 |
| 2012 | 23 May | 4 June | 30 May | 4 June | 2 | 45 | 51 |
| 2013 | 28 May | 10 June | 3 June | 10 June | 2 | 55 | 52 |
| 2014 | 27 May | 9 June | 3 June | 13 June | 3 | 54 | 47 |
| 2015 | 26 May | 11 June | 1 June | 11 June | 4 | 48 | [1] |
| 2016 | 1 June | 13 June | 6 June | 13 June | 2 | 52 | [1] |
| 2017 | 31 May | 12 June | 6 June | 12 June | 2 | 55 | [1] |
| 2018 | 30 May | 11 June | 5 June | 11 June | 2 | 51 | [1] |
| 2019 | 10 June | 1 July | 17 June | 1 July | 3 | 49 | [1] |
| 2020 | 27 May | 15 June | 8 June | 15 June | 2 | [1] | [1] |
| 2021 | 24 May | 7 June | 1 June | 7 June | 2 | 54 | 55 |
| Mean | 30 May | 15 June | 7 June | 15 June | - | 54 | 55 |

[1] – Temperature not recorded.

Table 3. Colorado River cutthroat trout spawning results at Dougherty Basin Lake, Utah, in 2021.

| Date | Lake water temp (F) | Number of females spawned | Mean Female TL (mm) (n) | Mean Male TL (mm) (n) | Total eggs | Eggs per fluid ounce | Mean number of eggs per female | Percent green eggs eyed |
|---|---|---|---|---|---|---|---|---|
| June 1 | 54 | 22 | 316 (22) | 298 (23) | 15,134 | 329 | 688 | 74 |
| June 7 | 55 | 16 | 290 (16) | 292 (19) | 8,568 | 408 | 536 | 67 |
| Total | -- | 38 | 305 (38) | 295 (42) | 23,702 | 354 | 624 | 72 |

Table 4. Colorado River cutthroat trout spawning totals at Dougherty Basin Lake, Utah, 1999-2021.

| Year | Total number of trout trapped | | | | | Number of females trapped | Number of females spawned | Percent of trapped females spawned | Mean length (mm) | | Eggs per fluid ounce | Mean number of eggs per female | Total eggs | Percent green eggs eyed | Percent survival (eggs to stocked fish) | Number of fish stocked |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inlet | Outlet | Fyke nets | Tall Four | Total | | | | Female | Male | | | | | | |
| 1999 | 31 | 11 | -- | -- | 42 | | 16 | | 282 | 284 | 387 | 483 | 7,734 | | 27% | 2,088 |
| 2000 | 12 | 9 | -- | -- | 21 | | 10 | | 287 | 279 | 402 | 642 | 6,428 | | 26% | 1,671 |
| 2001 | 149 | 35 | -- | -- | 184 | | 23 | | 305 | 290 | 334 | 697 | 16,032 | | 60% | 9,619 |
| 2002 | 245 | 52 | -- | 15 | 312 | | 73 | | 307 | 305 | 381 | 606 | 44,258 | | 21% | 9,294 |
| 2003 | 130 | 78 | -- | -- | 208 | | 66 | | 325 | 312 | 358 | 644 | 35,479 | | 29% | 10,289 |
| 2004 | 94 | 50 | -- | -- | 144 | | 20 | | 343 | 323 | 344 | 729 | 14,589 | | 26% | 3,793 |
| 2005 | 46 | 36 | 48 | -- | 130 | | 41 | | 330 | 328 | 339 | 561 | 23,022 | | 53% | 12,202 |
| 2006 | 32 | 68 | 105 | 32 | 237 | | 43 | | 297 | 302 | 385 | 394 | 16,927 | 62% | 54% | 9,141 |
| 2007 | 13 | 23 | 81 | 55 | 172 | | 49 | | 305 | 297 | 375 | 460 | 22,516 | 76% | 59% | 13,284 |
| 2008 | 9 | 22 | 121 | 103 | 255 | | 72 | | 307 | 307 | 385 | 623 | 44,880 | 22% | 6% | 2,693 |
| 2009 | 9 | 30 | 63 | 49 | 151 | | 48 | | 305 | 315 | 357 | 588 | 28,215 | 49% | 23% | 6,489 |
| 2010 | 7 | 6 | 134 | 79 | 226 | | 70 | | 302 | 323 | 401 | 550 | 38,496 | 10% | 6% | 2,310 |
| 2011 | 32 | 31 | 155 | 38 | 256 | | 77 | | 300 | 312 | 421 | 656 | 50,520 | 62% | 30% | 15,156 |
| 2012 | 15 | 37 | 71 | 38 | 239 | 110 | 64 | 58 | 301 | 323 | 447 | 509 | 32,598 | 22% | 11% | 3,488 |
| 2013 | 32 | 31 | 253 | 16 | 332 | 177 | 146 | 82 | 308 | 323 | 375 | 503 | 73,476 | 45% | 19% | 14,254 |
| 2014 | 26 | 27 | 259 | 163 | 475 | 243 | 118 | 49 | 284 | 321 | 408 | 496 | 58,253 | 63% | 32% | 18,500 |
| 2015 | 76 | 59 | 436 | 121 | 692 | 349 | 147 | 42 | 280 | 287 | 400 | 420 | 61,723 | 77% | 24% | 14,600 |
| 2016 | 157 | 85 | 358 | 128 | 728 | 364 | 167 | 46 | 285 | 293 | 384 | 449 | 74,930 | 80% | 23% | 17,559 |
| 2017 | 90 | 34 | 102 | 40 | 266 | 131 | 65 | 50 | 288 | 298 | 375 | 358 | 23,262 | 47% | <1% | 34 |
| 2018 | 15 | 16 | 171 | 56 | 258 | 132 | 60 | 45 | 283 | 294 | 344 | 412 | 24,744 | 42% | 21% | 5,290 |
| 2019 | 24 | 4 | 308 | 43 | 379 | 186 | 68 | 37 | 276 | 290 | 352 | 373 | 25,344 | 72% | 52% | 13,112 |
| 2020 | 12 | 8 | 126 | -- | 146 | 66 | 50 | 76 | 296 | 309 | 354 | 524 | 26,214 | 44% | 19% | 4,894 |
| 2021 | 2 | 14 | 110 | 72 | 198 | 82 | 38 | 46 | 305 | 295 | 354 | 624 | 23,702 | 71% | 57% | 13,450 |
| Means | 55 | 33 | 171 | 66 | 263 | 184 | 67 | 53 | 297 | 306 | 377 | 535 | 33,623 | 53% | 29% | 8,835 |

Table 5. Colorado River cutthroat trout introduced from remnant populations and spawned at Dougherty Basin Lake, 2015-2021.

| Year | White Creek | | Pine Creek | | Total |
|---|---|---|---|---|---|
| | Female (% total) | Male (% total) | Female (% total) | Male (% total) | |
| 2015 | 3 (2%) | 0 | 0 | 1 (0.7%) | 4 |
| 2016 | 0 | 1 (0.7%) | 5 (3%) | 2 (1.4%) | 8 |
| 2017 | 0 | 1 (2.3%) | 1 (1.5%) | 0 | 2 |
| 2018 | 0 | 0 | 6 (10%) | 5 (8.3%) | 11 |
| 2019 | 0 | 0 | 13 (19%) | 20 (31%) | 33 |
| 2020 | 0 | 0 | 10 (20%) | 16 (32%) | 26 |
| 2021 | 0 | 0 | 10 (26%) | 13 (31%) | 23 |
| Total | 3 (<1%) | 2 (<1%) | 45 (8%) | 57 (10%) | 107 |

Table 6. Colorado River cutthroat trout produced at the Duck Fork brood stocked for sport fishing purposes in the Southern Region.

| Year | Number Stocked | Number of Waters | Percent of Total CRCT |
|---|---|---|---|
| 2014 | 23,209 | 5 | 56% |
| 2015 | 16,000 | 3 | 52% |
| 2016 | 26,700 | 7 | 60% |
| 2017 | 29,701 | 9 | 100% |
| 2018 | 28,500 | 7 | 86% |
| 2019 | 29,979 | 10 | 70% |
| 2020 | 0[a] | 0 | -- |
| 2021 | 10,905 | 6 | 45% |
| Mean | 20,593 | 6 | 59% |

[a] – Duck Fork trap not operated in 2020.

Table 7. Numbers of brook trout collected during spawn operations at Dougherty Basin Lake, 2018-2021.

| Year | Brook Trout Captured |
|---|---|
| 2018 | 22[a] |
| 2019 | 53 |
| 2020 | 35 |
| 2021 | 32 |

[a] – Minimum number, as not all captures were recorded.