Shadow Mountain Reservoir

Fishery management report

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Introduction

Shadow Mountain Reservoir (SMR) in Grand County, Colorado is one of the reservoirs in the Colorado-Big Thompson Project and serves as the link between the waters of Lake Granby and Grand lake. SMR has a surface area of 1,337 acres, an average depth of 13 feet and a maximum depth of 37 feet. Due to its shallow depth profile, the lake hosts massive growth of rooted aquatic vegetation over nearly the entire area north of the islands (Figure 1). This vegetation can create difficult conditions for angling in late summer and early fall. Recreational use of SMR is managed by the U.S. Forest Service as part of the Arapaho National Recreation Area. Colorado Parks and Wildlife (CPW) manages the fishery of SMR, as in all public waters of the state. This report summarizes fishery management information for SMR through 2020.

Stocking

From 2014 through 2020, CPW stocked a total of 41,240 pounds of fish, for an annual average of 5,891 pounds (Table 1, below). This quantity of fish cost CPW approximately $282,297 to produce and stock, or an annual average of $40,328.

Some changes in stocking strategies have occurred over this period. Kokanee salmon have historically been stocked in SMR mainly to sustain an artificial spawning run that occurs annually in the fall in the pump canal. This is a popular fishery among local anglers. In 2015 and 2016, statewide shortages of Kokanee necessitated the cutting of Kokanee from the SMR stocking schedule. The 100,000 extra Kokanee stocked in 2018 were surplus fish available that year.

From a habitat perspective, SMR appears to be best suited to host a productive Brown Trout fishery, and this species is currently the main focus of SMR fisheries management. We believe that there is likely adequate natural reproduction and recruitment of Brown Trout in the inlet streams of SMR and Grand Lake (which is connected so that fish can freely move between the two) to support this fishery, but light stocking of Brown Trout has occurred on a roughly biennial basis in order to support and supplement this fishery. We have increased the number of Brown Trout stocked in recent years to attempt to accomplish management goals discussed later in this report.

In 2015 and 2016, we greatly increased the stocking of sub-catchable Rainbow Trout. This stocking density (~100/surface acre) corresponds more closely with that of other nearby reservoirs, and was partly intended to replace apparently unsuccessful Snake River cutthroat, which we last stocked in 2013.

In 2018 we stocked Rainbow-Cutthroat hybrid fingerlings instead of pure Rainbows, and in 2020 we stocked a mix of the two. This was mostly due to availability in the hatchery system, but if these fish appear to be more successful than the traditional pure Rainbow fingerling plants, we will continue to stock hybrids in the future.

Fishery Surveys

We have conducted gillnet surveys of the SMR fishery on seven occasions since 2010. We used a randomized netting protocol which consisted of setting standard experimental 6 x 150' gillnets for exactly six hours apiece in multiple locations around the lake (Figure 1, following page). Nets are set perpendicular to the nearest shoreline.

Table 1. Shadow Mountain Reservoir stocking history, 2014-2020.

	10" Catchable Rainbow	3-5" Fingerling Rainbow	1.5" Kokanee	2" Brown trout	3" Cutbow
2014	11,000	25,000	70,000		
2015	12,000	100,000		10,000	
2016	11,000	136,000			
2017	11,100	135,000	70,200	20,000	
2018	10,700		173,000	30,000	135,600
2019	14,300	138,200	70,300		
2020	14,000	33,700	70,000	47,200	101,800

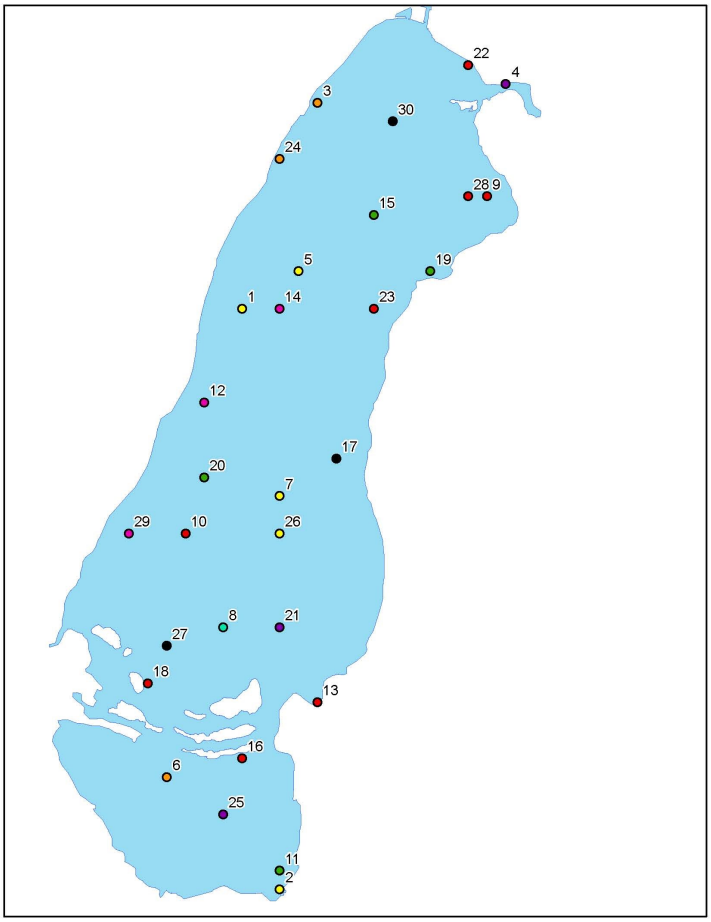

Figure 1. Randomly-selected locations of gillnet sets.

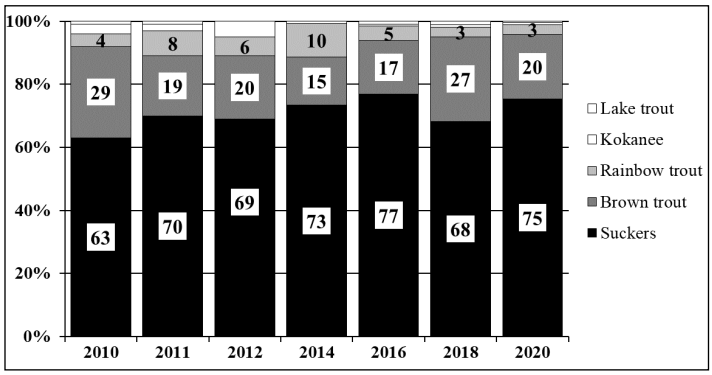

Figure 2. Species composition of catch in gillnet surveys.

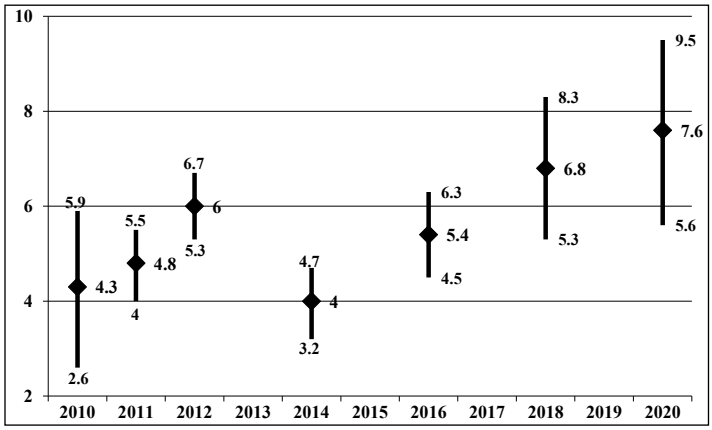

Figure 3. Average Brown Trout catch per net with 80% confidence intervals

2010 was a pilot study year, used to determine if this approach would provide useful information. We set 8 nets that year. Based on the catch rates observed in that year, we determined that 20 net sets would provide us with an acceptable level of precision to monitor the fishery. We proceeded to use 20 sets in all subsequent surveys. The same 20 sites were netted each year. The survey has been conducted near the beginning of June, in order to standardize for possible seasonal variations in fish movement.

The principal challenge to successful fisheries management at SMR is that the lake is overwhelmed with a huge biomass of White Sucker, an undesirable invasive species that does not contribute to the recreational fishery (Figure 2, left). For the sake of comparison, in nearby Lake Granby the percent composition of suckers in gillnet surveys conducted with the same methodology over the same period of time has averaged 14%. Lake Trout and Kokanee combined have never contributed more than 5% to the total catch at SMR. Kokanee are notoriously difficult to capture in gillnets even when they are present in good numbers, while Lake Trout occur only in small numbers in SMR, and they are not well-suited to the habitat there.

These surveys are designed to detect long-term population changes through changes in catch rates. Figures 3 and 4 (below) display catch rates for Brown Trout and suckers for each year. The values are average catch per 6-hour net set, with 80% confidence intervals (CI) displayed. We chose 80% CI's because the variability of this data is relatively high, and this is an acceptable level to inform management-level decision-making as opposed to published research. Over the course of these surveys, sucker catch has averaged 3.6 times the catch rate of Brown Trout. The 2020 survey yielded the highest catch rates to date of both Brown Trout and suckers. The high catch of Brown Trout may be a result of the increased numbers that were stocked in 2017 and 2018. There is no obvious explana-

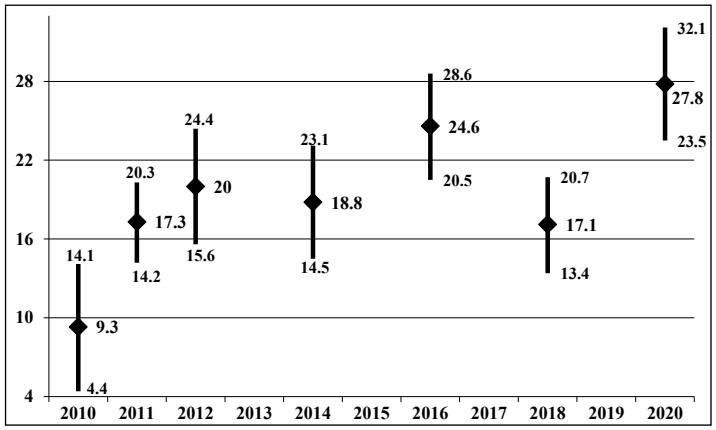

Figure 4. Average sucker catch per net with 80% confidence intervals

tion for the increase in sucker catch.

Figure 5 (right) clearly illustrates the challenge of fisheries management at SMR. Brown Trout can be efficient piscivores and will switch to a predominantly vertebrate prey base when they grow beyond approximately 14 inches, and will prey on other fish up to 2/3 of their body length. Unfortunately, because the size distribution of suckers is very large, in SMR there is very little vertebrate prey available to Brown Trout of this size, and so their growth apparently slows or stops. Brown Trout in SMR are lacking the "first rung on the ladder" to become efficient piscivores.

The reasons for increasing fingerling Rainbow Trout-stocking beginning in 2015 in SMR are twofold: first, we wish to establish higher quality angling opportunity for Rainbow Trout that is beyond simple put-and-take fishing for catchable hatchery fish. Experimenting with various strains of fingerling plants will allow us to determine if there is a specific strain that can thrive in SMR and contribute to the fishery there. Secondly, the presence of a higher density of 3-5" Rainbow fingerlings will provide some of the Brown Trout with the opportunity to switch to piscivory and grow into a size range where they could possibly exploit the sucker population. In 2017 and 2018 we increased Brown Trout stocking (Table 1). Through these two management changes, our goal is to improve the size structure of the Brown Trout so that they ultimately put more predation pressure on the sucker population.

Some hope for this strategy can be seen in the size structure of the White Sucker population. In most years there is an abrupt "jump" in abundance of larger fish, usually in the 12-14" range. For example, in 2012 this jump appeared between 13" and 14"; in 2018 it appeared between 12" and 13". There are far fewer fish appearing in the surveys below this apparent "threshold" size. The fish above that threshold are too large to be preyed upon by Brown Trout. If we can increase the densities and size structure of the Brown Trout population, it may be possible to suppress sucker recruitment to those larger sizes. In turn, overall numbers of suckers should decrease over time as the large, old fish "age out" of the population. This process will take several years to manifest itself because White Sucker are slow-growing and long-lived fish.

In each of the three most recent surveys (2016, 2018, and 2020), we have set a new record for the largest Brown Trout that we have captured in SMR. The 22" fish that we captured in 2020 had a recently-eaten White Sucker in its stomach. The two largest fish in the 2018 survey also had the best body condition of all the Brown Trout that we handled in that survey. These pieces of evidence suggest that although numbers are still low, more Brown Trout are successfully switching to larger prey sizes, which in turn enables their continued growth.

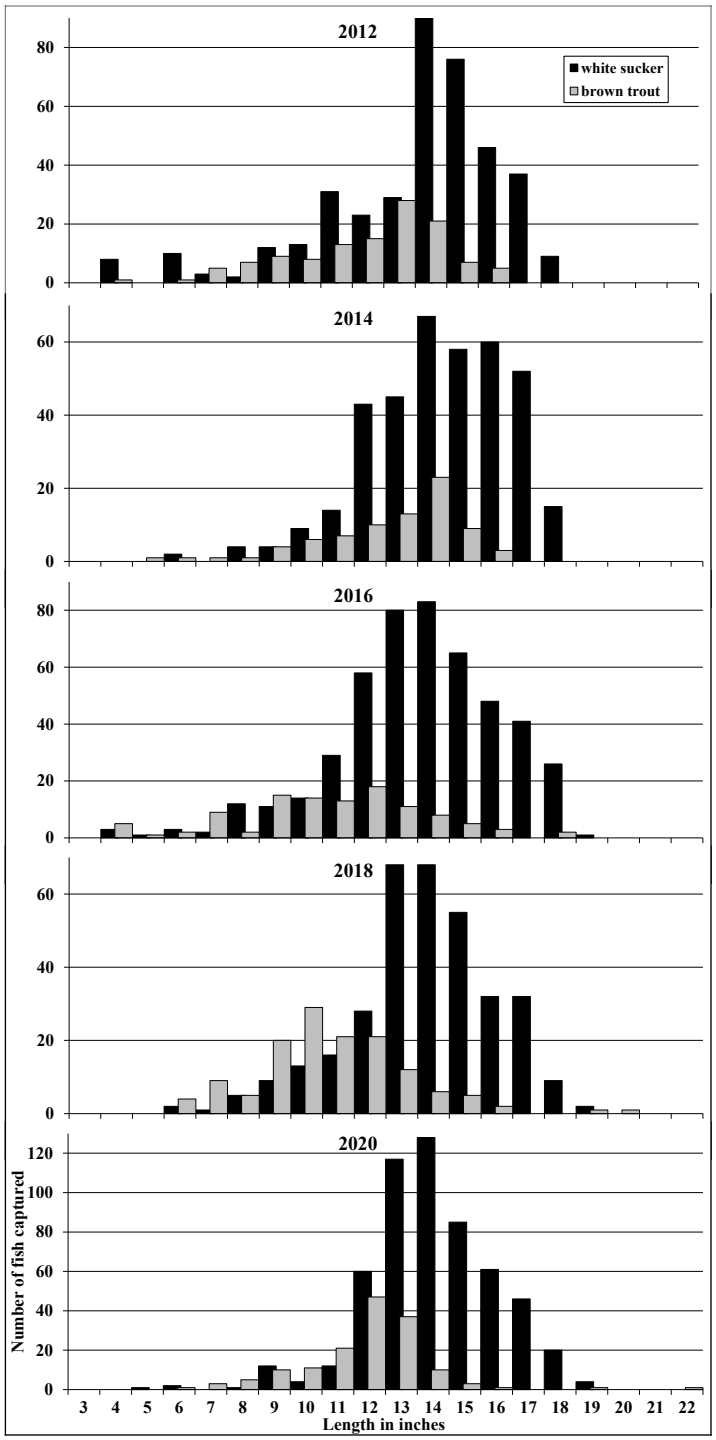

Figure 5. Size distribution of brown trout and white sucker captured in gillnet surveys, 2012-2018

In the fall of 2020, a significant portion of the watershed draining into SMR was burned in the East Troublesome fire. Impacts to the fishery are unknown at the time of this writing, however the information contained herein will provide a good baseline by which to assess impacts in future surveys.