

BRIGHT ANGEL CREEK COMPREHENSIVE BROWN TROUT CONTROL PROJECT
October 18, 2016 – February 7, 2017

SEASON REPORT



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Background

In the Colorado River in Grand Canyon, non-native Brown Trout (BNT; *Salmo trutta*) and Rainbow Trout (RBT; *Oncorhynchus mykiss*) may compete with and selectively prey upon native fishes, including Flannelmouth Sucker (FMS; *Catostomus latipinnis*), Bluehead Sucker (BHS; *Catostomus discobolus*), Speckled Dace (SPD; *Rhinichthys osculus*), and the endangered Humpback Chub (HBC; *Gila cypha*) (see Valdez and Ryel 1995, Gloss and Coggins 2005, Yard et al. 2011, Coggins et al. 2011, Whiting et al. 2014, Spurgeon et al. 2015). Bright Angel Creek, a tributary to the Colorado River, and areas nearby historically supported thriving populations of native fishes, and as recently as the 1970s, Brown Trout, a species native to Europe and Asia, were rare in Bright Angel Creek (Minckley 1978, Otis 1994). Since the 1990s, however, Brown Trout have become a predominant component of the fish community in the creek, and a corresponding decline in native fish such as Speckled Dace has been observed (Otis 1994). Bright Angel Creek is now an important spawning site for Brown Trout, and a large aggregation of Brown Trout is found in the Colorado River near the confluence with Bright Angel Creek (Speas 2002, Makinster et al. 2010).

In an attempt to restore the native fish fauna to Bright Angel Creek, an ambitious program of mechanical removal of nonnative trout has evolved. Current operations under the Bright Angel Creek trout control project were established through the NPS Comprehensive Fisheries Management Plan process (CFMP; NPS 2013), and prior to the completion of the CFMP, operations were guided by the “Bright Angel Creek Trout Reduction Project” Environmental Assessment (EA) and Finding of No Significant Impact (FONSI; NPS 2006) documents. In 2008 and 2011, the U.S. Fish and Wildlife Service issued Final Biological Opinions to the U.S. Bureau of Reclamation (BOR) on the Operation of Glen Canyon Dam, which outlined conservation measures to conduct trout reduction efforts in Bright Angel Creek and establish population redundancy of Humpback Chub in tributary refuges in Grand Canyon National Park (USFWS 2008 and 2011). In partial fulfillment of these measures, with funding provided by the BOR, Grand Canyon National Park re-initiated the Bright Angel Creek Trout Reduction Project in 2010 under the 2006 EA, with the primary goals of restoring and enhancing, to the extent feasible, native fish populations that once flourished in Bright Angel Creek, and to benefit Humpback Chub and other native fishes in the Colorado River (NPS 2006; Omana Smith et al 2012).

From 2010-2012, trout reduction efforts included the installation and operation of a weir and backpack electrofishing the lower 2900 meters of the creek (confluence to Phantom Creek; Omana Smith et al 2012). Beginning in the fall of 2012, removal efforts were expanded to encompass the entire length of Bright Angel Creek (approx. 16 kilometers) and Roaring Springs (approx. 1.5 kilometers). The operation of the weir was also extended from October through February to capture greater temporal variability in the trout spawn (Omana Smith et al 2012; NPS 2013). This report summarizes non-native fish removal and native fish monitoring activities in Bright Angel Creek and Roaring Springs for the 2016-17 season: from October 18th, 2016 through February 7th, 2017.

Project Objectives

The goal of this project is to reduce the abundance of nonnative Brown and Rainbow Trout in the Bright Angel Creek drainage to the maximum possible extent in order to restore the native fish community. This report summarizes the fourth season of intensive removal including the following:

1. Installation and operation of a weir and fish trap during the peak Brown Trout spawning period to intercept spawning trout moving between the Colorado River and Bright Angel Creek.
2. Three-pass depletion backpack electrofishing to remove trout from the entire Bright Angel Creek drainage, with a full-pass each winter season.
3. Monitoring of the Bright Angel Creek fish community response to trout removal by estimating relative abundances and population sizes of native and nonnative fishes.

All trout removed from Bright Angel Creek are prepared and distributed for beneficial use, and crews pursue outreach by sharing project objectives and methods with Phantom Ranch staff and park visitors.

Methods

Weir and fish trap

On October 9st 2016, a modified resistance board weir with an upstream fish trap was installed approximately 170 meters up Bright Angel Creek from its confluence with the Colorado River, and operated continuously through February 27th, 2017. The weir was checked twice daily, once in the morning and once in the evening, throughout this period. The time and date of each check were recorded as well as the water temperature and the operator's name. Handling and data collection for fish captures followed the Standard Operating Procedures of the Weir at Bright Angel Creek (2016a), including release of native fishes above the weir, and humane euthanization of non-native fishes followed by preparation for beneficial use (see below). In captured female trout, the weight of the entire egg mass (grams) and the weight of 100 eggs were recorded to the nearest 0.1 gram, allowing for the gravimetric estimation of the total fecundity of the individual.

Electrofishing

The 2016-17 Bright Angel Creek electrofishing season spanned October 18, 2016 – February 7, 2017, and followed the Bright Angel Creek Trout Reduction Project Standard Operating Procedures (2016b). Nine crew members participated in a three-day training during part of the first week of electrofishing, from October 18-20, 2016. Helicopter support included six long-line supply flights over the course of the season, with the first delivery to Manzanita bunkhouse on October 20, 2016. Electrofishing crews were based at Manzanita until December 15, 2016, when downstream progress allowed for the transition to Phantom Ranch bunkhouse, where crews were based through the rest of the season. Crew size varied from 7-10 personnel, and included both NPS staff and volunteers. Table 1 below summarizes the electrofishing effort in the Bright Angel Creek mainstem (BAC) and tributaries including Angel Springs (ASP), Roaring Springs (RIS),

Transept Creek (TSP), Wall Creek (WAL), and Phantom Creek (PHA). For the first time in the course of this project, teams of three, over two weeks of effort (11/8-11/15 and 11/16-11/22), electrofished upstream to the source along the Angel Springs branch, in overgrown and difficult to access terrain. Additionally, electrofishing passes were performed on the 170 m of BAC between the Colorado River confluence and the weir on three occasions (12/16/2016, 1 pass; 12/22/2016, 2 passes; 2/3/2017, 1 pass).

Table 1. Fishing effort across Bright Angel Creek (BAC) reaches and tributaries for the 2016-17 season. Trout hunts (TH) represent additional electrofishing targeting trout when time allowed in reaches where full 3 pass depletion had been completed. Unsampled reaches denoted by (-).

Stream / Reach	Effort
Roaring Springs	3 pass depletion
Angel Springs	3 pass depletion + TH
Transept Creek	single pass
Wall Creek	single pass
Phantom Creek	-
BAC Reach 5: RS/AS confluence to Transept	3 pass depletion + TH
BAC Reach 4: Transept to Ribbon	3 pass depletion + TH
BAC Reach 3: Ribbon to beaver ponds	3 pass depletion + TH
BAC Reach 2: beaver ponds to Phantom Creek	3 pass depletion
BAC Reach 1: Phantom Creek to Weir	3 pass depletion
BAC Reach -1: Weir to Colorado River	single pass
Ribbon Falls	-*

*Electrofishing in and near Ribbon Falls Creek was discontinued following consultation with Zuni.

All non-native Brown and Rainbow Trout were humanely euthanized and prepared for human consumption or for use at the Zuni aviary (see *Beneficial Use* below), consistent with a Memorandum of Agreement between the National Park Service and State Historic Preservation Office.

Beneficial Use

As determined through consultation with Traditionally Associated Tribes, trout removed from Bright Angel Creek via the weir or electrofishing are prepared and distributed for beneficial use, to the extent possible. Trout >200mm are prepared for human consumption, and trout <200mm are prepared for consumption at the Zuni aviary. All trout removed from Bright Angel Creek are cleaned and either smoked or placed in vacuum sealed bags and frozen until distributed to employees, volunteers, tribes, the general public, and the aviary for consumption.

Results

Weir

For a second consecutive season, trout captures in the weir were exceedingly low: a Brown Trout (12/13/16; 269 mm TL) and a Rainbow Trout (2/3/17; 368 mm TL), both ripe females. A single

Speckled Dace was the only native fish captured; unusually, no Flannelmouth or Bluehead Suckers entered the weir trap this season. Electrofishing between the weir and the confluence produced 15 Brown (153-451 mm TL; only two were >400 mm TL) and 24 Rainbow Trout (155-439 mm TL; only five were >400 mm TL). Of these, seven Browns (four females and three males) and 17 Rainbows (two females, 15 males) were ripe, suggesting that avoidance of the weir and trap may account for diminished trout captures, and that a reserve of potential spawners would still exploit the absence of a weir to run upstream. These observations justify continued operation of the weir and potentially increased electrofishing passes between the weir and the confluence, in order to disrupt any spawning that may be taking place in the short section of creek downstream of the weir by trout that are unable to move further upstream.

Electrofishing

Once again this season, total captures of Brown Trout (n=4902) have declined to the lowest level since BAC drainage-wide removal efforts were initiated in 2012-13 (Table 2). The population continues to exhibit a bimodal length-frequency distribution, with a fairly stable peak of age-0 or age-1 fish produced the previous season, and an annually declining peak of age-1+ fish over about 225 mm TL (Fig. 1; 84-568 mm TL, mean 170.5 mm TL). Within this shrinking catch of older cohorts, the decline in ripe/spent female Brown Trout is striking (Fig. 2), and suggestive of a near-term collapse in recruitment if the trend continues. Such a collapse seems to have taken place already in Rainbow Trout in the main reaches of Bright Angel Creek excluding Angel Springs (Fig. 3; 107-439 mm TL, mean 233.2 mm TL). This despite an upstream population in the difficult to access uppermost portion of Angel Springs, which was electrofished all the way to the source for the first time this year. This newly-exploited population exhibits a normal length-frequency distribution with a smaller mean (Fig. 4; 75-339 mm TL, mean 165.7 mm TL). Subsequent electrofishing passes will continue to target this population in 2017-18.

Evidence of positive responses in the populations of native fishes in Bright Angel Creek persists this season. For a second consecutive year, a cohort of young-of-year Bluehead Suckers was detected, with 39 individuals <100 mm TL sampled; the successful cohort first observed in 2015-16 was represented this season by 58 captures between 120-169 mm TL (Fig. 5; 52-367 mm TL, mean 219.4 mm TL). Successful reproduction was likewise detected for a second year in Flannelmouth Suckers, with 11 juveniles between 84-117 mm TL captured in reach 1 (Fig. 6; mean 99.7 mm TL). Additionally, five adult Flannelmouth >400 mm TL were captured above the weir, most or all of which had been electrofished below the weir and moved upstream in the weeks prior. Speckled Dace total captures are down slightly from 2015-16 (see Table 2) after several years of dramatic increases, perhaps having reached a zone of equilibrium density in reach 1, though increases in reaches 2 and 3 suggest that the population continues to expand upstream. The population exhibits a fairly normal length-frequency distribution (Fig. 7; 10-260 mm TL, mean 80.4 mm TL) based on a subset of captures that were measured (n=3440).

Table 2. Total electrofishing captures by species across Bright Angel Creek (BAC) reaches and tributaries for the 2016-17 season. BNT = Brown Trout, RBT = Rainbow Trout, BHS = Bluehead Sucker, FMS = Flannelmouth Sucker, and SPD = Speckled Dace.

	BNT	RBT	BHS	FMS	SPD
Roaring Springs					
Angel Springs	23	3915			
Transept Creek	17				
Wall Creek	2				
Phantom Creek					
BAC Reach 5: RS/AS confluence to Transept	1103	108	0		
BAC Reach 4: Transept to Ribbon	1249	8	0		
BAC Reach 3: Ribbon to beaver ponds	1688	11	68		53
BAC Reach 2: beaver ponds to Phantom Creek	717	35	119		2908
BAC Reach 1: Phantom Creek to Weir	88	26	137	14	7195
BAC Reach -1: Weir to Colorado River	15	24	3	3	21
TOTAL:	4902	4127	327	17	10177

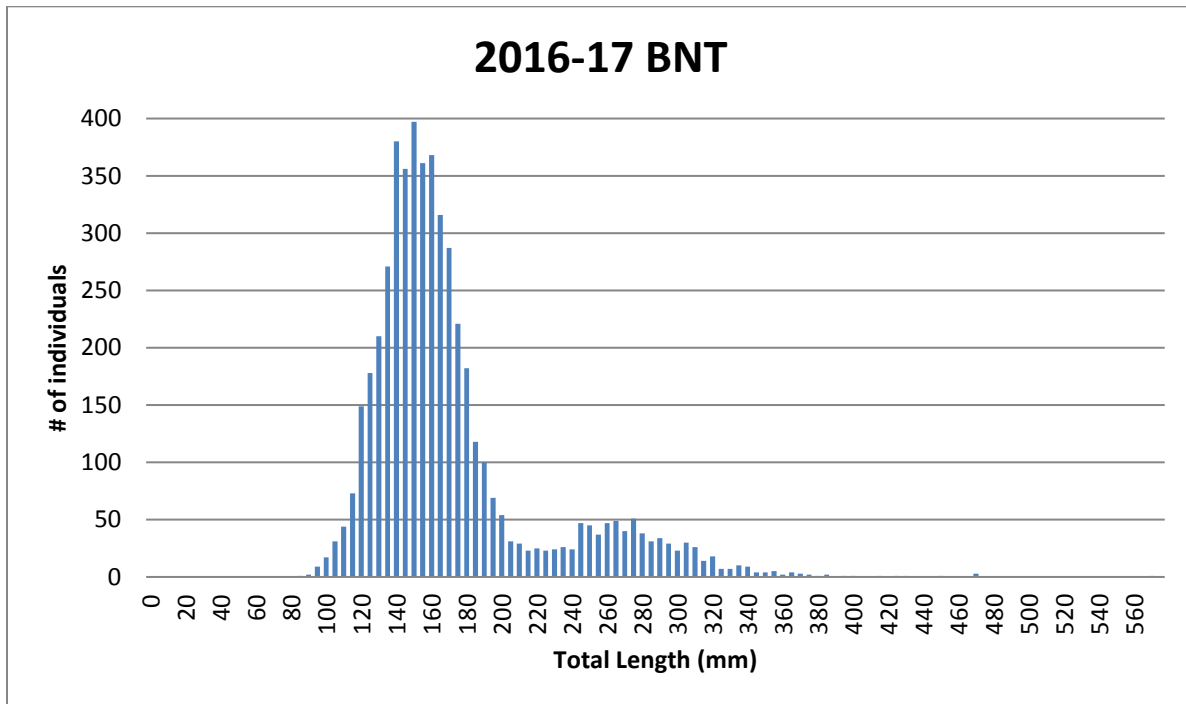


Figure 1. Length-frequency of Brown Trout captured via electrofishing during the 2016-2017 season.

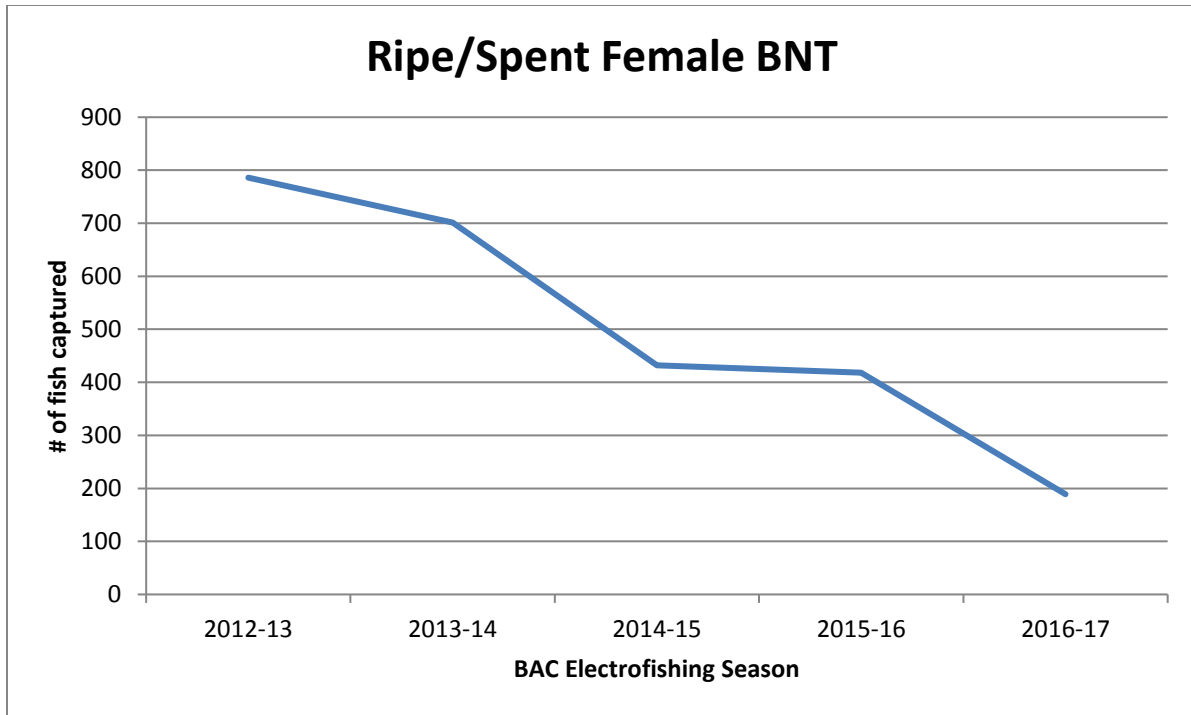


Figure 2. Declining captures of ripe/spent female Brown Trout over five seasons of electrofishing removals.

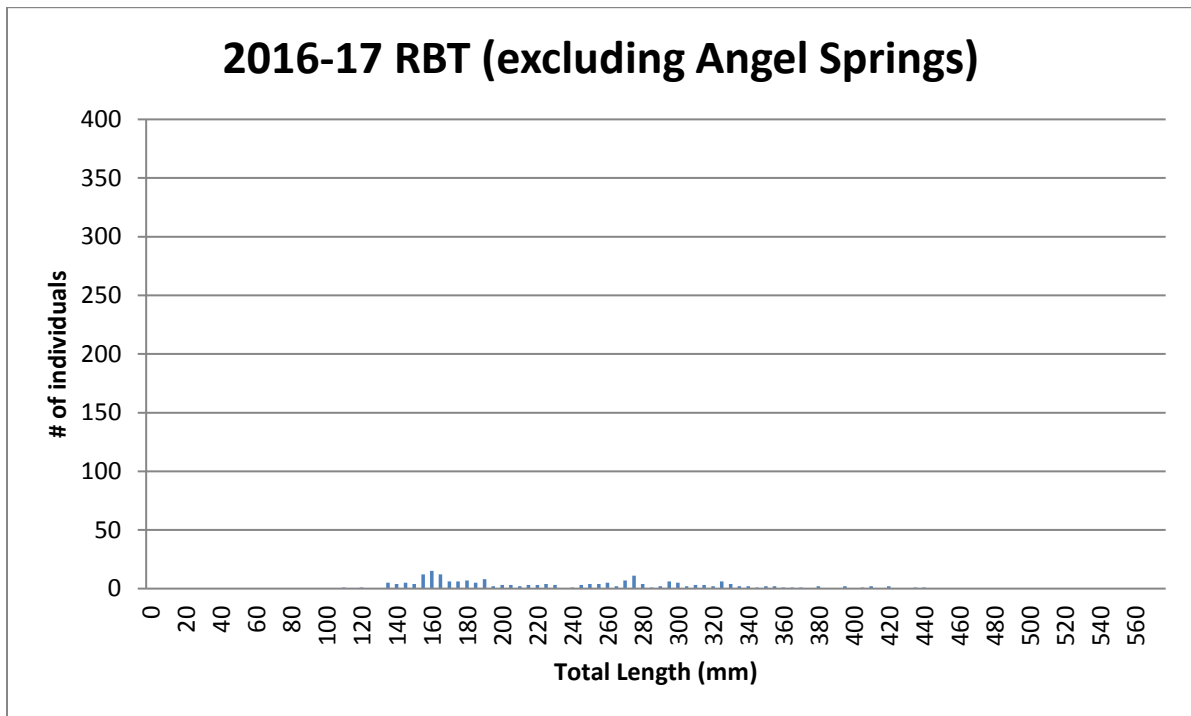


Figure 3. Length-frequency of Rainbow Trout captured via electrofishing during the 2016-2017 season (All reaches of Bright Angel Creek, but excluding Angel Springs).

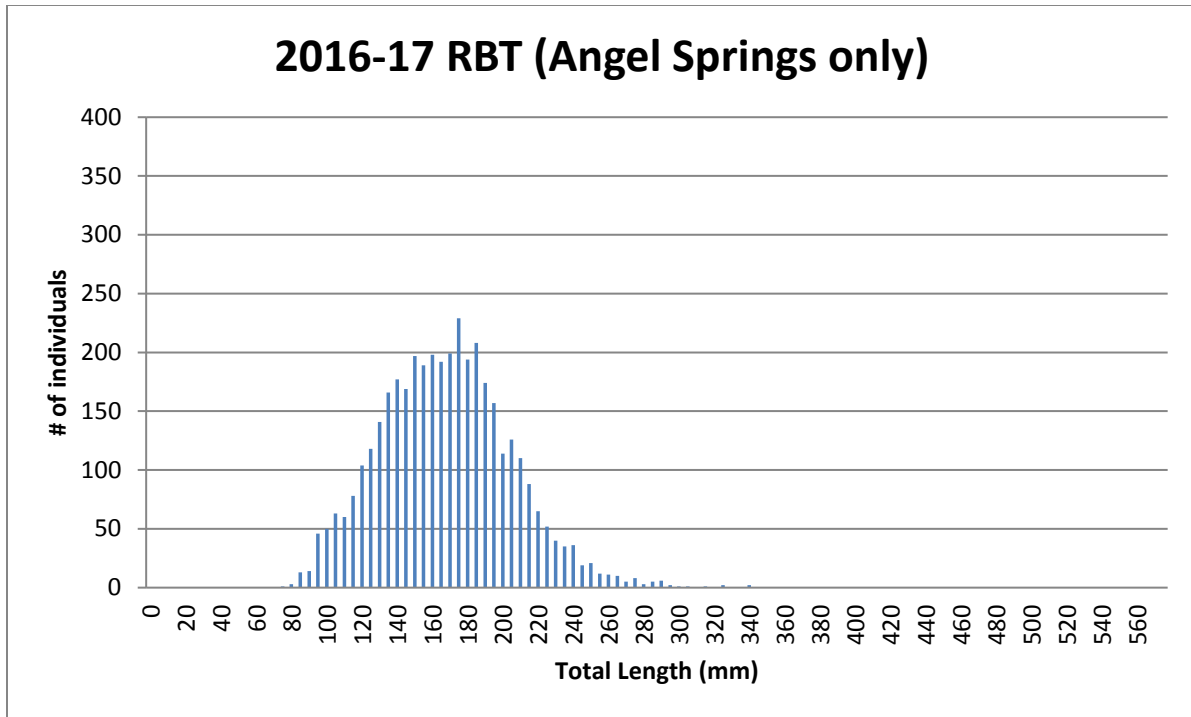


Figure 4. Length-frequency of Rainbow Trout captured via electrofishing during the 2016-2017 season (Angel Springs only).

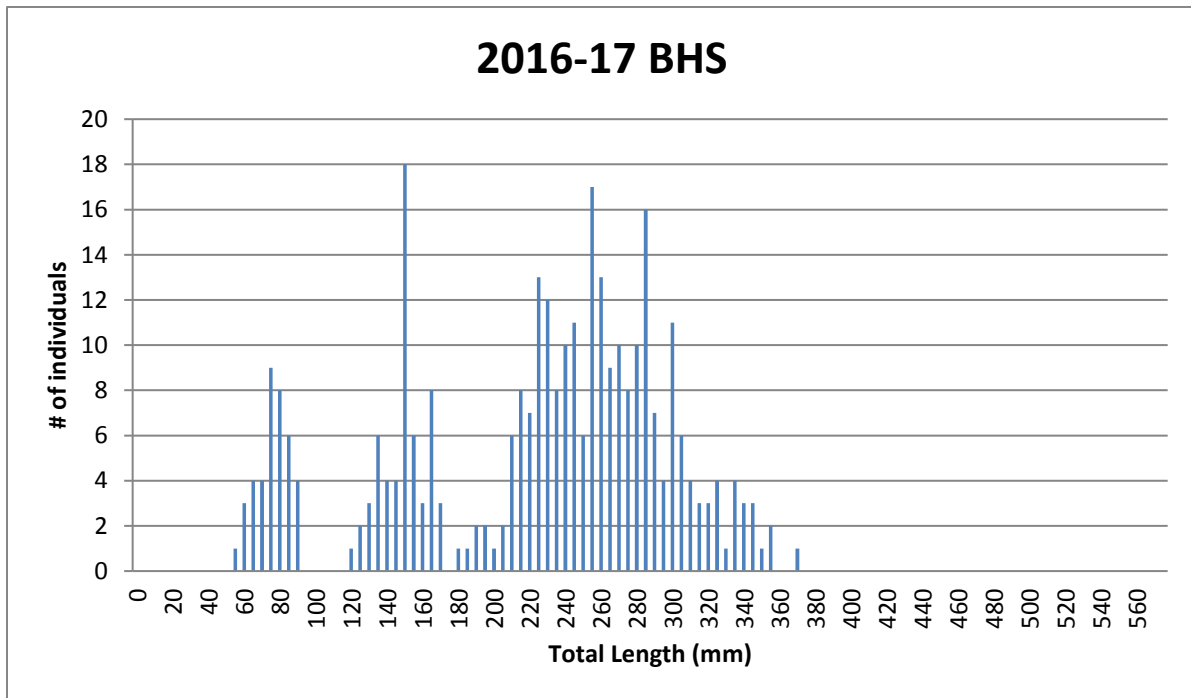


Figure 5. Length-frequency of Bluehead Suckers captured via electrofishing during the 2016-17 season (same-season recaptures removed).

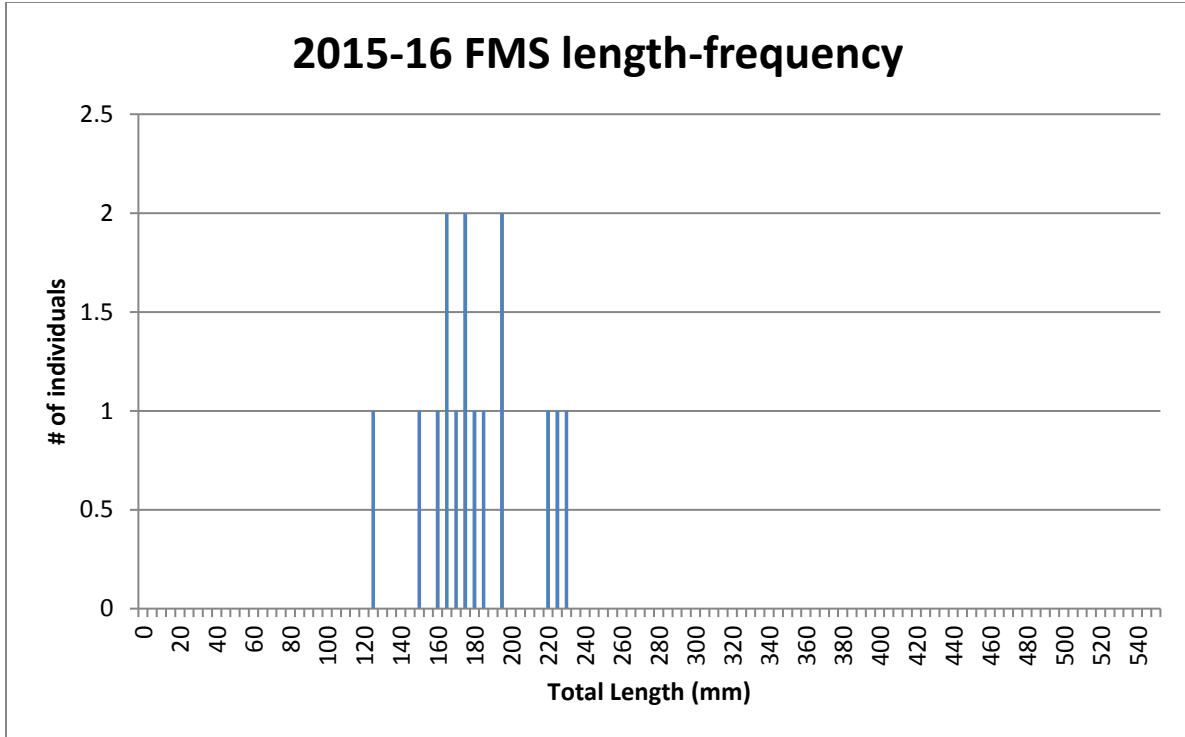


Figure 6. Length-frequency of juvenile Flannemouth Suckers captured via electrofishing during the 2015-16 season.

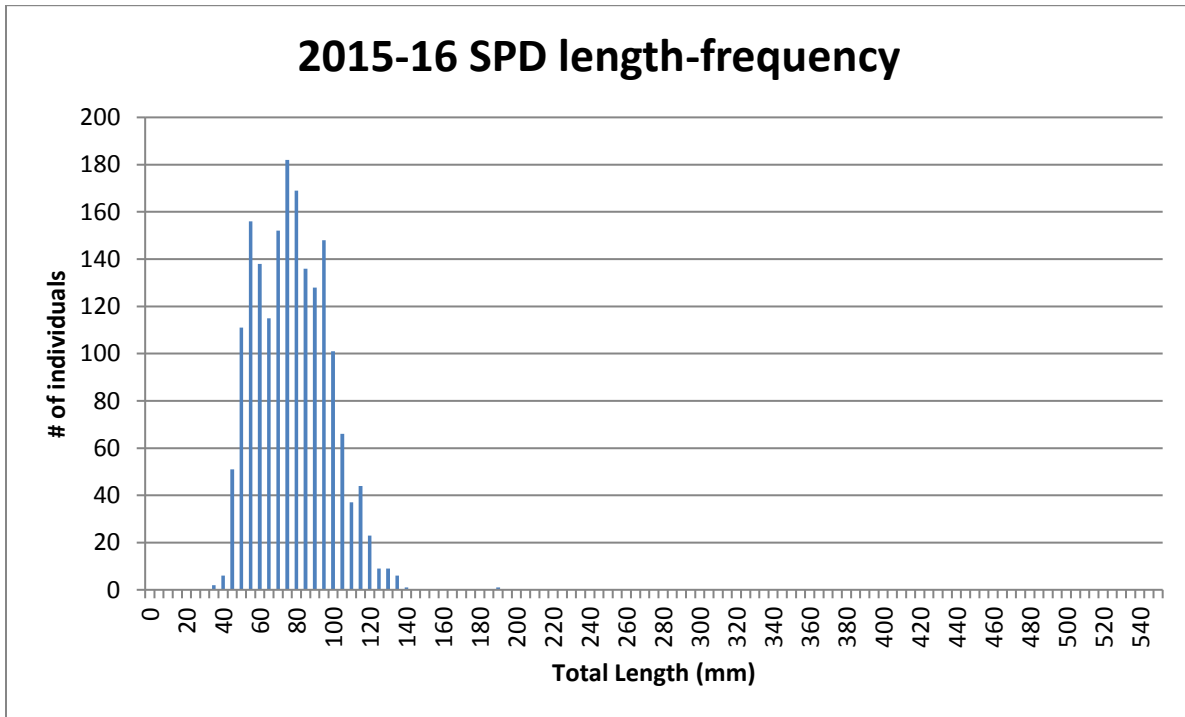


Figure 7. Length-frequency of Speckled Dace captured via electrofishing during the 2015-16 season. N=3440 measured individuals.

References:

- Coggins, Jr., L.G., M.D. Yard, and W.E. Pine III. 2011. Nonnative fish control in the Colorado River in Grand Canyon, Arizona: An effective program or serendipitous timing? *Transactions of the American Fisheries Society* 140: 456-470.
- Gloss, S.P. and L.G. Coggins. 2005. Fishes of Grand Canyon. Pages 33-56 in: Gloss, S.P., Lovich, J.E., and T.S. Melis (Eds.), *The state of the Colorado River ecosystem in Grand Canyon*. U.S. Geological Survey Circular 1282.
- Leibfried, W., Johnstone, L., Rhodes, S., and M. Laurretta. 2005. Feasibility study to determine the efficacy of using a weir in Bright Angel Creek to capture Brown Trout. Final report of SWCA Environmental Consultants submitted to Grand Canyon Science Center, Grand Canyon National Park (SWCA Project # 6462-091).
- Makinster, A.S., Persons, W.R., Avery, L.A., and A.J. Bunch. 2010. Colorado River fish monitoring in Grand Canyon, Arizona; 2000 to 2009 summary. No. 2010-1246. U.S. Geological Survey.
- Minckley, C.O. 1978. A report on aquatic investigation conducted during 1976-1977, on Bright Angel, Phantom, and Pipe Creeks, Grand Canyon National Park, Coconino County, Arizona. Annual Investigation Report submitted to Grand Canyon National Park, Grand Canyon, Ariz. Northern Arizona University, Flagstaff.
- National Park Service, U.S. Department of the Interior. 2006. Finding of no significant impact for Bright Angel Creek trout reduction project, Grand Canyon National Park, Grand Canyon, Arizona.
- National Park Service, U.S. Department of the Interior. 2013. Finding of no significant impact for the Comprehensive Fisheries Management Plan for Grand Canyon National Park and Glen Canyon National Recreation Area, Grand Canyon National Park, Grand Canyon, Arizona.
- National Park Service, U.S. Department of the Interior. 2016a. Standard operating procedures: Operation of the weir at Bright Angel Creek. Grand Canyon National Park, Grand Canyon, Arizona.
- National Park Service, U.S. Department of the Interior. 2016b. Bright Angel Creek trout reduction project standard operating procedures. Grand Canyon National Park, Grand Canyon, Arizona.
- Omana Smith, E.C., B.D. Healy, W.C. Leibfried, and D.W. Whiting. 2012. Bright Angel Creek trout reduction project: Winter 2010-2011 report. Natural Resource Technical Report NPS/GRCA/NRTR—2012/646. National Park Service, Fort Collins, Colorado.

- Otis IV, E.O. 1994. Distribution, abundance, and composition of fishes in Bright Angel and Kanab creeks, Grand Canyon National Park, Arizona. Thesis, University of Arizona, Tucson, Arizona.
- Persons W.R., D.L Ward, L.A. Avery and A.C. Burtner. 2011. Standardized methods Grand Canyon Fisheries Research. U.S. Department of the Interior, U.S. Geological Survey, GrandCanyon Monitoring and Research Center, 43. p
- Speas, D.W. 2002. Annual Report. Arizona Game and Fish Department. Prepared for the Grand Canyon Monitoring and Research Center, Flagstaff, AZ.
- Sponholtz, P.J., and D.R. Van Haverbeke. 2007. Bright Angel Creek trout reduction project summary report on fall 2006 weir and electrofishing efforts. Report by U.S. Fish and Wildlife Service to Grand Canyon Science Center, Grand Canyon National Park (USFWS-AZFRO-FL-07-006).
- Spurgeon, J.J., C.P. Paukert, B.D. Healy, C.A. Kelley, and D.P. Whiting. 2015. Can translocated fish retain their trophic niche when confronted with a resident invasive? Ecology of Freshwater Fish 24(3): 456-466.
- U.S. Fish and Wildlife Service. 2008. Final biological opinion on the operation of Glen Canyon Dam. U.S. Fish and Wildlife Service, Phoenix, Arizona.
- U.S. Fish and Wildlife Service. 2011. Final biological opinion on the operation of Glen Canyon Dam. U.S. Fish and Wildlife Service, Phoenix, Arizona.
- Valdez, R.A. and R.J. Ryel. 1995. Life history and ecology of the humpback chub (*Gila cypha*) in the Colorado River, Grand Canyon, Arizona. Report # TR-250-08. BIO/WEST, Inc., Logan, Utah.
- Yard, M.D., L.G. Coggins, C.V. Baxter, G.E. Bennett, and J. Korman. 2011. Trout piscivory in the Colorado River, Grand Canyon: Effects of turbidity, temperature, and fish prey availability. Transactions of the American Fisheries Society: 140:471:486.
- Whiting, D. P., C. P. Paukert, B. D. Healy, and J. J. Spurgeon. 2014. Macroinvertebrate prey availability and food web dynamics of nonnative trout in a Colorado River tributary, Grand Canyon. Freshwater Science 33(3): 872 – 884.