

I. Project Title: **Population estimates of humpback and roundtail chub in Westwater Canyon, Colorado River, Utah.**

II. Bureau of Reclamation Agreement Number(s): #R14AP00007

Project/Grant Period: Start date: 5/1/2014

End date: 09/30/2018

Is this the final report? Yes _____ No x

III. Principal Investigator(s):

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IV. Abstract:

Westwater Canyon on the Colorado River contains one of the five remaining populations of the endangered humpback chub in the Upper Colorado River Basin. Overall, this population of humpback chub has remained relatively stable since 2000, with population estimates around 2000 individuals. In 2017, trammel nets and electrofishing gear were used to sample humpback and roundtail chubs in Westwater Canyon. Important metrics of population status including catch rates, size structure, and population size were calculated for humpback and roundtail chub. Catch rates of humpback chub in 2017 were the third highest (0.3 fish /hr) since starting three pass population estimates in 1998. The highest CPUE occurred in 2016 (0.5 fish/hr) and the second highest was in 1998 (0.4 fish/hr). The reduction in CPUE this is likely due to environmental factors (increased water temperature) and not a reduction in the numbers of humpback chubs. This was the final year in this two-year cycle of monitoring.

V. Study Schedule: Ongoing: initial year of fieldwork cycle-2016, final year of fieldwork cycle-2017.

VI. Relationship to RIPRAP:

GENERAL RECOVERY PROGRAM SUPPORT ACTION PLAN

- V. Monitor populations and habitat and conduct research to support recovery actions (research, monitoring, and data management).
- V.A. Measure and document population and habitat parameters to determine status and biological response to recovery actions.

COLORADO RIVER ACTION PLAN: MAINSTEM

- V. Monitor populations and habitat and conduct research to support recovery actions (research, monitoring, and data management).
- V.A. Conduct research to acquire life history information and enhance scientific techniques required to complete recovery actions
- V.C.2. Westwater.

VII. Accomplishment of FY 2017 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1: Sampling:

In 2017, three sampling passes occurred in Westwater Canyon during September and October as part of the continued efforts to monitor humpback and roundtail chub populations within the Colorado River. Sampling pass one occurred during September 5-12, pass two occurred during September 20-27, and pass three occurred during October 5-12. During each pass, sites were surveyed for two consecutive nights at Miners Cabin (RM 123.5), Upper Cougar (RM 121.7), and Little Hole (120.8). The Hades bar site (RM 120.1) was sampled for one night per pass.

Mean daily discharge during passes was measured using data collected remotely from the USGS gauge #09163500 (Colorado River near Colorado-Utah State Line). Temperature was measured once daily at each site due to temperature sensors being cancelled at the USGS gauge. Mean flow for the first pass was 3,798 cfs (3,798 – 4,080 cfs), and temperature ranged from 21.5 – 24.3 °C. Mean flow for the second pass was 4,431 cfs (4,040 – 4,940 cfs), and temperature ranged from 12.8 – 17.9 °C. Mean flow for the third pass was 5,407 cfs (4,960 – 5,770 cfs), and temperature ranged from 9.5 – 14.4 °C.

Humpback and roundtail chub were sampled using trammel nets, electrofishing, and submersible antennas during 2017 sampling. Trammel nets were set each day at 15:00 and checked every two hours until 23:00 when they are pulled. The nets were reset the next morning at 5:00, checked every two hours and pulled at 11:00. Due to elevated

water temperatures on pass one, we delayed net setting by two hours on our last night to reduce stress on the fish. Three to six trammel nets were set at each site depending upon habitat availability. Electrofishing was conducted every afternoon at 14:00. All *Gila sp.* and endangered fishes were identified to species when possible, measured (total length; mm), weighed (g), scanned for a PIT tag, PIT tagged (if necessary), and released. There were six total antennas set for the duration of the 2017 field season (two at Miners and Upper Cougar, and one at Little Hole and Hades). Data from the antennas are still being processed and will not be included in this annual report at this time, but a revised report incorporating the antenna data will be sent out once all data is acquired (January, 2018).

Sampling efforts in 2017 resulted in the capture of 374 individual adult (≥ 200 mm) humpback chub and 1,237 individual adult roundtail chub. Additionally, 19 sub-adult (<200 mm) humpback chub, 132 sub-adult roundtail chub, and 67 sub-adult *Gila spp.* were collected. Fish identified as *Gila sp.* were too small to reliably identify in the field. Humpback chub captures were 17% sub-adult and 83% adult. Roundtail chub captures were 12% sub-adult and 88% adult. The sub-adult percentages for both humpback and roundtail chub include the 67 *Gila spp.* collected.

The average total length of captured humpback chub during 2017 sampling was 269 mm with a range of 106-371 mm (N=427) and the average total length of roundtail chub captured was 265 mm with a range of 95-496 mm (N=1,472). The mean length of *Gila spp.* caught during electrofishing and trammel net surveys was 113 mm with a range of 58 to 149 mm. Analysis of length frequency histograms suggests that there is a broad range of adult humpback and roundtail chub within the Westwater Canyon population (Figure 1). The small modes centered around 120 mm and 190 mm for humpback and roundtail chub indicate that recruitment is occurring. However, when we consider the length frequencies of *Gila spp.* recruitment appears strong but we are unable to differentiate humpback chub recruits from roundtail chub recruits for these smaller size classes.

Trammel net surveys resulted in 1,284 hours of total effort during fall of 2017 sampling. During 2017 sampling in Westwater Canyon, humpback chub trammel net catch per unit effort (CPUE) was 0.31 fish per hour (SE=0.02). Catch per unit effort was relatively consistent among passes with slight non-significant increases during passes one and three (Figure 2). Pass one in 2017 was considerably lower than pass one in 2016 and passes two and three each had relatively similar CPUE in 2016 and 2017 (Figure 2). The lower CPUE in 2017 (0.31 fish/hr: 2017 compared to 0.5 fish/hr: 2016) is because of a reduced CPUE experienced during pass one in 2017. That reduction in CPUE is likely due elevated water temperatures experienced during pass one in 2017. Catch rates for humpback chub were highest at the Little Hole and Upper Cougar camps (Figure 3). Roundtail chub CPUE was 0.98 fish per hour (SE=0.05). Roundtail chub catch rates increased as passes increased (Figure 2). Roundtail chub catch rates were highest at

Miner's and Little Hole camps (Figure 3). Electrofishing was most effective at capturing smaller size class (<200 mm) chubs and adult roundtail chub. Catch per unit effort was highest for juvenile humpback chub during pass two (Figure 4). Passes two and three had the highest electrofishing CPUE for juvenile roundtail chub (Figure 4). Adult roundtail chub electrofishing CPUE was relatively the same for all passes (Figure 4). Miner's camp had the highest electrofishing CPUE for adult humpback and roundtail chubs (Figure 5). Upper Cougar camp had the highest catch rates for juvenile humpback and roundtail chubs (Figure 5). Miner's camp had the highest electrofishing CPUE for the smaller *Gila spp.* (Figure 5).

Closed capture population models (Huggin's p and c) were calculated in Program MARK to estimate population size and capture probability for humpback chub and roundtail chub. Model averaging was used to estimate populations for both humpback and roundtail chub because AIC weights were less than 0.90 on all models (Table 1). Population estimates for both humpback and roundtail chubs used the M_0 (constant p), M_t (time varying p), and M_b (behavioral response) models to calculate the estimates. The model averaged estimate for humpback chub for 2017 is 3,656 (95% CI 1,177-6,133, SE=1,097, CV=0.30). The model averaged capture probabilities for humpback chub ranged from 0.03-0.05. The model averaged estimate for roundtail chub for 2017 is 11,300 (95% CI 8,055-14,545, SE=1,645, CV=0.15). The model averaged capture probabilities for roundtail chub ranged from 0.02-0.05. The population estimates for humpback and roundtail chubs are likely inflated due to lower capture probabilities experienced in 2017. Capture probabilities should increase after adding the antenna data to these estimates and will likely increase the precision of these population estimates.

Task 2 – Data entry:

The 2017 data was entered and quality checked and will be transferred to the UCRRP database manager by January 15, 2018.

Task 3 – Annual reporting:

An annual progress report including a summary of the 2017 data was submitted by November 13, 2017. A final report will be completed in 2018.

VIII. Additional noteworthy observations:

Two razorback sucker, two Colorado pikeminnow, and 14 bonytail were also captured. Several nonnative species were captured and removed including 99 black bullheads, one black crappie, one brown trout, two green sunfish, three flannelmouth x white sucker hybrid, one bluehead x white sucker hybrid, 22 gizzard shad, four largemouth bass, 11 smallmouth bass, and 5 white suckers.

IX. Recommendations:

- Monitoring efforts should remain as currently specified in the Westwater scope of work.
- We should also incorporate a robust design mark-recapture analysis for roundtail chub in the next final report.
- We are going to add an additional pass during an off year (2018 or 2019) to test the effectiveness of only using hoopnets to sample chubs in Westwater Canyon. We are exploring the option of using hoopnets because of the delayed mortality associated with trammel nets (Hunt et al. 2012) and their ability to capture all size classes of fishes. Also hoopnets would give us the opportunity to calculate recruitment rates when coupled with electrofishing and submersible antennas.
- Submersible antennas should still be used to boost the number of recaptures and increase capture probabilities.
- Purchase additional submersible antennas (5) to boost recapture rates for chubs and determine if chubs are areas of Westwater Canyon below the camps (i.e. in and below the rapids).
- Examine the effects of nonnative fish expansion (as a separate study) on the Westwater chub population. Nonnative fish (smallmouth bass and walleye) populations are in higher concentrations upstream and downstream of Westwater Canyon (pers comm Chris Michaud) and while the Westwater Canyon fish community continues to be dominated by native fishes, current effects and future risks of nonnative fish expansion into and around the area are unknown.

X. Project Status: Both years of two-year project was completed. The project is on track and ongoing. No changes in objective, deadlines, predicted funding, project direction or probability of success are foreseen.

XI. FY 2017 Budget Status

- A. Funds Provided: \$ 95,939
- B. Funds Expended: \$ 95,939
- C. Difference: \$ 0
- D. Percent of the FY 2017 work completed, and projected costs to complete: 100%
- E. Recovery Program funds spent for publication charges: \$ 0

XII. Status of Data Submission: Data will be transferred to USFWS by January 15, 2018

XIII. Signed: Brian Hines
Principal Investigator Date: 11/2/2017

XIV. Literature Cited:

Hunt, T.A., D.L. Ward, C.R. Propper, A.C. Gibb. 2012. Effects of capture by trammel net on Colorado River fishes. *Journal of Fish and Wildlife Management* 3(1): 133-141.

Table 1. Program MARK model output for all models used for the 2017 population estimates on humpback and roundtail chubs in Westwater Canyon, UT.

Humpback Chub						
Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Num. Par	Deviance
{p(t)=c(t)} constrained last p}	938.6721	0	0.56145	1	4	3704.3301
{p(t)=c(t)}	939.1668	0.4947	0.43842	0.7809	3	3706.8391
{p(.)c(.)}	955.7958	17.1237	0.00011	0.0002	2	3725.4788
{p(.)=c(.)}	958.6708	19.9987	0.00003	0.0001	1	3730.3609
Roundtail Chub						
{p(t)=c(t)}	2987.557	0	0.71754	1	3	15151.724
{p(t)=c(t)} constrained last p}	2989.422	1.8646	0.28246	0.3936	4	15151.584
{p(.)c(.)}	3089.867	102.3102	0	0	2	15256.037
{p(.)=c(.)}	3114.237	126.6794	0	0	1	15282.409

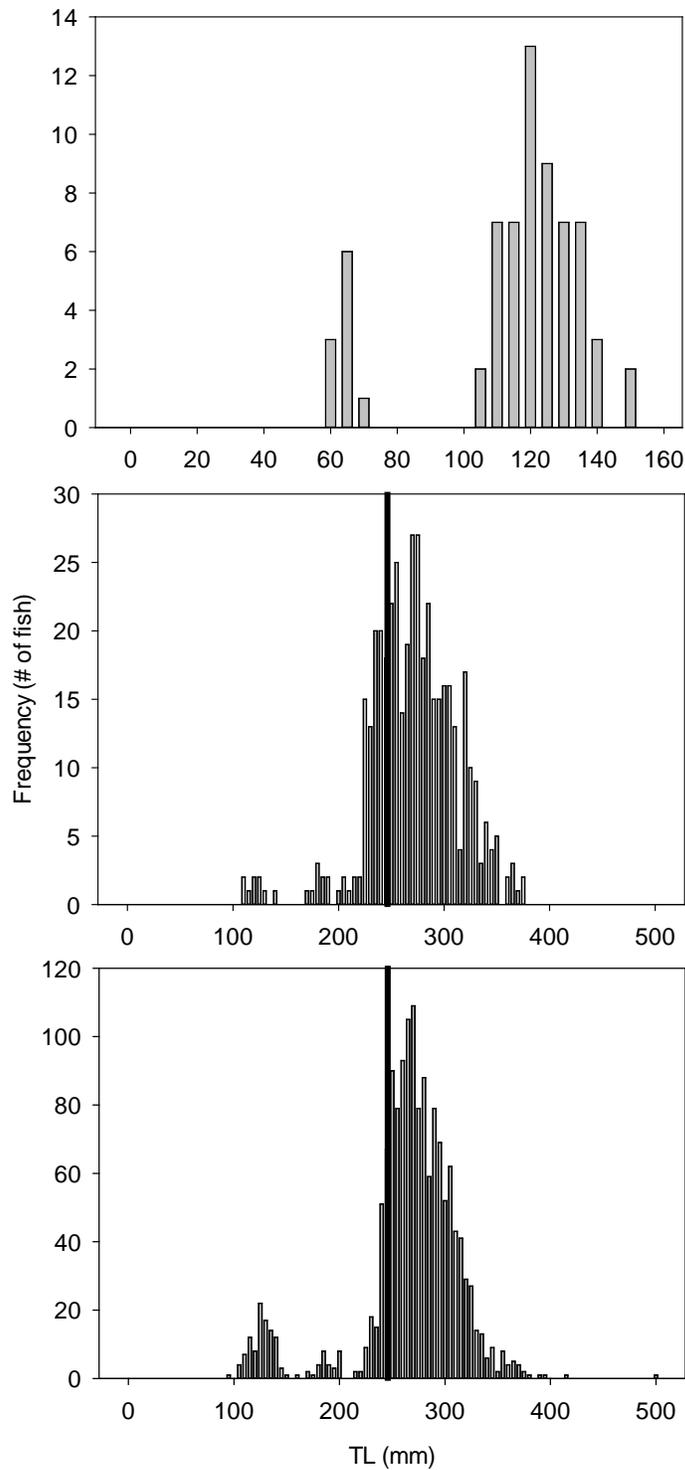


Figure 1. Length-frequency histograms for A.) *Gila spp.* B.) humpback chub, and C.) roundtail chub during Westwater Canyon sampling in 2017. Black bars denotes the separation of sub-adult and adult fish.

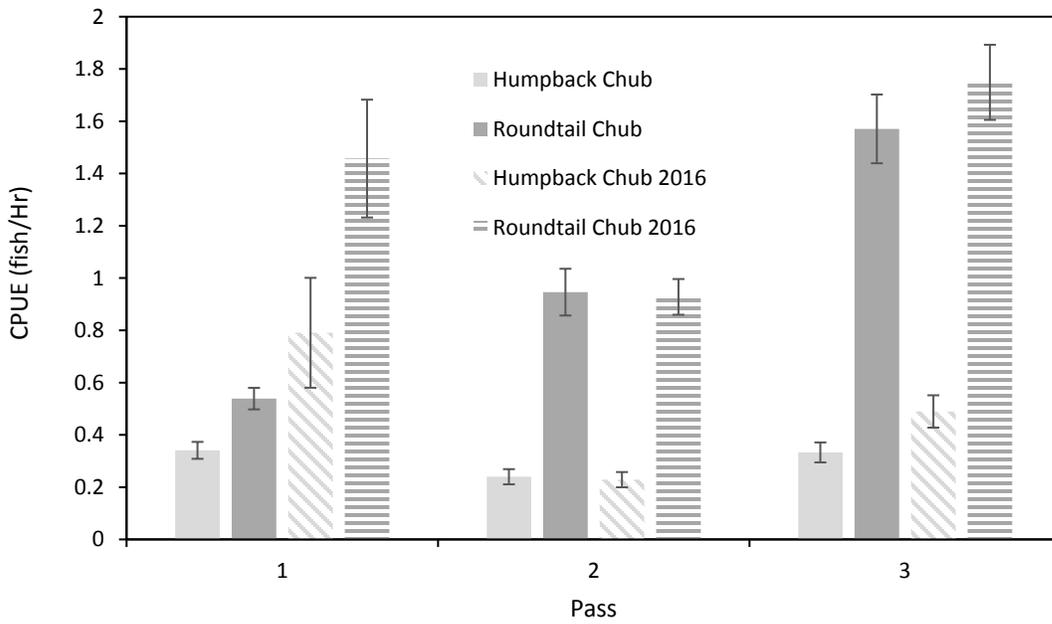


Figure 2. Catch per unit effort (fish/hour) by sampling pass for humpback and roundtail chub captured in trammel nets during fall of 2016 and 2017. Error bars represent $\pm 1SE$.

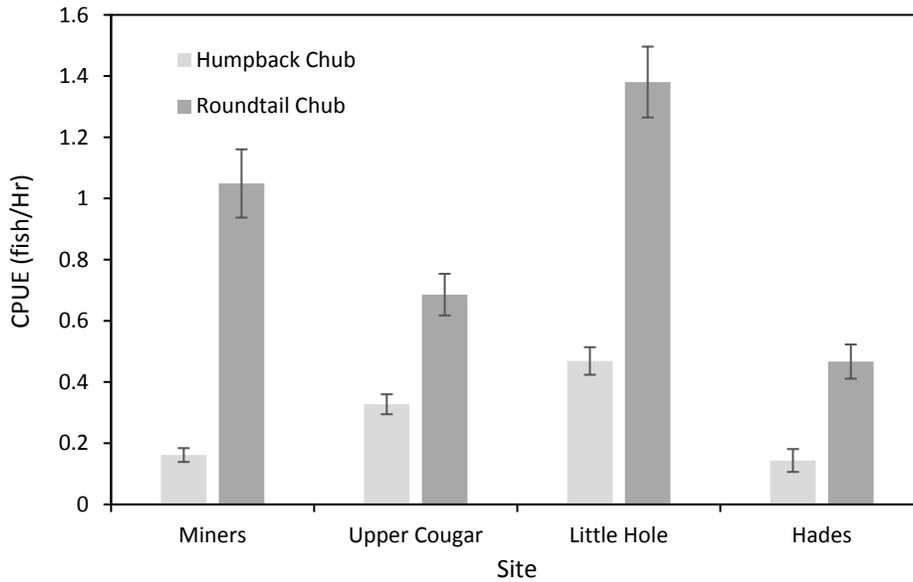


Figure 3. Catch per unit effort (fish/hour) by camp for humpback and roundtail chub captured in trammel nets during fall of 2017. Error bars represent $\pm 1SE$.

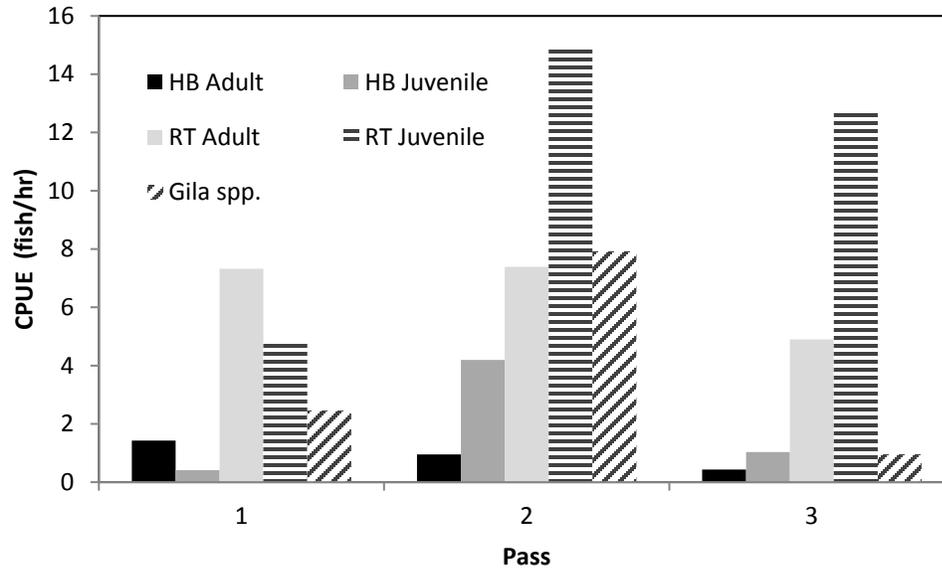


Figure 4. Catch per unit effort (fish/hour) by sampling pass for humpback and roundtail chub captured electrofishing during fall of 2017.

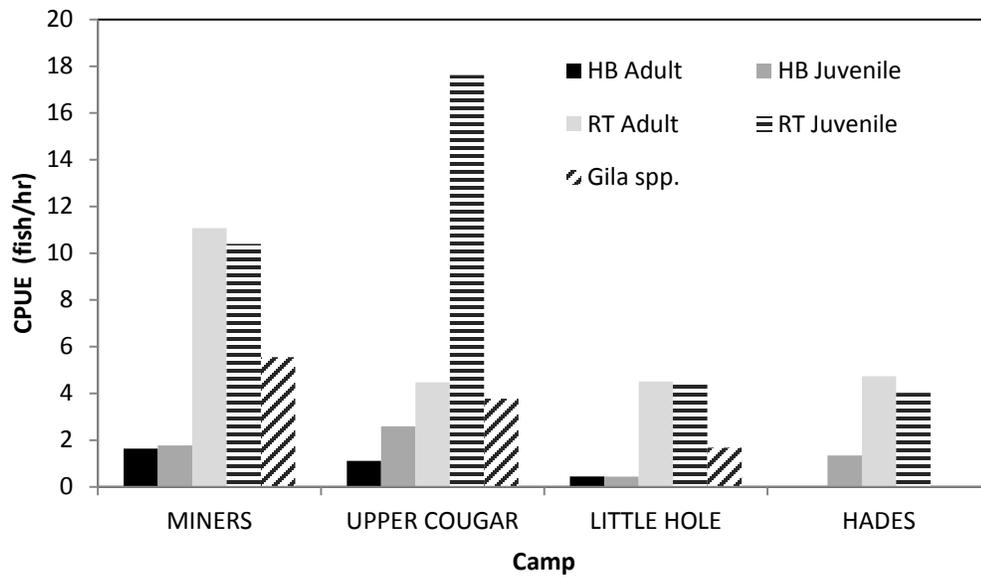


Figure 5. Catch per unit effort (fish/hour) by camp for humpback and roundtail chub captured electrofishing during fall of 2017.