COLORADO RIVER RECOVERY PROGRAM RECOVERY PROGRAM
FY 2018 ANNUAL PROJECT REPORT PROJECT NUMBER: <u>129</u>

I. Project Title: **Humpback chub population estimates for Desolation/Gray Canyons, Green River Utah.**

II. Bureau of Reclamation Agreement Number: R14AP00007

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IV. Abstract: Achievement of recovery goals (2002 amended recovery plan) for humpback chub requires monitoring six self-sustaining populations in the upper and lower Colorado River basins; Desolation and Gray Canyons is the sole extant population in the Green River subbasin. Humpback chub were sampled at six sites in Desolation and Gray Canyons with trammel nets, scented hoop nets, and submersible PIT antennas during September and October of 2018 to monitor the population. Sites included the four long-term sites with two additional sites chosen from previously sampled sites. Three passes occurred so population estimates could be calculated for each individual site and then extrapolated to the entire reach. Mean catch per unit effort (CPUE) for humpback chub captured via trammel nets at all sites sampled was 0.06 fish per net hour and ranged from 0.01 to 0.11. Mean CPUE was similar to previous years when sampling occurred during fall. Hoop nets resulted in successful documentation of both young-of-the-year and juvenile chub. The proportion of first year adult humpback chub captured was 13% and was the highest proportion since 2003. Antennas detected 27 individual chubs. Population estimates were calculated for all sites. However, only two sites met the previously set criteria for reliable estimates so interpretation of these estimates should be made with caution. Site population estimates ranged from five to 186 chub.

V. Study Schedule: Initial year 2018 – final year 2019 (calendar years).

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.

GREEN 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.B.   Conduct population estimate for humpback chub.

V.B.1.   Desolation/Gray

VII. Accomplishments of FY18 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1: Complete three sampling trips in Desolation/Gray Canyon from August to October 2018

Three sampling passes were completed through Desolation and Gray Canyons on 9/12–9/18/18, 9/24–10/03/18, and 10/11–10/17/18. Mean daily flows during sampling ranged from 1930-4360 cubic feet per second (USGS gauge #09315000, Green River at Green River). Average water temperatures during each pass were 22º C, 19º C, and 8º C respectively.

Sampling sites included the four long-term trend sites (Cedar Ridge, Log Cabin, Cow Swim, Coal Creek) and two sites selected from those previously sampled during the 2001-2015 sampling (Wild Horse, Range Creek). Four sites were within Desolation Canyon and two sites were within Gray Canyon. Specific site locations were at river miles 185.0 (Cedar Ridge), 178.5 (Wild Horse), 174.5 (Log Cabin), 160.0 (Cow Swim), 151.0 (Range Creek), and 145.5 (Coal Creek). All sites were sampled with trammel nets (eight per site), scented hoop nets (15 per site), and submersible PIT antennas (two per site). Six antennas were deployed during the first pass. The additional 6 antennas were deployed during the second pass. All antennas were retrieved during the third pass.

Task 2: Data entry, analysis, and reporting:

The 2018 data have been entered and quality checked and will be transferred to the UCREFRP database manger by January 15, 2019.

Total effort included 1883 trammel net hours, 4657.8 hoop net hours and 6402.2 antenna set hours over three passes. The large increase in effort (Table 1) was based on the recommendations in the 2017 final report (Howard and Caldwell 2017). Humpback chub were captured at all sites. Trammel and hoop nets resulted in 129 humpback chub captures; 115 adults (108 individuals) and 14 juveniles (14 individuals). Four juveniles were not tagged because they were too small. Antennas detected 27 individual humpback chub. Mean CPUE for trammel nets at the long-term trend sites was 0.07 fish per net hour. Mean CPUE for humpback chub captured by trammel nets at all sites sampled was 0.06 fish per net hour and ranged from 0.01 to 0.11. Mean at all sites was similar to the means of previous fall sampling years suggesting a stable population (Figure 1). Total length of chubs captured ranged from 54 to 358 mm (Figure 2). Increasing hoop net effort in 2018 resulted in the documentation of both young-of-year humpback chub (<100 mm) and juvenile humpback chub (100-200 mm); 12 of the 14 fish under 200 mm total length were captured in hoop nets. The proportion of first year adult (200-220 mm) humpback chub captured was 13% and was the highest proportion since 2003 indicating successful reproduction and recruitment (Figure 3).

Table 1. Effort for each gear type, total number of captures and/or encounters of identified humpback chub, and unidentifiable juvenile chub (Gila sp.) in Desolation and Gray Canyons, 2001 – 2018. All captures and encounters from all sampled sites are included except antenna detections; only the total number of individuals detected is reported

Year	Month (passes)	# Sites sampled	Trammel nets		Submersible Antennas		Hoop net/minnow trap		Electofishing	
			Hours	HBC	Hours	HBC	Hours	HBC (*Gila sp.*)	Hours	HBC
2001	6-7 (3)	12	2803	214	-	-	-	-	8	3
2002	6-7 (3)	12	2008	239	-	-	1440	6 (1)	22.5	38
2003	9-10 (3)	12	3042	236	-	-	1946	4 (1)	11	1
2006	9-10 (3)	12	3289	119	-	-	729	9	16.4	12
2007	9-10 (3)	12	2727	130	-	-	988	6	-	-
2010	9-10 (3)	5	1163	68	-	-	-	-	7	5
2011	9-10 (3)	6	1013	55	-	-	-	-	6.4	8
2014	9-10 (3)	6	1276	99	471	11	346	15 (1)	9.3	6
2015	9-10 (3)	6	1596	85	1567	20	1825**	10 (7)	-	-
2018	**9-10 (3)**	**6**	**1883**	**105**	**6402**	**27**	**4658**	**24 (4)**	-	-

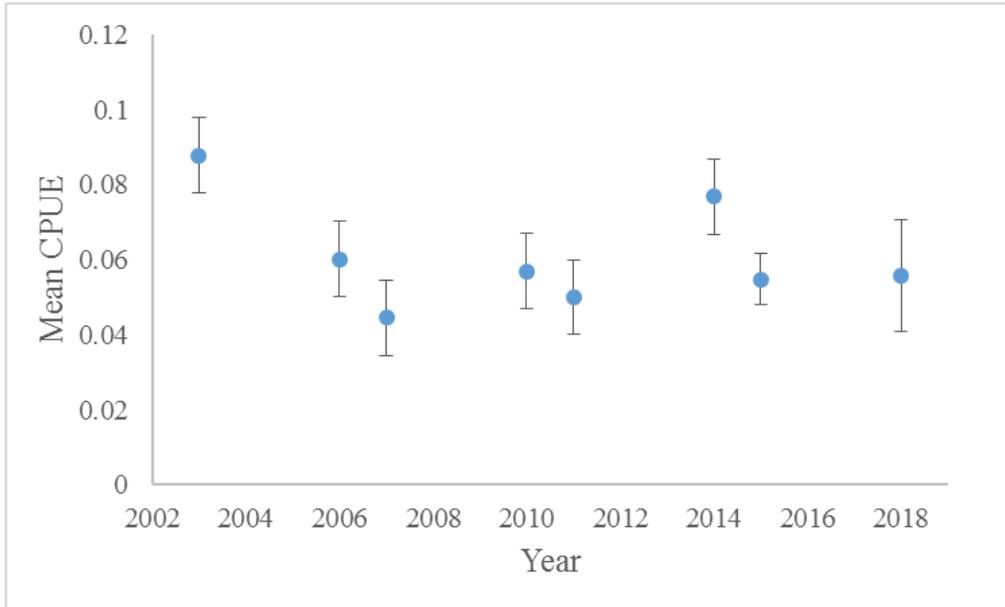*Hoop net effort from trip 1 not included in total due to incorrect setup

Figure 1.   Mean trammel net catch per unit effort of humpback chub in Desolation and Gray Canyons of all sites sampled during years when sampling occurred in fall.
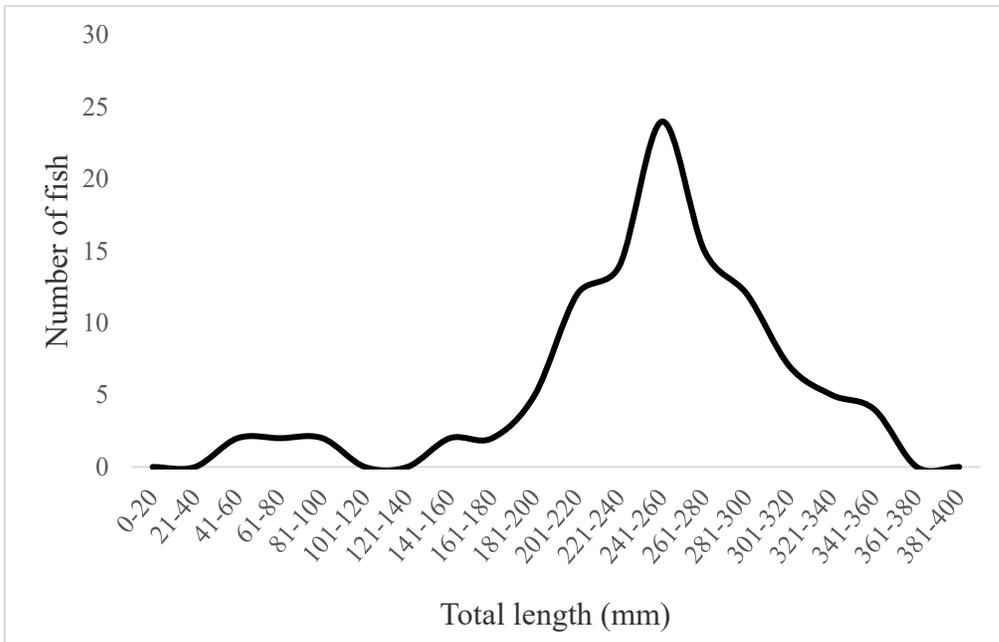

Figure 2. Length frequencies of humpback chub captured by trammel and hoop nets in Desolation and Gray Canyons, 2018.
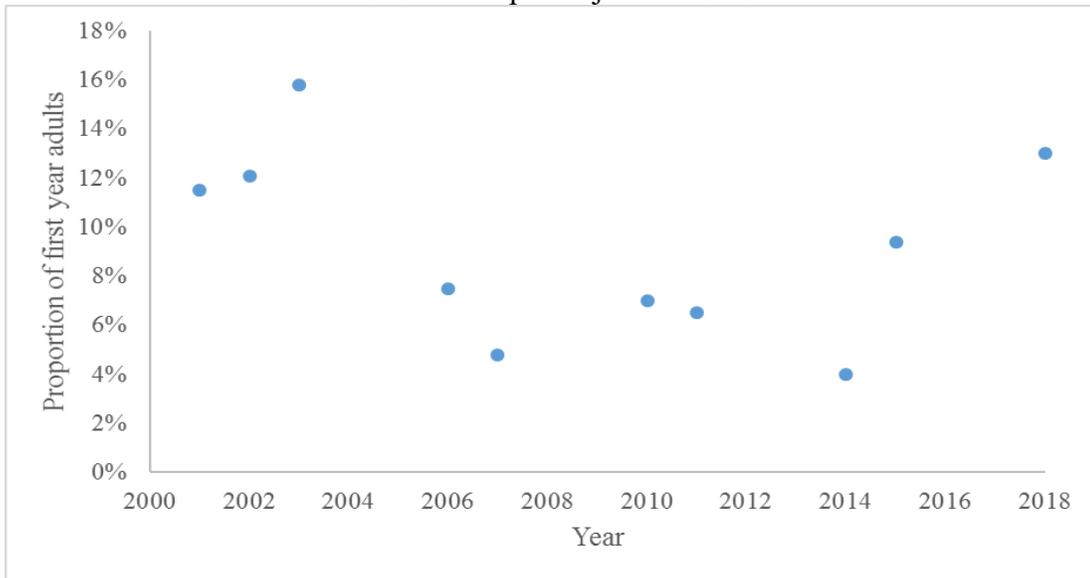
Figure 3. Proportion of total number of adult chubs (>200 mm) captured that were first year adults (200–220 mm), 2001 – 2018.

Closed population estimates were calculated for all sites with Program MARK utilizing the Huggins p (capture probability) and c (recapture probability) model. However, only two of the sites (Coal Creek and Wild Horse) met the previously established criteria for reliable estimates; at least 15 individuals and 2 recaptures. Three models were developed for each site: M_o (constant capture probability; p(.)=c(.)), M_t (time varying capture probability; p(t)=c(t)), and M_b (behavioral response; capture probability differs from recapture probability; p(.),c(.)). Model averaging was used for parameter and population estimation when the top model AIC weight was less than 0.90. Program MARK's output for all models used are summarized in Table 2. Population estimates are reported for all sites and summarized in Table 3. Parameters estimates are summarized in Table 4. Population estimates for Cedar Ridge, Cow Swim, Log Cabin, and Range Creek should be interpreted with caution as they did not meet the criteria for reliable estimates.

Table 2. Program MARK Huggins p and c model output by site for all models used in population estimation. Models are listed from top to bottom by AIC weight (highest to lowest). Models were averaged at all sites where AIC weights for the top model were <0.90.

Site	Model	AICc	AIC weighted	Model likelihood	Number of parameters	Deviance
Cedar Ridge	{p(.),c(.)}	41.569	0.529	1.00	2	57.95
	{p(.)=c(.)}	42.445	0.341	0.65	1	61.02
	{p(t)=c(t)}	44.378	0.130	0.25	3	58.46
Wild Horse	{p(.)=c(.)}	49.474	0.658	1.00	1	63.29
	{p(.),c(.)}	51.360	0.256	0.39	2	62.99
	{p(t)=c(t)}	53.553	0.086	0.13	3	62.91
Log Cabin	{p(.)=c(.)}	39.534	0.777	1.00	1	45.85
	{p(t)=c(t)}	42.028	0.223	0.29	3	43.71
Cow Swim	{p(t)=c(t)}	58.887	0.900	1.00	3	116.62
Coal Creek	{p(.)=c(.)}	96.816	0.552	1.00	1	169.86
	{p(.),c(.)}	98.611	0.225	0.41	2	169.57
	{p(t)=c(t)}	98.631	0.223	0.40	3	167.46
Range Creek	{p(t)=c(t)}	13.499	0.766	1.00	3	6.36
	{p(.)=c(.)}	15.871	0.234	0.31	1	15.33

Table 3. Summary by site of Desolation and Gray Canyons humpback chub population estimates, the associated standard errors and confidence intervals generated in program MARK for 2018. Model averaging was used to generate all estimates except Cow Swim.

Site	Population estimate	Standard error	Lower 95% confidence interval	Upper 95% confidence interval
Cedar Ridge*	48	61	0	167
Wild Horse	46	31	0	106
Log Cabin*	31	17	0	65
Cow Swim*	186	174	54	929
Coal Creek	94	46	3	184
Range Creek*	5	3	0	11

*Did not meet reliable estimate criteria of at least 15 captures and two recaptures

Table 4. Capture probability (p) and recapture probability (c) estimates generated in program MARK for 2018. Model averaging was used to generate all estimates except Cow Swim.

Site	Parameter	Parameter estimate	Standard error	Lower 95% confidence interval	Upper 95% confidence interval
Cedar Ridge*	p_1	0.29	0.25	0.04	0.81
	p_2	0.28	0.25	0.03	0.81
	p_3	0.28	0.25	0.03	0.82
	c_1	0.06	0.05	0.01	0.31
	c_2	0.05	0.05	0.01	0.30
Wild Horse	p_1	0.15	0.15	0.02	0.63
	p_2	0.15	0.15	0.02	0.63
	p_3	0.15	0.15	0.02	0.63
	c_1	0.11	0.07	0.03	0.35
	c_2	0.11	0.07	0.03	0.35
Log Cabin*	p_1	0.14	0.09	0.03	0.42
	p_2	0.17	0.12	0.04	0.51
	p_3	0.15	0.09	0.04	0.43
	c_1	0.17	0.12	0.04	0.51
	c_2	0.15	0.09	0.04	0.43
Cow Swim*	p_1	0.05	0.05	0.01	0.30
	p_2	0.08	0.07	0.01	0.39
	p_3	0.01	0.01	0.00	0.10
Coal Creek	p_1	0.14	0.10	0.03	0.47
	p_2	0.15	0.11	0.03	0.47
	p_3	0.13	0.10	0.02	0.47
	c_1	0.12	0.06	0.04	0.30
	c_2	0.11	0.05	0.04	0.26
Range Creek*	p_1	0.05	0.13	0.00	0.90
	p_2	0.82	0.34	0.05	1.00
	p_3	0.24	0.21	0.03	0.75
	c_1	0.82	0.34	0.05	1.00
	c_2	0.24	0.21	0.03	0.75

*Did not meet reliable estimate criteria of at least 15 captures and two recaptures

The mean site density of 70 fish per site (Coal Creek and Wild Horse) was extrapolated across the 63 available habitats (Badame 2012) found in Desolation and Gray Canyons to

provide a total population estimate of 4410 humpback chub. However, the reach-wide estimate should be interpreted with caution given that four of the sites did not meet the set criteria and there were large standard errors associated with the individual site estimates. In addition, two sites only represent 3% of the 63 total sites and the accepted standard for representation is 20%.

Increasing effort in all sampling methods, as previously recommended, successfully resulted in capturing more fish in a variety of size classes. However, even with a large increase in effort and more chub captures we were still unable to generate reliable site estimates at four sites reinforcing the difficulty of generating a reach-wide population estimate.

Task 3: Final Report

A final report will be prepared in 2020 detailing the sampling that occurred in 2018 and 2019.

VIII.   Additional noteworthy observations:
Other endangered species captured during sampling included one bonytail, 23 Colorado pikeminnow, and 26 razorback suckers. Unfortunately, two Colorado pikeminnow (390 and 424 mm total length; both untagged) and one humpback chub (314 mm total length) died as a result of entanglement in a trammel net. The chub mortality occurred during the second sampling trip when water temperatures averaged 19º C during mid-day. The chub was originally captured and tagged in 2002 at 270 mm; then captured again in 2006 at 296 mm; then no encounters till 2018. All three encounters were at Coal Creek.

Six black bullheads, 27 black crappie, four green sunfish, one northern pike, 20 smallmouth bass and three white suckers were removed during sampling.

IX.   Recommendations:
- Trammel nets, however stressful to fish, continue to be the best sampling tool for adult humpbacks and therefore should continue to be used in sampling. Continue to schedule sampling passes to avoid water temperatures above 22º C.
- An increased effort in hoop net sampling increased YOY and juvenile chub captures allowing for the documentation of reproduction and recruitment. The large hoop net effort should continue so these important aspects of the population can be monitored.
- Continue to determine how best to incorporate antenna data into the population models.
- Increasing effort resulted in more chub captures, better documentation of reproduction and recruitment but still failed in improving site estimates and thus did not improve the reach-wide estimate. Given the difficulty to obtain a reasonable reach-wide population estimate it may be beneficial to change recovery goals for this specific population to metrics that are more feasible to

monitor; such as, reproduction, recruitment, survival, CPUE, and population estimates specific to long term trend sites.

X. Project Status: Project is on track and ongoing.

XI. FY 2018 Budget Status

  A.   Funds Provided: $94,940
  B.   Funds Expended: $94,940
  C.   Difference: $0
  D.   Percent of the FY 2018 work completed, and projected costs to complete: 100%
  E.   Recovery Program funds spent for publication charges: $0

XII. Status of Data Submission: The 2018 data have been entered and quality checked and will be transferred to the STREAMS database manger by January 15, 2019.

XIII. Signed: __John Caldwell__   __November 20, 2018__
                      Principal Investigator   Date

XIV. Literature Cited:

Badame, P.V. 2012. Population estimates for humpback chub (*Gila cypha*) in Desolation and Gray Canyons, Green River, Utah 2006-2007. Final report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program. Denver, Colorado.

Howard, J. and J.M. Caldwell. 2017. Population Estimates for Humpback Chub (*Gila cypha*) in Desolation and Gray Canyons, Green River, Utah 2001-2015.