

I. Project Title: Population monitoring of humpback and bonytail chub in Cataract Canyon

II. Bureau of Reclamation Agreement Number(s): R19AP00059

Project/Grant Period: Start date (Mo/Day/Yr): Oct 1, 2018
End date: (Mo/Day/Yr): Sept. 30, 2023
Reporting period end date: Sept. 30, 2019
Is this the final report? Yes _____ No x

III. Principal Investigator:

Zach Ahrens
Utah Division of Wildlife Resources
Moab Field Station
1165 S. Hwy 191 Suite 4
Moab, UT 84532
Phone: 435-259-3783; Fax: 435-259-3785
E-mail: zachahrens@utah.gov

IV. Abstract:

The purpose of this project is to track humpback chub and bonytail population dynamics via biennial monitoring and comparison of adult and juvenile catch rates, population size structures and longitudinal distributions to past years. 2019 sampling yielded above average catch per unit effort (CPUE) for adult humpback chub. The year's effort also documented continuing reproduction & recruitment via captures of sub-juvenile chub and juvenile humpback chub.

V. Study Schedule: On-track and ongoing.

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.3. Cataract Canyon

VII. Accomplishment of FY 2019 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1: Complete one sampling trip in Cataract Canyon in fall of 2019:

Sampling summary

Field crews successfully completed the scheduled sampling pass from 20-29 October 2019 at three long-term monitoring sites and one additional site (Figure 1). At each site, five to eight trammel nets (depending on site area, navigability, and suitability for nets) were simultaneously deployed to collect catch rate trend data for adult humpback chub *Gila cypha* and bonytail *Gila elegans*. Net deployment lasted from approximately 05:00 to 11:00, then again from 15:00 to 23:00 hours each day. Net checks occurred promptly every two hours to avoid fish mortality.

To track catch rates for young-of-year and juvenile humpback chub, between 20 and 30 scented hoop nets were also deployed at each site. Nets were scented with Purina Aquamax 500 sport fish food in perforated plastic containers. Hoop net deployment was continuous throughout the stay at each site, and nets were checked for fish twice daily at approximately 09:00 and 15:00.

All endangered fish and roundtail chub *Gila robusta* were measured for total length (mm) and weighed (g). Each individual was then scanned for a PIT tag if greater than or equal to 150 mm in total length (TL) and a tag was implanted if not present.

River flows—estimated from combined USGS stream gage data at Potash on the Colorado River and Mineral Bottom on the Green River—ranged from 6,300 to 6,930 cubic feet per second (cfs). Water temperatures measured on-site ranged from 10.5-12.0 degrees Celsius. We also collected Secchi depth measurements to quantify water turbidity. These ranged from 440-540 mm during the trip.

Adult humpback chub and bonytail catch rates

Seventeen unique adult humpback chub (total length ≥ 200 mm) were captured over 570 trammel net-hours for an overall catch per unit effort (CPUE) of 0.03 fish per hour. This rate is greater than the 1991-2017 average of 0.027 fish per hour (Table 1). Linear model fit of annual humpback chub CPUE through time denotes no significant trend (Figure 2).

Three adult humpback chub were captured in 3,746 hoop net-hours. This CPUE of 0.001 fish per hour is very close to the only other hoop net effort of similar magnitude (2017; Table 1).

Of the 20 unique humpback chub captured, 2 had been previously encountered (recapture rate of 0.1). Each had been captured once previously in Cataract Canyon at the same site as their 2019 capture (in 2015 and 2017, respectively).

Three unique bonytail were captured in 2019. All fish were captured via trammel net, and all fish had been previously marked with PIT tags. STReAMS records indicate these

fish were stocked in 2015, 2018 and 2019 on the Green River (RMI 120), Colorado River (RMI 166.7) and Salt Creek (RMI 2.5), respectively.

Juvenile & sub-juvenile catch rates

Eighteen sub-juvenile *Gila spp.* (total length < 150 mm) were captured during 3,746 hoop net-hours for a CPUE of 0.005 fish per hour. This rate is less than half the 2017 CPUE. One juvenile humpback chub (total length 150-199 mm) was also captured via hoop net.

No juvenile humpback chub were captured via trammel nets in 2019.

Population size structure

As in recent years, humpback chub size structure continues to be bi-modal, with limited representation of juveniles in captures (Figure 3).

Analysis of variance found significant difference in mean total length of those *Gila spp.* presumed to be age-0 (i.e., total length \leq 100 mm) between years 2015-2019 ($F(2,62) = 15.5$, $p < 0.001$; Figure 4). Post-hoc Tukey's HSD test found 2019 lengths differed significantly from both 2015 ($p = 0.007$) and 2017 ($p < 0.001$). Smaller age-0 chub in 2019 may be attributable to extended spring runoff and resulting delay of spawning.

Longitudinal distribution of humpback chub

Adult humpback chub were captured at every site except Site 4 (Rapid 12). As in 2017, overall CPUE was driven by site-specific dynamics; specifically high catch rates at Site 1 (Ahrens 2017, Figure 5).

Task 2: Data entry, analysis, reporting:

This document fulfills analysis & reporting as outlined in the FY19 Scope of Work. Data will be formatted and transferred to the UCREFRP database manager by January 15, 2020.

Annual canyon-wide humpback chub CPUE (see Table 1) has been historically reported and analyzed as:

$$(total\ adult\ fish / total\ net\ hours) \sim year$$

This method of population tracking is statistically problematic for multiple reasons. Firstly, it simplifies a large number of samples (i.e. individual 2-hour net sets) into a single annual data point, thereby sacrificing the descriptive power of the data set unnecessarily. Second, it violates assumptions of independence (population size and catch rates are dependent upon those of previous years) and—should the full data set be used—residual normality (most samples catch zero target fish and thus are not normally distributed). Section IX offers potential alternative methods.

A rigorous final report may make better use of the full dataset with a two-part model accounting for the zero-inflated catch data. For example:

- 1) Are there fish?

$$I(N) \sim \text{Bern}(p_y)$$

where I is a variable indicating presence (1) or absence (0) and p_y is probability of presence in year y .

2) If so, how many?

$$(n_t | I(N) = 1) \sim \text{NBin}(\mu, \sigma^2)$$

where n_t is the number of target fish given the species is present.

Alternatively, modeling CPUE rather than counts may be achieved with a continuous probability distribution (e.g. Gamma).

VIII. Additional noteworthy observations:

Nonnative piscivores

Two walleye *Sander vitreus* and one striped bass *Morone saxatilis* were captured and euthanized during sampling. No PIT tags were detected in these fish, and guts contained no identifiable fish remains.

Ancillary captures of Gila spp.

Seventeen unique roundtail chub *Gila robusta* were captured in Cataract Canyon during 2019. Twelve of these fish were captured via trammel net for an overall CPUE of 0.02 fish per hour, an unusually high catch rate for this taxon. In contrast, annual roundtail chub catch rates from 2011-2017 ranged from zero to 0.005 fish per hour. The apparent resurgence of roundtail chub in Cataract Canyon merits continued attention.

Two apparent hybrid chub were also captured, PIT-tagged, and released.

Nonnative fish use of tributary streams

One walleye *Sander vitreus* was observed in the tributary stream at Dark Canyon (RMI - 33.5), along with numerous shad *Dorosoma spp.* and common carp *Cyprinus carpio*. The walleye was manually removed from the stream and euthanized.

Submersible PIT antennas

Two PIT antennas were deployed for the duration of the stay at each site. No chub species were detected during antenna deployment. Tag detections are summarized in Table 3.

IX. Recommendations:

- Continue biennial adult humpback chub and bonytail monitoring via trammel netting.
- Continue concurrent sub-juvenile *Gila spp.* monitoring via hoop netting.
- Investigate new statistical analysis techniques for the full dataset in order to more

fully and accurately monitor this population.

- Synthesize data from 2003 (and possibly earlier) to the present in a summary report. In addition to benefits of the above recommendation analysis of the full breadth of the Project 130 dataset may elucidate opportunities to efficiency (e.g., eliminating sampling times which are ineffective) and investigating the relationships of covariates (e.g., environmental conditions and nonnative fish catch rates) with chub catch rates.

X. Project Status: On track and ongoing.

XI. FY 2019 Budget Status

- A. Funds Provided: \$37,009
- B. Funds Expended: \$37,009
- C. Difference: \$0
- D. Percent of the FY 2019 work completed: 100%
Projected costs to complete: \$0
- E. Recovery Program funds spent for publication charges: \$0

XII. Status of Data Submission (Where applicable):

Data will be formatted and transferred to the UCREFRP database manager by January 15, 2020.

XIII. Signed: Zach Ahrens 27 November 2019
Principal Investigator Date

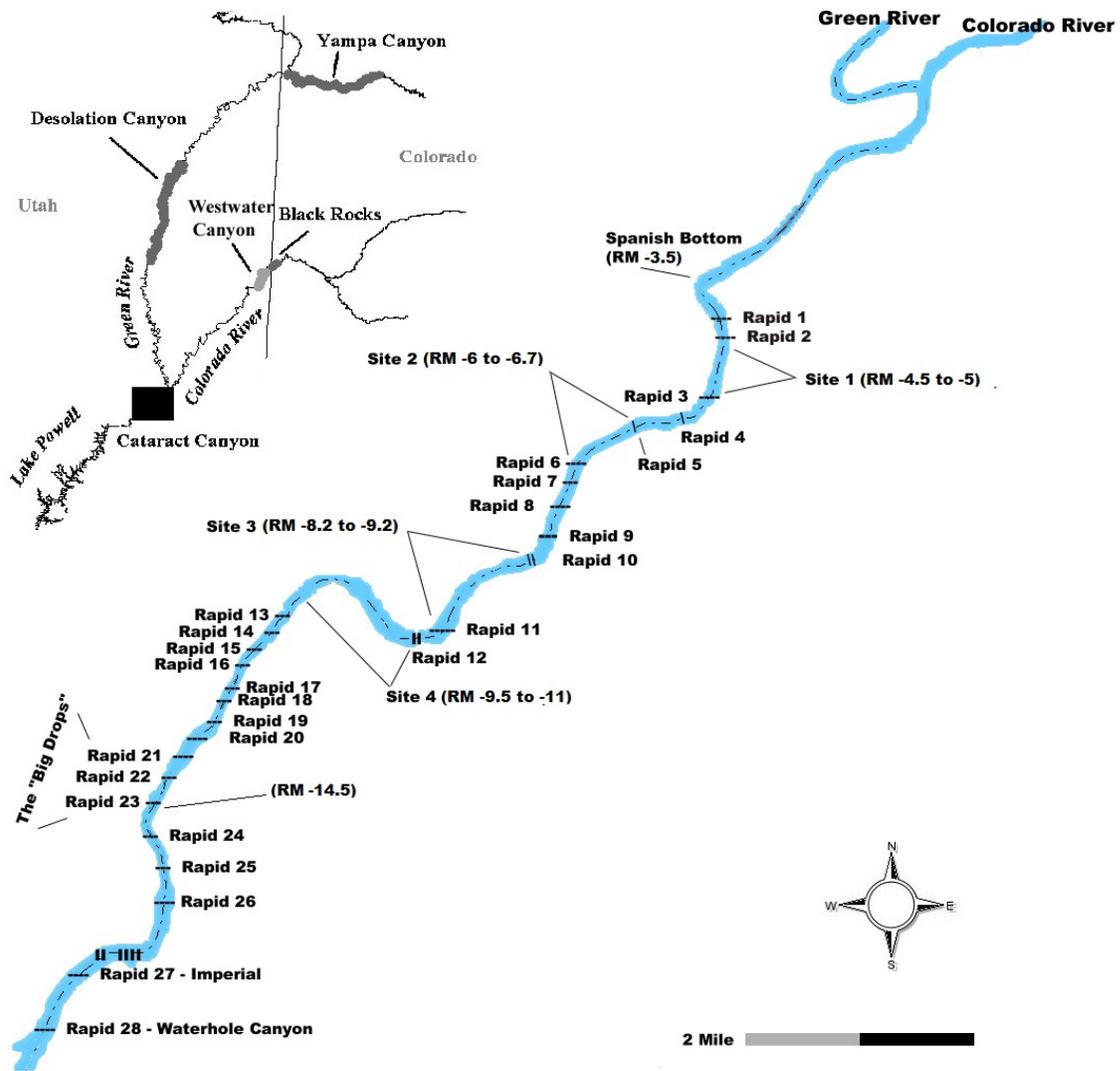


Figure 1. Map depicting Upper Basin humpback chub population distributions (upper left), Cataract Canyon sampling sites, rapids and other landmarks.

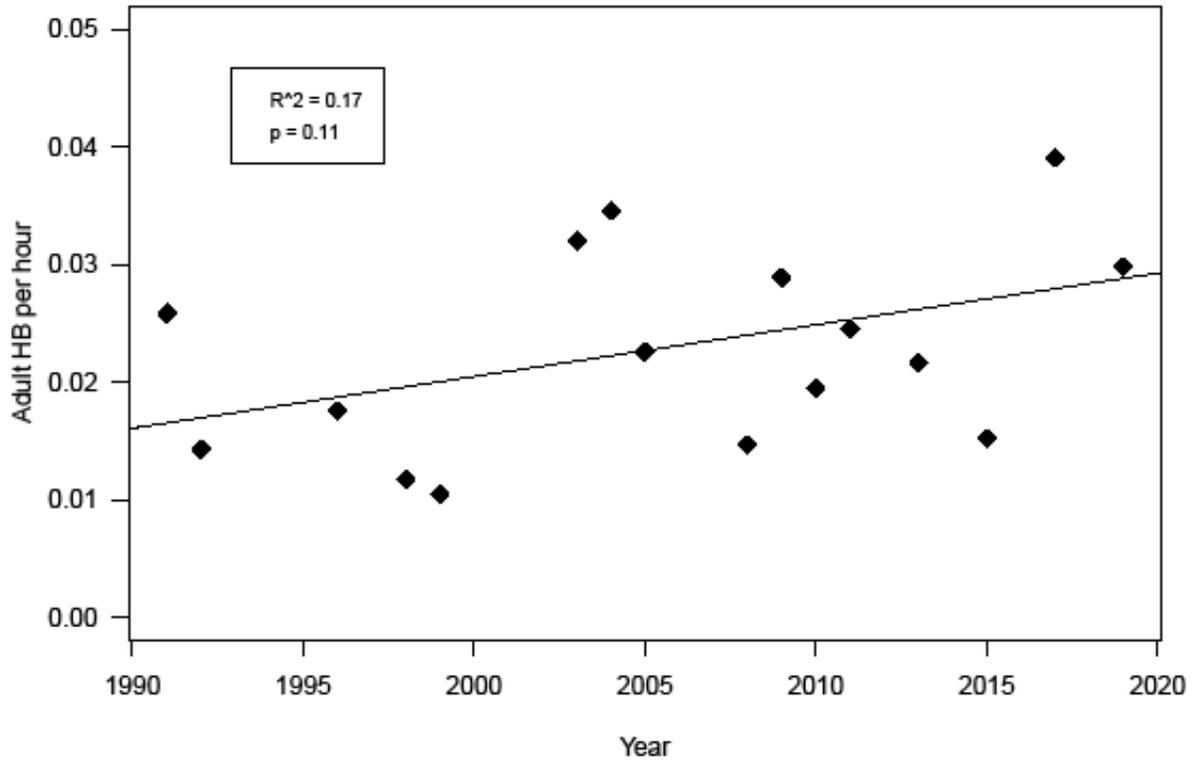


Figure 2. Overall adult humpback chub CPUE by year. Cataract Canyon, 1991-2019. Trend line denotes linear regression model fit which is not statistically significant ($p = 0.11$).

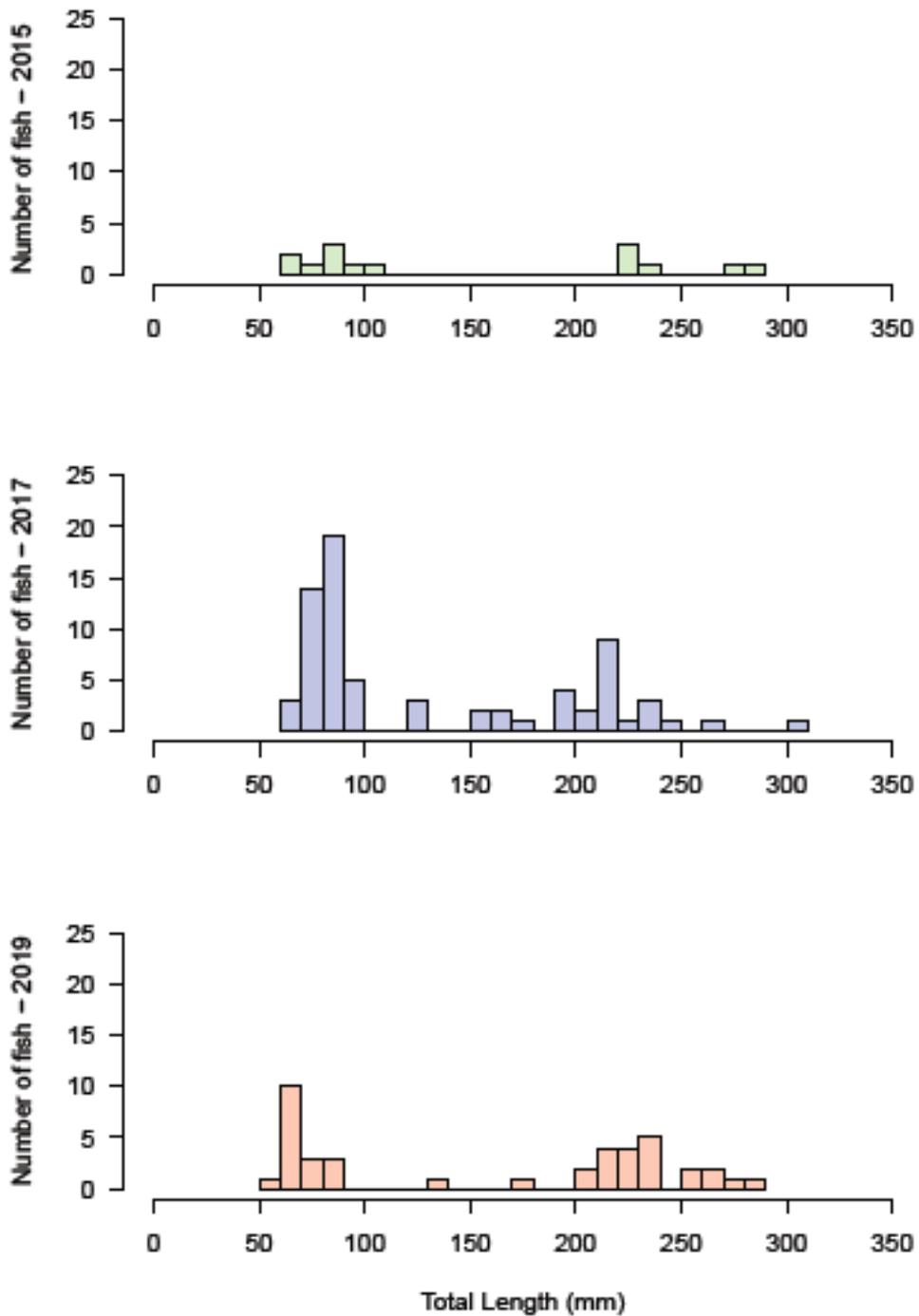


Figure 3. Length frequency distribution of all humpback chub and sub-juvenile *Gila* not identified to species, Cataract Canyon, 2015 - 2019.

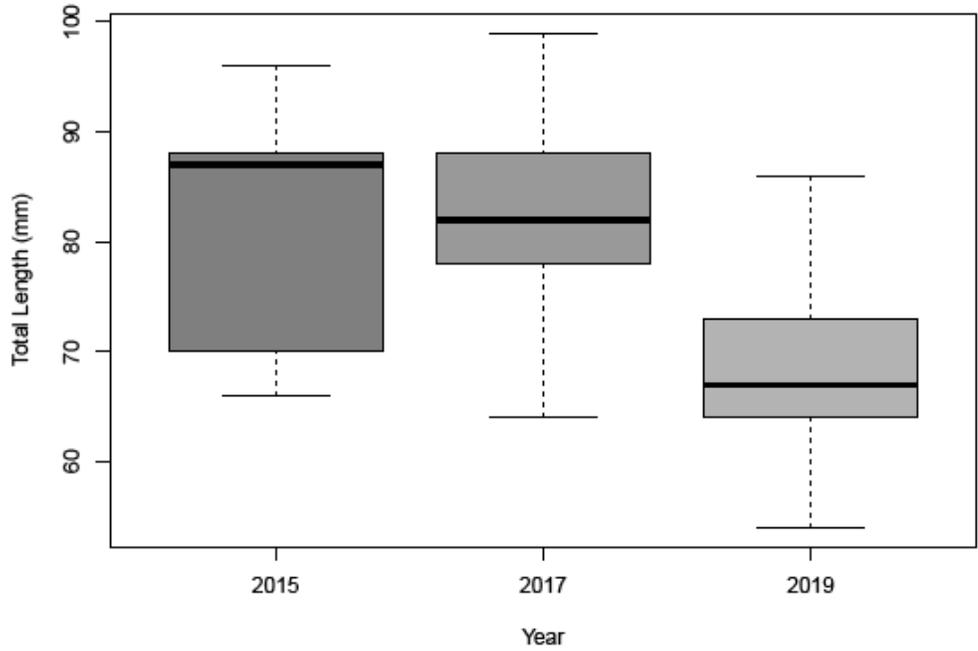


Figure 4. Total length comparison of presumed age-0 *Gila* by year, 2015-2019. Analysis of variance found significant difference between years ($F(2,62) = 15.5, p < 0.001$). Post-hoc Tukey's HSD test found 2019 lengths differed significantly from both 2015 ($p = 0.007$ and 2017 ($p < 0.001$).

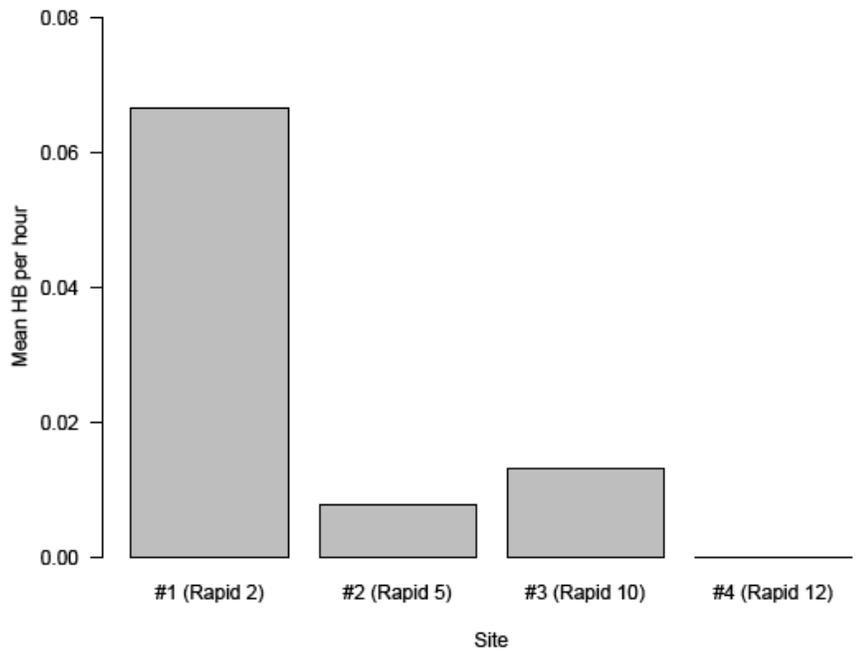


Figure 5. Mean humpback chub trammel net CPUE, by site, Cataract Canyon, 2019. Site #1 is the upstream-most site.

Table 1. Comparison of methods, years sampled, effort, and catch rates for adult humpback chub and bonytail, juvenile humpback chub, and *Gila spp.* < 150 mm in total length; all sites combined, Cataract Canyon, 2003-2019. Reports annual and overall totals of captures and effort plus annual CPUEs averaged for each species and gear type.

Method	Year	Number of fish				CPUE fish/hr				
		HB adult	HB juv.	BT adult	<i>Gila</i> sub-juv.	Effort (hrs)	HB adult	HB juv.	BT adult	<i>Gila</i> sub-juv.
Trammel net	2003	44	0	20	0	1375	0.032	0.000	0.015	0.000
	2004	43	0	1	0	1245	0.035	0.000	0.001	0.000
	2005	31	0	5	0	1375	0.023	0.000	0.004	0.000
	2008	6	0	0	0	409	0.015	0.000	0.000	0.000
	2009	18	0	1	0	623	0.029	0.000	0.002	0.000
	2010	11	0	2	0	566.2	0.019	0.000	0.004	0.000
	2011	9	0	0	0	366.8	0.025	0.000	0.000	0.000
	2013	11	0	0	0	508.3	0.022	0.000	0.000	0.000
	2015	5	0	0	0	329.2	0.015	0.000	0.000	0.000
	2017	17	2	2	0	435.5	0.039	0.005	0.005	0.000
	2019	17	0	3	0	570.1	0.030	0.000	0.005	0.000
Total/Average		212	2	34	0	7803.1	0.027	0.000	0.004	0.000
Scented hoop net	2013	0	0	0	0	30	0.000	0.000	0.000	0.000
	2015	0	0	1	8	1683	0.000	0.000	0.001	0.005
	2017	2	4	0	46	3025	0.001	0.001	0.000	0.015
	2019	3	1	0	18	3746	0.001	0.000	0.000	0.005
Total/Average		5	5	1	72	8484	0.001	0.001	0.000	0.008

Table 2. Total fish captured, all gear types, Cataract Canyon 2019.

Species	Number of fish
black bullhead <i>Ameiurus melas</i>	1
bluehead sucker <i>Catostomus discobolus</i>	22
bonytail <i>Gila elegans</i>	2
channel catfish <i>Ictalurus punctatus</i>	191
common carp <i>Cyprinus carpio</i>	18
Colorado pikeminnow <i>Ptychocheilus lucius</i>	0
flannelmouth sucker <i>Catostomus latipinnis</i>	70
green sunfish <i>Lepomis cyanellus</i>	4
gizzard shad <i>Dorosoma cepedianum</i>	3
humpback chub <i>Gila cypha</i>	21
hybrid sucker <i>Catostomus latipinnis</i> x <i>Xyrauchen texanus</i>	1
native chub <i>Gila spp.</i>	21
red shiner <i>Cyprinella lutrensis</i>	2
roundtail chub <i>Gila robusta</i>	19
razorback sucker <i>Xyrauchen texanus</i>	9
striped bass <i>Morone saxatilis</i>	1
speckled dace <i>Rhinichthys osculus</i>	1
walleye <i>Sander vitreus</i>	2
yellow bullhead <i>Ameiurus natalis</i>	9

Table 3. Summary of submersible PIT antenna detections, Cataract Canyon, 2019. Additional tags (n = 2) were detected but not attributed to species in STReaMS as of 27 November 2019.

Most Recent Tag	Tag Deploy Date	Tag Deploy River	Common Name	Source Hatchery	Days In River
3DD003D4B176B	9/18/2019	Colorado River	razorback sucker	Ouray National Fish Hatchery - Grand Valley Unit	70
3DD003BC4B696	9/25/2018	Green River	razorback sucker	Southwestern Native Aquatic Resources & Recovery Center	428
3DD003BC4BAAE	9/25/2018	Green River	razorback sucker	Southwestern Native Aquatic Resources & Recovery Center	428
3DD003BC19457	9/12/2014	Green River	razorback sucker	Ouray National Fish Hatchery - Randlett Unit	1902
3D91C2E0B5368	9/13/2013	Green River	razorback sucker	Ouray National Fish Hatchery - Randlett Unit	2266
3D91C2DFDED75	9/12/2013	Colorado River	razorback sucker	Ouray National Fish Hatchery - Grand Valley Unit	2267
3D91C2DE20BC2	8/26/2013	Colorado River	razorback sucker	Ouray National Fish Hatchery - Grand Valley Unit	2284
3D91C2DD88675	9/11/2012	Green River	razorback sucker	Ouray National Fish Hatchery - Randlett Unit	2633
3D91C2D9E56E0	9/15/2011	Green River	razorback sucker	Ouray National Fish Hatchery - Randlett Unit	2995
3D91C2D9E4AD5	9/15/2011	Green River	razorback sucker	Ouray National Fish Hatchery - Randlett Unit	2995
3D91C2D918C36	9/1/2011	Green River	razorback sucker	Ouray National Fish Hatchery - Randlett Unit	3009
3D91C2D90A415	9/1/2011	Green River	razorback sucker	Ouray National Fish Hatchery - Randlett Unit	3009
3D9257C6B1BCC	9/28/2007	Green River	razorback sucker	Ouray National Fish Hatchery - Randlett Unit	4443