Spring 2018 Monitoring of Humpback Chub (*Gila cypha*) and other Fishes in the Lower 13.57 km of the Little Colorado River, Arizona

Trip Report for:

April 17-27, 2018 and May 15-25, 2018

Prepared for: U.S. Geological Survey Grand Canyon Monitoring and Research Center Flagstaff, Arizona

by

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INTRODUCTION

In spring 2018, the U.S. Fish and Wildlife Service with assistance from Navajo Nation Department of Fish and Wildlife (NNDFW) and volunteers conducted two (April 17-27, May 15-25) native fish monitoring trips on the Little Colorado River (LCR), Arizona. These trips were designed to gather population and biological data on the fish community in the lower 13.57 km of the LCR. The primary emphasis of the study was on the Grand Canyon population of endangered Humpback Chub (*Gila cypha*, HBC) using mark-recapture abundance estimation. This trip report summarizes the sampling efforts and data collected on the LCR physical properties and fishes captured on both trips. The annual report to Grand Canyon Monitoring and Research Center (GCMRC) will present the mark-recapture population estimates for spring 2018.

METHODS

The lower 13.57 km of the LCR was separated into nine contiguous ~1.5 km reaches. For both spring monitoring trips, one survey crew was stationed at each of three camps along the river: Salt (rkm 10.4 above the confluence), Coyote (rkm 9.0 km), and Boulders (rkm 1.9 km) (Figure 1). Each camp was responsible for sampling an upper, middle, and lower reach within their designated area.

	April 16-26, 20	18		May 15-25, 2018	
Camp	Name	Affiliation	Camp	Name	Affiliation
	David R. Vanhaverbeke	USFWS		Michael Pillow	USFWS
Salt	Brad Buechel	USFWS	Salt	Kim Yazzie	NNDFW
	Bill Pine	Volunteer		Marshall Lindsay	AGFD
	Jim Walters	USFWS		Jim Walters	USFWS
Covoto	Dennis Stone	USFWS	Coyote	Diane Haas	Volunteer
Coyote	Chad Baumler	USFWS		Kim Quaranta	Volunteer
	Andrew Mathis	Volunteer		David R. Vanhaverbeke	USFWS
Boulders	Rick Deshler	USFWS	Boulders	Rick Deshler	USFWS
	Chase Ehlo	USFWS		Kirsten Tinning	Volunteer
	Zeke Smith	Volunteer			

Participating Personnel:

Hoop Netting:

Each reach was sampled for three overnight (~24 hr) hoop net (0.5-0.6 m diameter, 1.0 m length, 6 mm mesh, single 10 cm throat) sets amounting to 60 net hauls per reach and 180 hauls per camp. The nets were deployed primarily along the shoreline and positioned in habitat suspected of yielding high numbers of HBC. In many cases, hoop nets were repositioned if the catch was

poor or an alternate site was available nearby (e.g. across the river). All hoop nets were set with consideration for human safety and resource impacts.

Data Collection:

Both net set- and fish-specific data were collected for each net set. Along with set and pull times, all net locations were recorded (rkm above the confluence with the Colorado River) and marked on aerial maps of the LCR provided by GCMRC (Figure 1). Total length (TL, mm), fork length (FL, mm), sex (male/female), and sexual condition (ripe/not ripe) were recorded for HBC, Bluehead Sucker (*Catostomus discobolus*, BHS), and Flannelmouth Sucker (*Catostomus latipinnis*, FMS). Only TL was recorded for all other species captured. All large-bodied native fish (HBC, BHS, FMS) were scanned for passive integrated transponder (PIT, Biomark, Inc.) tags. PIT tag numbers for each fish were recorded along with the physical attribute data described above. With few exceptions, all HBC \geq 80mm TL without a tag were PIT-tagged, as were FMS and BHS \geq 150mm TL.

Water turbidity (Hach 2100p turbidimeter) was recorded each afternoon (between 12pm and 8pm) at Coyote camp in April and Salt camp in May. Turbidity data is reported in mean (n=3 samples/day) Nephelometric Turbidity Units (NTU). LCR flow data were downloaded after both trips from the USGS gauge station (09402300) near the mouth of the LCR and presented as mean daily cubic feet per second (cfs). A more detailed description of standard sampling methods and sub-reach divisions can be found in Van Haverbeke et al. (2013).

PIT Tag Antennas:

Starting in 2014, the USFWS began piloting a project to supplement hoop net capture data with PIT tag antennas (Marsh & Associates, LLC) deployed from shore at specific locations. These battery-powered antennas detect and record PIT tag numbers along with date and time of contact of PIT tagged fish that swim in its proximity. The purpose of the antennas is to detect previously tagged fish that may not enter hoop nets on a particular trip, to increase the overall number of fish contacted, and to detect the movement of fish within or between sampled sub-reaches in the LCR. These antennas can also provide survival information for fish that have avoided capture for many years.

In the LCR, one shore-based antenna was installed in April 2015 near Coyote Camp at rkm 8.68 above the confluence and was powered by a 12V battery and solar panel charger. This antenna is programmed to continuously record date, time, and PIT tag number of detected fish throughout the year, for as long as the battery kept its charge. Rodent damage that occurred in late fall 2017 caused a power failure in the Coyote antenna, resulting in no data collected for spring 2018.

During the April 2018 LCR monitoring trip, six portable, submersible antennas were deployed in Boulders reach on both sides of Amazon Island between rkm 1.10 and 1.55 (4 on the right, 2 on the left) to better understand movement of HBC around Amazon Island. The river along left side

of Amazon Island has mostly swift, turbulent current, a series of small travertine pour-overs, and scattered boulders. On the right side of Amazon Island is a single travertine pour-over, however most of the channel consists of calm and deeper water with a more densely vegetated shoreline and sandy substrate.

All antennas were deployed at a single, fixed location and programmed to record continuously for between six and eight days, depending on battery life. For all antennas deployed, species and capture history was determined for each tag detected using a database of tagged fish in Grand Canyon.

RESULTS

Presented below are summary data relating to fish captures, detections and physical parameters of the LCR. All lengths are TL and all flow data from the USGS gauge station are provisional and subject to revision.

Little Colorado River:

Mean daily discharge during both spring 2018 trips remained around base flow, ranging between 220 and 223 cfs in April and 217 and 218 cfs in May (Figure 2). Daily mean turbidity levels ranged from 45.7 to 63.4 NTU in April and 53.2 to 61.1 NTU in May, which are near-optimum levels for high hoop-net catchability of HBC and FMS (*sensu*, Stone 2010).

Hoop Netting Effort

Personnel from each camp set 180 hoop nets over the course of each 9-day monitoring trip. This resulted in 1,080 hoop net sets over the course of both trips totaling 25,501 hrs of hoop netting effort (Table 1). April and May netting effort (soak time) ranged from 14.57 hrs to 32.55 hrs and averaged 23.61 hrs, SD=3.22).

Humpback Chub:

Of the 7,869 fish captures for both spring trips combined, most (n=4,304; 54.7%) were HBC (Table 2). The number of unique captures was identified for all fish with PIT tags. Overall, 80.8% (n=3,450) of the tagged HBC \geq 70 mm TL captured during both spring trips were unique.

HBC catch per unit effort (CPUE) was calculated by comparing total chub captures to total effort (net set hours) for each camp and trip. CPUE was highest (Table 1) at Salt camp in both April (0.184 HBC/hr) and May (0.188 HBC/hr).

Length frequency histograms for both trips show a couple of distinct peaks, or modes, centered on size classes (Figure 3). In April, a peak is centered around 140 mm, which represents captures of age-1 HBC. The other April HBC size (TL) data show a peak around 240 mm, representing the adults in the system. May trip data show peaks similar to April, with the age-1 peak centered

around 150 mm, the age-2+ peak around 250 mm. In May, we also begin to see the age-0 HBC appear in our nets, with a few (n=17) captures less than 60 mm.

Flannelmouth Sucker:

FMS made up 11.8% (n=929) of total fish captures for both spring trips (Table 2). Of the FMS \geq 150 mm TL (n=582) captured in combined trips 95.0% (n=553) were unique.

Catch per unit effort was calculated for tagged FMS \geq 150 mm captured during the second spring trip and compared to CPUE calculated for spring trips in previous years. Only data from the second spring trips were used because of the historic variability of turbidity-related capture efficiency levels during first spring trips in previous years. Figure 4 shows a FMS CPUE increase since 2015, with 2018 being the 3rd highest capture rate (0.57 FMS per net +/- 0.04 SE) in 18 years of data collection.

Length frequency histograms for FMS in April show a relatively even distribution of sizes captured between 60 mm and 500 mm. In May, a larger age-0 cohort appears around 40mm with the capture of 133 FMS <70 mm TL (Figure 3).

Bluehead Sucker:

BHS made up 22.6% (n=1,775) of the total fish captures in April and June (Table 2). Of the total BHS captures during both trips, 97.6% (n=1,132) were unique.

BHS CPUE was also calculated for tagged BHS \geq 150 mm for the second spring trip and compared to CPUE calculated for spring trips in previous years. Figure 4 shows May BHS CPUE (1.59 BHS/net, SE ±0.41) an increase from June 2017.

Length frequency histograms for BHS captured in both April and May show captures distributed around two distinct peaks, one at 50 mm (presumably age-0 fish) and the other at 250 mm, likely representing age-2+ fish (Figure 3).

Other fish species:

Speckled Dace (*Rhinichthys osculus*, SPD), another native fish species in the LCR, made up 6.2% (n=486) of the total captures and there were 15 age-0 suckers that were too small to identify to species. Also, one large (323 mm TL) sucker was identified as a FMS x Razorback Sucker (*Xyrauchen texanus*, RBS) hybrid (FRH), but was grouped with the FMS for analysis purposes in this report and another fish was given a PIT tag, but not identified to species in the data (UNK, Table 2). Non-native fish species made up 4.8% (n=374) of total captures for both spring trips. These non-native species were: Fathead Minnow (*Pimephales promelas*, FHM, n=330), Plains Killifish (*Fundulus zebrinus*, PKF, n=21), Channel Catfish (*Ictalurus punctatus*, CCF, n=3), Red Shiner (*Cyprinella lutrensis*, RSH, n=2), Black Bullhead (*Ameiurus melas*,

BBH, n=1), Common Carp (*Cyprinus carpio*, CRP, n=1), and Rainbow Trout (*Oncorhynchus mykiss*, RBT, n=1) (Table 2).

Sex Condition:

Sex (male or female) was determined for 62.5% (n=2,637) of HBC \geq 100 mm TL, 97.4 % (n=1,410) of BHS \geq 150 mm TL, and 34.5% (n=202) of FMS \geq 150 mm TL captured, and sex condition (ripe, not ripe, or spent) was determined for all tagged HBC and suckers. For HBC captured in April for which sex was determined, most males (n=593, 73.9%) were ripe (Table 3). This decreased in May, when just over half of the male HBC \geq 100mm (n=412, 53.9%) captures were ripe. For female HBC in April, 5.8% (n=31) were ripe, compared to 2.4% (n=14) in May. Figure 1 shows the locations where ripe female HBC were captured during spring 2018 monitoring.

Male BHS were overwhelmingly ripe on both trips (April: n=436, 96.2%; May: n=650, 95.9%), while 54.8% (n=69) of the females captured in April and 52.9% (n=81) of the females captured in May were ripe. Only two (8.6%) ripe, male FMS and three (7.9%) ripe female FMS were captured in April. In May, three ripe male (7.9%) and three ripe female (4.6%) FMS were captured. (Table 3).

Antennas:

<u>Boulders:</u> The six portable, submersible PIT tag antennas that were deployed in Boulders reach in April were active for between 144.5 and 184.8 hrs, with an average active time of 164.7 (SD=15.1) hrs (Table 4). During that time, the antennas detected 387 unique tags. The total number of unique HBC detected around Amazon Island was 318 (82.2% of all unique Amazon Island detections).

Overall, of the 1,042 unique fish contacted in Boulder's reach (rkm 0.0 - 4.66) in April (antennas, hoop nets, or both), the six antennas set between rkm 1.30 and 1.41 detected 37.1% (n=387, Table 4). Thirty-six percent (n=233) of all unique HBC encountered in Boulders reach were detected by antenna, and would have been missed by hoop net only sampling and 13.1% (n=85) were detected by antennas and caught in hoop nets (Table 5).

Also, there were 55 HBC, 7 BHS, and 2 FMS detected by an antenna that have not been captured by hoop nets in more than five years, two HBC, and one FMS have not been captured in more than 10 years. That FMS, last captured in 2003, has not been handled in more than 14 years. There were ten fish detected by antennas that could not be identified to species because there were no capture records for them in the GCMRC master database.

LITERATURE

- Stone, D.M. 2010. Overriding effects of species-specific turbidity thresholds on hoop-net catch rates of native fishes in the Little Colorado River, Arizona. Transactions of the American Fisheries Society 139(4):1150-1170.
- Van Haverbeke, D.R., Stone, D.M., Coggins, L.G. Jr., Pillow M.J. 2013. Long-term monitoring of an endangered desert fish and factors influencing population dynamics. Journal of Fish and Wildlife Management 4(1):163-177.

TABLES & FIGURES

Trip	Reach	Eff	fort	Total	CPUE		
		net sets	hours	HBC	per set	per hour	
April	Boulders	180	4,138	473	2.63	0.114	
	Coyote	180	4,404	802	4.46	0.182	
	Salt	180	4,150	764	4.24	0.184	
	Total	540	12,691	2,039	3.78	0.161	
May	Boulders	180	4,089	632	3.51	0.155	
	Coyote	180	4,390	820	4.56	0.187	
	Salt	180	4,330	813	4.52	0.188	
	Total	540	12,809	2,265	4.19	0.177	
Grand Total		1,080	25,501	4,304	3.99	0.169	

Table 1. Summary of effort (number of hoop nets set and total hoop net hours), total Humpback Chub (HBC) captured, and mean HBC catch per unit effort (fish captured per net-hour) at each camp per trip during spring 2018 Little Colorado River monitoring.

Table 2. Summary of all fish captured by camp and by species during spring 2018 Little Colorado River monitoring.

Trip I	Dooch	Species	s*											т	Total
	Keach	HBC	BHS	FMS	SPD	FHM	CCF	CRP	BBH	PKF	RSH	RBT	SUC	UNK	Total
April	Boulders	473	281	164	68	25	0	0	0	1	1	0	0	0	1,013
	Coyote	802	371	149	53	33	1	0	0	1	0	0	1	0	1,411
	Salt	764	93	52	100	85	0	1	1	0	0	0	1	0	1,097
	Total	2,039	745	365	221	143	1	1	1	2	1	0	2	0	3,521
May	Boulders	632	367	229	45	4	1	0	0	2	1	1	0	0	1,282
	Coyote	820	242	263	42	51	1	0	0	15	0	0	0	1	1,435
	Salt	813	421	72	178	132	0	0	0	2	0	0	13	0	1,631
	Total	2,265	1,030	564	265	187	2	0	0	19	1	1	13	1	4,348
Gran	nd Total	4,304	1,775	929	486	330	3	1	1	21	2	1	15	1	7,869

*HBC = humpback chub (*Gila cypha*), BHS = bluehead sucker (*Catostomus discobolus*), FMS = flannelmouth sucker (*Catostomus latipinnis*), SPD = speckled dace (*Rhinichthys osculus*), FHM = fathead minnow (*Pimephales promelas*), CCF = channel catfish (*Ictalurus punctatus*), CRP = Common Carp (*Cyprinus carpio*), BBH = black bullhead (*Ameiurus melas*), PKF = plains killifish (*Fundulus zebrinus*), RSH = Red Shiner (*Cyprinella* lutrensis), RBT = Rainbow Trout (*Oncorhynchus mykiss*), SUC = undetermined sucker species, UNK = species unknown/not recorded.

Table 3. Summary of sex condition of all unique male and female BHS and FMS \geq 150, and HBC \geq 100 mm by trip, captured in spring 2018. *The 39 female HBC captured in April that were classified as 'spent' in the data were grouped into the 'not ripe' category for this analysis.

			April Trip		May Trip			
Species	Sexual Condition	Male	Female	Undetermined Sex	Male	Female	Undetermined Sex	
IDC	Ripe	593 (73.9%)	31 (5.8%)		412 (53.9%)	14 (2.4%)		
нвс	Not Ripe	209 (26.1%)	467 (94.2%)	681	352 (46.1%)	559 (97.6%)	904	
рис	Ripe	436 (96.2%)	69 (54.8%)		650 (95.9%)	81 (52.9%)		
внэ	Not Ripe	17 (3.8%)	57 (45.2%)	10	28 (4.1%)	72 (47.1%)	27	
FMS	Ripe	2 (8.6%)	3 (7.9%)		3 (8.6%)	3 (4.6%)		
	Not Ripe	30 (91.4%)	68 (92.1%)	172	32 (91.4%)	58 (95.4%)	211	

Table 4. Boulders Camp antenna set location (side and distance from confluence), duration, unique humpback chub PIT tag detections, and humpback chub detection rate (detections/hr) for each antenna set in the Little Colorado River in April 2018.

Set L	location in	n Little Colorado River	Set Duration	Unique HBC	Detection Rate
RKM	Side	Site	(h)	Detections (n)	(HBC/hr)
1.30	С	Amazon Island, Left Side	184.03	8	0.04
1.31	R		164.10	161	0.98
1.32	R	Amazon Island Dight Sida	157.25	167	1.06
1.33	R	Amazon Island, Kight Side	153.47	232	1.51
1.35	R		144.53	80	0.55
1.41	С	Above Amazon Island	184.75	1	0.01

Species	Antenna	Hoopnet &	Hoopnet	Total
_	Only (n)	Antenna (n)	Only (n)	
BHS	39 (14.6%)	1 (0.4%)	228 (85.1%)	268
FMS	15 (12.9%)	4 (3.4%)	98 (84.5%)	117
HBC	233 (36.0%)	85 (13.1%)	329 (50.9%)	647
UNK	10 (100%)	0	0	10
Grand Total	297 (28.5%)	90 (8.6%)	655 (62.9%)	1,042

Table 5. Summary of all fish contacted by antennas, hoop nets, or both in Boulders reach (rkm 0.0 - 4.66) during the April 2018 trip. Percentages represent the proportion of fish captured per gear type. UNK = PIT tag numbers were not found in the Grand Canyon fish database.



Figure 1. Map of the lower 13.56 km of the Little Colorado River showing the locations of all three camps and hoop nets (small, red circles) set during the U.S. Fish and Wildlife Service spring monitoring in 2018. The map also shows the location of each ripe female HBC (larger, yellow circles) captured during both spring monitoring trips.



Figure 2. Spring 2018 water quality summary. Gray area represents provisional mean daily flows (ft³/sec, cfs) of the Little Colorado River at the USGS gauge station (09402300) at the mouth of the Little Colorado River April 10-May 31, 2018. White circles indicate afternoon turbidity (Nephelometric Turbidity Units, NTUs) of the Little Colorado River per sample day at Salt Camp (rkm 10.44). Dashed lines represent the turbidity threshold between three HBC catchability zones: high catch zone (\leq 54 NTU), transition zone (55-544 NTU), and low catch zone (\geq 545 NTU, Stone 2010).



April and June Trip Length Frequency Distributions for HBC, FMS, and BHS

Figure 3. Length frequency distributions for all Humpback Chub (*Gila cypha*, HBC), Flannelmouth Sucker (*Catostomus latipinnis*, FMS), and Bluehead Sucker (*Catostomus discobolus*, BHS) captures during monitoring of the Little Colorado River in April (top) and May (bottom) 2018. Note: Scale differs with species.

Figure 4. Relative abundance (catch per unit effort, CPUE \pm SE) of Bluehead Sucker (black circles) and Flannelmouth Sucker (red triangles) during the second spring Little Colorado River monitoring trips 2001-2017. Note: Scale differs with species. Second spring trip occurred between April and May: 2003-2006, in May only: 2002, 2007-2009, 2012-2016, 2018 and in June only: 2001, 2010, 2011, and 2017.

