

Spring 2016 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 19-29
and
May 17-27, 2016

Prepared for:

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

by

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INTRODUCTION

In April and May 2016, the U.S. Fish and Wildlife Service with assistance from the Arizona Game and Fish Department (AGFD) and volunteers conducted two (April 19-29, May 17-27) ten-day native fish monitoring trips on the Little Colorado River (LCR), Arizona. These trips were designed to gather population and biological data on the native fish community in the lower 13.57 km of the LCR, with the primary emphasis 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. The annual report to Grand Canyon Monitoring and Research Center (GCMRC) will present the mark-recapture population estimates for spring 2016.

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 (10.4 km above the confluence), Coyote (9.0 km), and Boulders (1.9 km). Each camp was responsible for sampling an upper, middle, and lower reach within their designated area.

Participating Personnel:

April 19-29, 2016			May 17-27, 2016		
Camp	Name	Affiliation	Camp	Name	Affiliation
Salt	David R. Van Haverbeke	USFWS	Salt	David R. Van Haverbeke	USFWS
	Robin Osterhoudt	AGFD		Kirsten Tinning	Volunteer
	Mark Van Haverbeke	Volunteer		Bill Pine	Volunteer
Coyote	Jim Walters	USFWS	Coyote	Jim Walters	USFWS
	Michael Pillow	USFWS		Chase Ehlo	USFWS
	Lisa Winters	AGFD		Laurie Nessel	Volunteer
	Kristy Manuell	AGFD		Rick Deshler	USFWS
Boulders	Dennis Stone	USFWS	Boulders	Brad Buechel	USFWS
	Rick Deshler	USFWS		Julie Schroeter	Volunteer
	Wendy Sealy	USFWS			

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. Generally, 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 set-specific 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 standard aerial maps of the LCR provided by GCMRC. 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 ≥ 80 mm TL without a tag were PIT tagged, as were FMS and BHS ≥ 150 mm TL.

Water turbidity (Hach 2100p turbidimeter) was recorded each afternoon (between 12pm and 7pm) at Boulders camp during both trips. Turbidity data is reported in mean ($n=3$ samples/day) Nephelometric Turbidity Units (NTU). LCR flow data was downloaded after both trips from the USGS gauge station (09402300) at the mouth of the LCR and is 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).

Submersible Antennas:

Starting in 2014, the USFWS began piloting a project to supplement hoop net capture data with submersible 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 Little Colorado River, one antenna was installed in April 2015 near Coyote Camp at 8.68 km above the confluence and was powered by a 12V battery and solar panel charger. This antenna was 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.

During the spring 2016 LCR monitoring trips, three portable, submersible antennas were deployed near typical hoop net sets in Boulders reach. In April, all three antennas were deployed and programmed to record continuously for three nights near the corresponding hoop net sets at 2.03, 2.21, and 2.83 km, and were then moved near different hoop net sets at 1.32, 1.57, and 1.86 km. In May, each antenna was deployed at a single location (1.32, 1.94, and 2.83 km) for approximately eight days, pausing only for a battery swap on day five. 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 reported in TL and all flow data from the USGS gauge station are provisional and subject to revision.

Little Colorado River:

Mean daily discharge during the entire April trip remained at base flow, fluctuating between 212 cfs and 215 cfs (Figure 1). Daily mean turbidity levels at Boulders camp ranged from 60.6 to 87.6 NTU in April, remaining just outside the HBC high-catch zone threshold reported in Stone (2010).

The mean daily discharge for the May trip (214-222 cfs) also remained at base flow for most of the trip, with the exception of a minor freshet that reached the lower LCR on the evening of May 21, which increased mean discharge to 222 cfs before dropping back to near base flow levels (216 cfs) the next day. This freshet also caused a spike in daily afternoon turbidity levels from between 57 and 82 NTU for the first few days to 3,607 NTU on May 21. Turbidity then dropped back to 80 NTU by May 24 (Figure 1).

Hoop Netting Effort

Personnel from each camp set 180 hoop nets over the course of the 9-day monitoring effort with the exception of the Salt camp crew in April, who only set 160 nets. This resulted in 1,060 total hoop net sets over the course of both trips totaling 24,597 hrs of hoop netting effort (Table 1). April and May hoop net effort (time in the water) ranged from 16.08 hrs to 31.25 hrs and averaged 23.20 hrs, SD=2.95).

Humpback Chub:

Of the 5,834 fish captures for both spring trips combined, most (n=3,317; 56.9%) were HBC (Table 2). The number of unique captures was identified for all fish with a PIT tag. Overall, 83.7% (n=2,776) of the HBC captured during both spring trips were unique. Of these unique HBC, the majority (n=2,643, 95.2%) were either tagged for the first time in spring 2016 or had been captured by USFWS or cooperating agencies within the past five years. There were, however, nine HBC that had not been captured in more than 10 years. Of those nine, two (410 mm, 405 mm) were last captured in 2002 (14 years) and one of them (375 mm) was last captured in 1995 (21 years).

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 Coyote camp for both trips (April: 0.170 HBC/hr; May: 0.75 HBC/hr).

Length frequency histograms for both trips show distinct peaks, or modes, centered on size classes (Figure 3). In April, a distinct peak centered around 110 mm, which represents captures of age-1 HBC and the peak around 360 mm represents sub-adult and adult HBC (age 2+). May trip data show similar peaks, with the age-1 peak centered around 120 mm. In May, we also begin to see the age-0 HBC appear in our nets, with a few (n= 10) captures less than 60 mm.

Flannelmouth Sucker:

FMS made up 8.5% (n=494) of total fish captures for both spring trips (Table 2). Of the FMS captured during April and May trips, 83.2% (n=411) were unique. Of these unique fish, 17 had not been captured in more than five years and four FMS had travelled more than 130 miles from their last capture location in the Colorado River.

Catch per unit effort was calculated for tagged FMS ≥ 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 2 indicates a FMS CPUE increase from 2015, but still an overall decrease from its highest documented point in 2010.

Length frequency histograms for FMS indicate the presence of few age-0 fish in April, which increase in size and quantity by the May sampling (Figure 3). These figures also show adult size group peaks centered around 170 mm and 420 mm in both April and May trips (Figure 3).

Bluehead Sucker:

BHS made up 20.9% (n=1,217) of the total fish captures in April and May (Table 2). Of the total BHS captures during both trips, 83.5% (n=1,016) were unique and most (n=984, 96.9%) were captured and tagged for the first time. Only four of the BHS recaptures had been at large more than five years (range: 5.5 – 9.1 years), but one travelled over 140 miles since its last capture.

BHS CPUE was also calculated for tagged BHS ≥ 150 mm for the second spring trip and compared to CPUE calculated for spring trips in previous years. Figure 2 indicates that BHS CPUE increased significantly from 2015, but still shows an overall decrease from 2008 and 2013 capture rates.

Length frequency histograms for BHS captured in April and May show one peak centered around 240 mm, likely representing age-2+ fish (Figure 3). In May, a second peak also appears around 40-50mm, representing the age-0 size class that became vulnerable to our sampling gear.

Other fish species:

Speckled Dace (*Rhinichthys osculus*, SPD) made up 12.0% (n=701) and non-native fish species made up only 1.7% (n=102) of total captures for both spring trips. These non-native species were: Channel Catfish (*Ictalurus punctatus*, CCF, n=21), Fathead Minnow (*Pimephales promelas*, FHM, n=73), Common Carp (*Cyprinus carpio*, CRP, n=1), Black Bullhead (*Ameiurus melas*, BBH, n=1), Green Sunfish (*Lepomis cyanellus*, GSF, n=1), and Red Shiner (*Cyprinella lutrensis*, RSH, n=1) (Table 2).

Sex Condition:

Sex (male or female) was determined for 44.5% (n=1,236) of HBC, 85.3 % (n=1,016) of BHS, and 50.4% (n=207) of FMS captured, but sex condition (ripe, not ripe, or spent) was determined for all tagged HBC and suckers. For HBC ≥ 150 mm, most males (n=499, 71.2%) were ripe. We also captured 32 (6.2%) ripe females. Male BHS ≥ 150 mm were overwhelmingly ripe (n=696, 97.3%), while ripe females made up 39.5% (n=60) of all females captured. Male and female FMS were less likely to be ripe, with 34.1% (n=29) of males and 11.3% (n=13) of females exuding gametes (Figure 4).

Antennas:

Coyote: The submersible PIT tag antenna that was installed near Coyote Camp at 8.68 km was active for 4,372.5 hours (182.2 days) between April 18, 2015 and April 20, 2016. The antenna shut down and powered up approximately 82 times during that time, likely due to battery drainage and lack of sun exposure on the solar panel. Most (3,735 hours) of this active time occurred between April and November, 2015. During the winter months, the antenna was mostly inactive, powering down on November 6, 2015 and then powering up on February 3, 2016 for 27 minutes. Following that, the antenna was active nearly each day for a gradually increasing amount of time, until it was checked after April 19, 2016 when it was active for just over 19 hours.

Throughout the year, the antenna detected 474 unique PIT tags, most of which were HBC (86%, n=409) (Figure 5). The antenna also detected 49 FMS, five BHS, three CRP, one CCF, and seven PIT tags that were not found in the database. There were 45 fish that were detected ten or more times, and three HBC that had more than 200 detections at the Coyote antenna. A CRP was detected that had not been captured in 12 years, as well as a FMS that had not been captured in over 11 years, and a HBC that has avoided capture for 10 years.

Boulders: The portable, submersible PIT tag antennas that were deployed near hoop nets during spring 2016 monitoring efforts detected a total of 807 unique tags in April and May combined. The antenna with the highest number of unique detections and most unique detections per hour for both spring trips was deployed around 2.83 km (Table 3). The antennas with the lowest detection per hour rate were deployed around 2.03 km in April and 1.93 km in May (Table 3).

Overall, the three antennas deployed in Boulders reach on both trips accounted for 38.8% (n=625) of all fish contacted (antennas, hoop nets, or both gears) in that reach (0.0 – 4.66 km) (Table 4). Of particular interest, is that nearly 44% (n=460) of all unique HBC encountered in Boulders reach during spring monitoring were detected by antenna, and would have been missed by hoop net only sampling. Additionally, over 13% (n=143) were both detected by antennas and caught in hoop nets (Table 4). Also, there were 70 HBC and 17 FMS detected by an antenna that have not been captured in more than five years.

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.

DATA ARCHIVING

The data for these trips are archived at Grand Canyon Monitoring and Research Center in six Microsoft Access files:

LC20160419_Boulders.mdb
LC20160419_Coyote.mdb
LC20160419_Salt.mdb

LC20160517_Boulders.mdb
LC20160517_Coyote.mdb
LC20160517_Salt.mdb

TABLES & FIGURES

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 2016 Little Colorado River monitoring.

Trip	Reach	Effort		Total HBC	CPUE	
		net sets	hours		per set	per hour
April	Boulders	180	4,078	308	1.71	0.076
	Coyote	180	4,317	735	4.08	0.170
	Salt	160	3,685	536	3.35	0.145
	Total	520	12,080	1,579	3.04	0.131
May	Boulders	180	4,099	379	2.11	0.092
	Coyote	180	4,332	760	4.22	0.175
	Salt	180	4,085	599	3.33	0.147
	Total	540	12,517	1,738	3.22	0.139
Grand Total		1,060	24,597	3,317	3.13	0.135

Table 2. Summary of all fish captured by camp and by species during spring 2016 Little Colorado River monitoring.

Trip	Reach	Species*											Total
		HBC	BHS	FMS	SPD	FHM	GSF	CCF	CRP	BBH	RSH	SUC	
April	Boulders	308	253	78	110	7	0	0	0	0	0	0	756
	Coyote	735	214	115	130	28	1	4	0	0	0	1	1,228
	Salt	536	112	22	220	24	0	4	0	1	0	0	919
	Total	1,579	579	215	460	59	1	8	0	1	0	1	2,903
May	Boulders	379	61	117	42	1	0	0	1	0	1	2	604
	Coyote	760	367	121	32	3	0	6	0	1	0	0	1,290
	Salt	599	210	41	167	10	0	7	0	3	0	0	1,037
	Total	1,738	638	279	241	14	0	13	1	4	1	2	2,931
Grand Total		3,317	1,217	494	701	73	1	21	1	5	1	3	5,834

*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*), GSF = green sunfish (*Lepomis cyanellus*), CCF = channel catfish (*Ictalurus punctatus*), CRP = Common Carp (*Cyprinus carpio*), BBH = black bullhead (*Ameiurus melas*), RSH = red shiner (*Cyprinella lutrensis*), SUC = undetermined sucker species.

Table 3. Boulders Camp antenna set duration, unique PIT tag detections by location (distance from the confluence), and detection rate (detections/hr) for each antenna set in the Little Colorado River.

Set Location (km)	Set Duration (h)		Unique Detections		Detections Per Hour	
	<i>April</i>	<i>May</i>	<i>April</i>	<i>May</i>	<i>April</i>	<i>May</i>
2.83	67.50	195.05	194	299	2.87	1.53
2.21	67.95	--	37	--	0.54	--
2.03	69.92	--	31	--	0.44	--
1.94	--	187.47	--	107	--	0.57
1.86	66.77	--	36	--	0.54	--
1.57	67.62	--	51	--	0.75	--
1.32	69.25	186.05	42	137	0.61	0.74

Table 4. Summary of all fish contacted by antennas, hoop nets, or both in Boulders reach (0.0 – 4.66 km) during both spring 2016 trip combined. Percentages represent the proportion of fish captured per gear type. UNK = PIT tag numbers were not found in the Grand Canyon fish database.

Species	Antenna Only (n)	Hoopnet & Antenna (n)	Hoopnet Only (n)	Total
BHS	58 (21.6%)	10 (3.7%)	201 (74.7%)	269
CCF	2 (100%)	0 --	0 --	2
CRP	1 (100%)	0 --	0 --	1
FMS	62 (27.9%)	8 (3.6%)	152 (68.5%)	222
HBC	460 (43.7%)	143 (13.6%)	450 (42.7%)	1053
UNK	42 (100%)	0 --	0 --	42
Grand Total	625 (38.8%)	182 (11.3%)	803 (49.9%)	1610

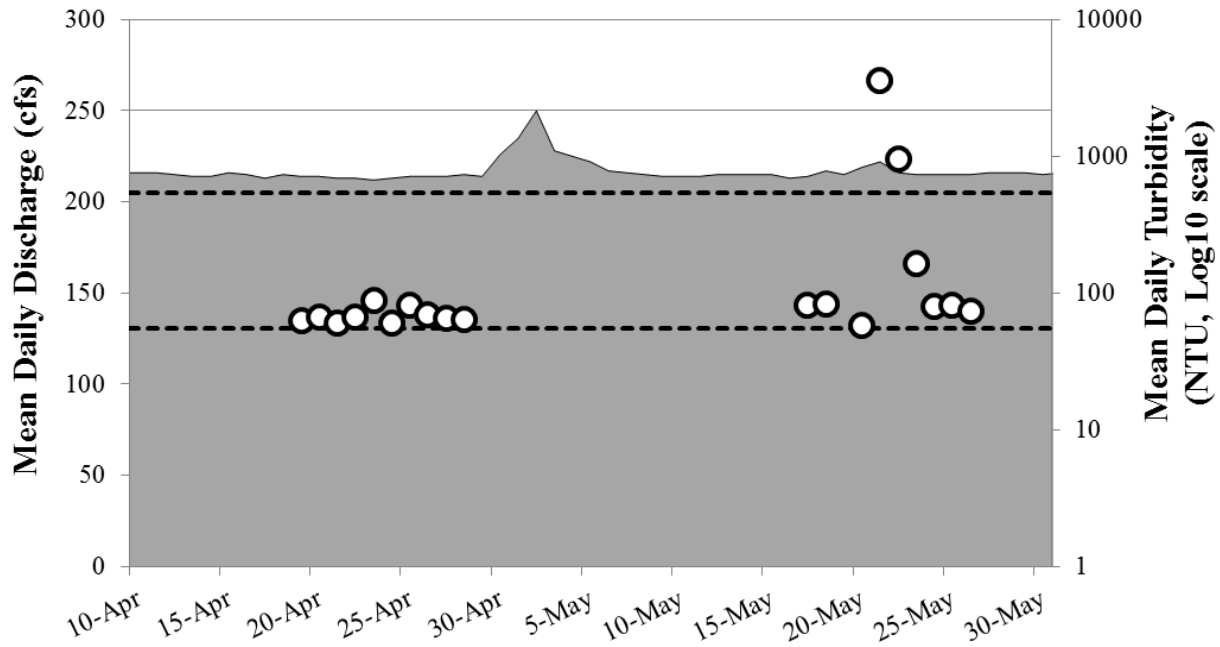


Figure 1. Spring 2016 water quality summary. Gray area represents provisional mean daily flows (ft³/sec, cfs) of the Little Colorado River at the USGS gauge station (09402300) at the mouth of the Little Colorado River April 10-May 31, 2016. White circles indicate afternoon turbidity (Nephelometric Turbidity Units, NTUs) of the Little Colorado River per sample day at Boulders Camp (1.9 RKM). Dashed lines represent the turbidity threshold between three HBC catchability zones: high catch zone (≤ 54 NTU), transition zone (55-544 NTU), and low catch zone (≥ 545 NTU, Stone 2010).

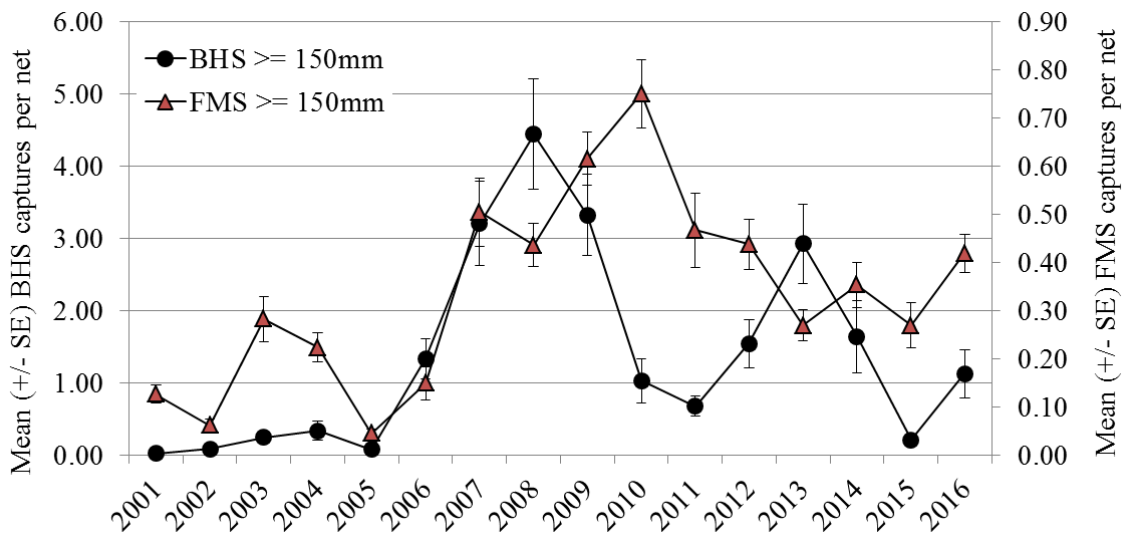


Figure 2. Relative abundance (catch per unit effort, CPUE \pm SE) of Bluehead Sucker (black circles) and Flannelmouth Sucker (red triangles) during the second spring Little Colorado River monitoring trips 2001-2016. Note: Scale differs with species.

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

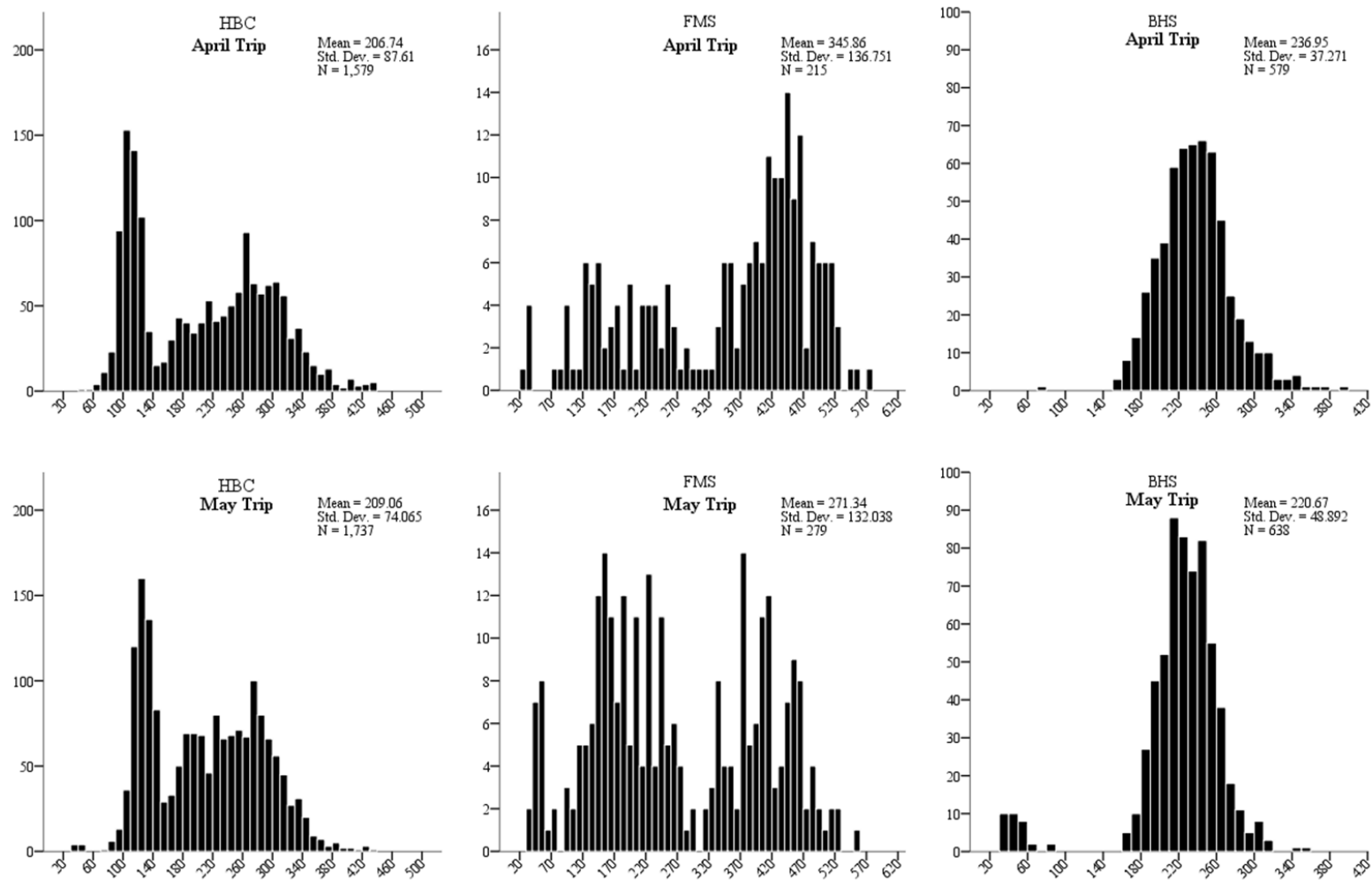


Figure 3. Length frequency distributions for all Humpback Chub (*Gila cypha*, HBC), Bluehead Sucker (*Catostomus discobolus*, BHS) and Flannemouth Sucker (*Catostomus latipinnis*, FMS) captures during monitoring of the Little Colorado River in April (top) and May (bottom) 2016. Note: Scale differs with species.

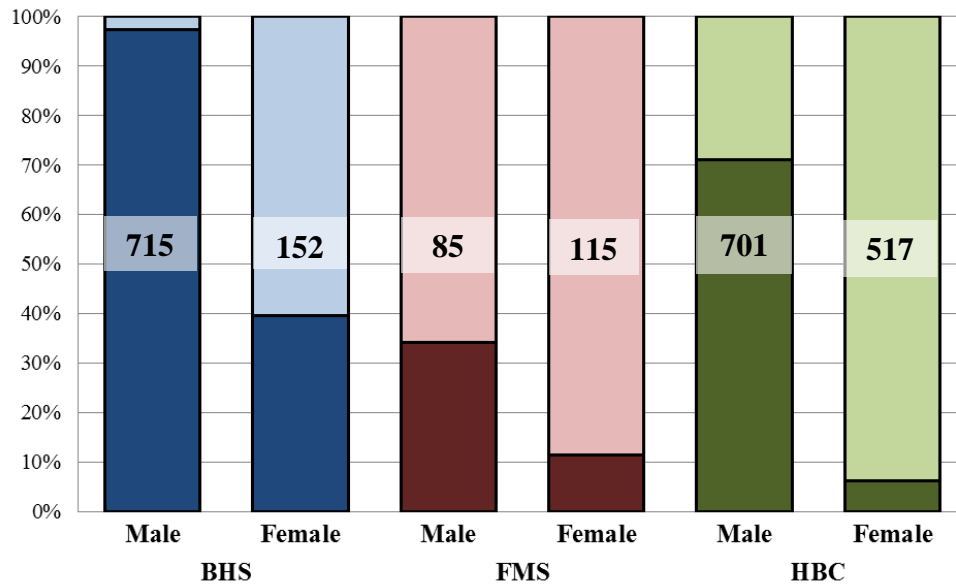


Figure 4. Sex condition proportion of all unique male and female BHS, FMS, and HBC ≥ 150 mm captured in spring 2016 for which sex was determined. The dark portions of the bars represent the proportion of the total fish that were ripe. Numbers indicate the total (n) fish represented by each bar.

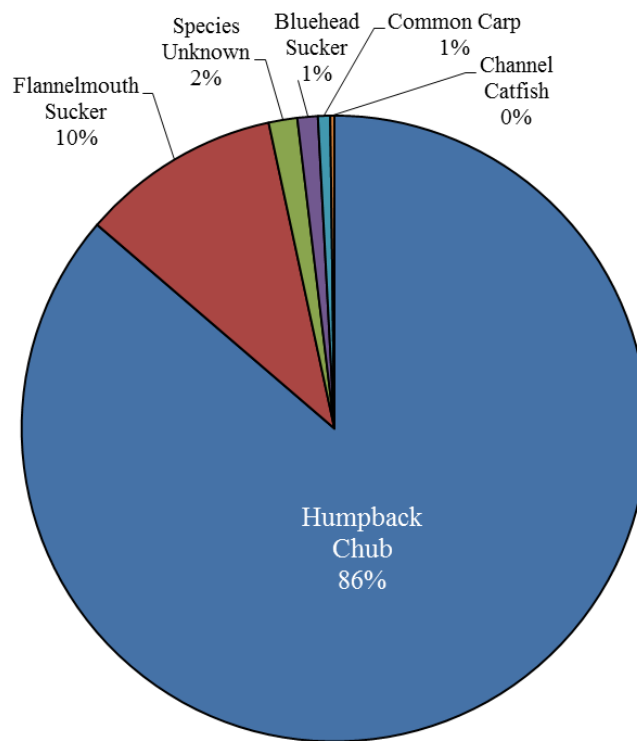


Figure 5. Species composition of unique PIT tags detected between April 2015 and April 2016 with the Coyote Camp submersible antenna installed at 8.68 km in the Little Colorado River.