

**Spring 2016 Monitoring of Humpback Chub (*Gila cypha*)  
and other Fishes above Lower Atomizer Falls  
in the Little Colorado River, Arizona**

Trip Report for May 17-25, 2016

Prepared for:  
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by

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## INTRODUCTION

In 2016, the U.S. Geological Survey's Grand Canyon Monitoring and Research Center (GCMRC) contracted the U.S. Fish and Wildlife Service (USFWS) to monitor Humpback Chub (*Gila cypha*) above Lower Atomizer Falls (RKM 13.57) to RKM 17.67 in the Little Colorado River (LCR; Fig. 1). This portion of the LCR became of interest after juvenile Humpback Chub were translocated above Chute Falls (RKM 14.11) and released at RKM 16.20 in 2003. To date 2,971 juvenile chub (median= 87 mm TL; range = 50-137 mm TL) have been translocated above Chute Falls. The reach above Chute Falls has been repeatedly sampled for fishes since the 2003 translocation, and the reach between Lower Atomizer Falls and Chute Falls (hereafter, Atomizer reach) has been sampled since 2006. From 2006 to 2009 the monitoring protocol included using two-pass mark recapture methods to estimate population size of Humpback Chub, but since 2010 capture probability data have been used to estimate chub abundances. This trip report summarizes information on Humpback Chub and other fishes that were captured, LCR physical parameters, and sampling efforts during the May 2016 monitoring trip. Humpback Chub population estimates resulting from this trip will be presented in an annual report.

## STUDY AREA

Cooley (1976) reported that the perennial discharge in the lower 21 km of the LCR essentially begins at Blue Spring (RKM 20.74; ~90 ft<sup>3</sup>/s) and is supplemented downriver by numerous other springs resulting in a final discharge between 217 and 232 ft<sup>3</sup>/s near the confluence (Fig. 1). Springs located between RKM 16.10–20.74 account for about nine-tenths of the perennial flow. The springs release waters supersaturated with dissolved CO<sub>2</sub>, which gradually diffuse from the river as it flows downstream and allows carbonates to precipitate in the form of travertine and unconsolidated marl.

During the May 2016 monitoring trip above Lower Atomizer Falls, all fish sampling was conducted between RKM 13.58–17.67. This stretch of river was separated into the "Atomizer reach" from above Lower Atomizer Falls to just below Chute Falls (RKM 13.58–14.10), and the "Chute Falls reach" from above Chute Falls (RKM 14.11) to RKM 17.67 (Fig. 1). The short 0.54 km Atomizer reach also encompasses a waterfall known as Upper Atomizer Falls. Each of these three travertine dams (Lower and Upper Atomizer Falls, and Chute Falls) give rise to over a two meter drop in river elevation, and are collectively known as the Atomizer Falls Complex. The Atomizer reach contains a myriad of travertine formations (dams, terraces and cascades), hydrologic configurations (deep plunge pools, shallow pockets, falls, rapids, runs, and eddies) and diverse bottoms (boulders and rocks, gravel, sand, and unconsolidated marl). In contrast, the ~3.6 km upper reach above Chute Falls consists of proportionally fewer and

much smaller travertine structures, shallower depths, and more homogenous bottoms blanketed with sand and unconsolidated marl.

Historically, Chute Falls was considered to be an impassible chemical and/or physical barrier to all upriver migrations of Humpback Chub (Kaeding and Zimmerman 1983; Mattes 1993; Robinson et al. 1996), but this assumption was proven incorrect by USFWS monitoring efforts in 2007, 2009, and 2014. Although Chute Falls likely impedes the upriver migrations of many chub, USFWS has thus far detected six chub that migrated above this falls and into the uppermost, perennial corridor of the LCR.

## METHODS

During the May 17-25, 2016 monitoring trip, the two reaches above and below Chute Falls were sampled by biologists Dennis Stone (USFWS), Michael Pillow (USFWS), and Sara Panek (volunteer). Hoop nets (50-60 cm in diameter, 100 cm long, a single 10 cm throat, 6 mm nylon mesh netting) were the sole fishing gear used, and were baited near their cod ends by attaching nylon mesh bags (30 x 30 cm, 6 mm mesh) filled with ~160 g AquaMax™ Grower 600 for Carnivorous Species (Purina Mills Inc., Brentwood, MO) to maximize fish captures (Stone 2005). During this trip, the crew sampled the reach above Chute Falls with three nets deployed for three consecutive ~24 h hauls and 30 nets for four ~24 h hauls. The Atomizer reach was sampled with 17 nets for three ~24 h hauls. Many nets were re-deployed to new locations between hauls to increase capture probability.

All captured fishes were identified to species, and examined for the presence and number of external anchorworms (*Lernaea cyprinacea*) and other visible parasites. Speckled Dace (*Rhinichthys osculus*) were often just tallied per net set to reduce handling, but all other fishes were measured to total length (TL mm); hereafter, all references to fish lengths infer TL. All Humpback Chub were scanned for previously implanted Passive Integrated Transponder (PIT) tags (Biomark, Inc.), whereby untagged individuals were implanted with a 134.2 KHz PIT tag. In addition, adult chub were inspected for sex, spawning condition (e.g., ripe, spent) and spawning characteristics (e.g., spawning tuberculation and coloration). For additional fish handling protocols see Persons et al. (2015).

This report focuses entirely on “unique” Humpback Chub, which refers to individuals counted only once during the trip, regardless of how many times they were recaptured. PIT tags of previously tagged chub captured during this study were queried in other data bases to distinguish known translocated chub from other chub. Ultimately, all Humpback Chub captured in the study reaches were classified as being (1) translocated, (2) local chub, which were unmarked when first captured in our study reaches, or (3) upriver migrants, which were initially captured and PIT-tagged in downriver locations. Likewise, all descriptions of

Black Bullhead (*Ameiurus melas*), Channel Catfish (*Ictalurus punctatus*), and Green Sunfish (*Lepomis cyanellus*) refer to unique individuals because of their low captures. Because Speckled Dace and Fathead Minnow (*Pimephales promelas*) were commonly captured and these fishes were not marked, their tallies may include some recaptured individuals.

At Translocation Camp (RKM 16.20) measurements of water temperatures (°C) and turbidity (nephelometric turbidity unit [NTU]; Hach Model 2100P Turbidimeter, Loveland, CO) were taken between 16:00-20:00 hours each day, and around 08:00 in the morning on two days during a small freshet. Provisional mean daily discharge data from the U.S. Geological Survey gage 09402300 located ~1.05 km above the LCR confluence were downloaded (<http://nwis.waterdata.usgs.gov>) to provide discharge information during the sampling trip.

Summary statistics were calculated for physical parameters, sampling efforts, fishes captured, spawning conditions, and external parasites. Length frequency histograms were constructed for all unique Humpback Chub and local vs. translocated chub captured in the study reaches. Statistics and figures were computed using SPSS statistical software (version 22; IBM Corp.).

## **RESULTS and DISCUSSION**

### **Physical parameters and sampling efforts:**

All 51 net sets in the Atomizer reach and first nine net sets above Chute Falls from May 17-20, 2016 occurred under base flow discharges and low turbidities (range of mean daily discharges = 215-219 ft<sup>3</sup>/s; turbidity range = 2.21--11.00 NTU), which were ideal abiotic conditions for high hoop-net catch rates of native fishes (Stone 2010a). A small freshet occurred during the evening of May 20th before we began sampling most of the corridor above Chute Falls. The next day, while we were deploying 30 nets for their first haul, the turbidity levels ranged from 1,090 - 2,276 and the mean daily discharge was 222 ft<sup>3</sup>/s. Therefore, we conducted four rather than three daily hauls of these nets, so that the last three hauls would be pulled at low turbidities. Ultimately, these 30 net sets were pulled at 81 NTU during the first haul, and from 6.90-3.48 NTU for the last three hauls. Captures of Humpback Chub were relatively high even during the first haul under the higher turbidities because all nets were baited (Stone 2005). Cumulatively, we deployed 51 net sets for a total of 1,132 fishing hours in the Atomizer reach (RKM 13.58–14.11) and 129 net sets for a total of 3,057 fishing hours above Chute Falls (RKM 14.24–17.67). The LCR maintained relatively warm water temperatures throughout the trip (range= 20.4-22.8 °C).

### **Humpback Chub:**

**General overview.**- Humpback Chub were the second most commonly captured fish in the reaches above and below Chute Falls (Table 1). A total of 545 unique chub (median = 210 mm; range = 94-420 mm) were captured during the trip, which included 263 chub (142 mm, 94-346 mm) captured above Chute Falls and 282 chub (230 mm, 113-420 mm) in the Atomizer reach (Table 1, Fig. 2). Four chub (116 mm, 165 mm, 208 mm and 228 mm) captured at RKM 17.66 and RKM 17.67 constituted the furthest upriver captures.

Adult Humpback Chub ( $\geq 200$  mm) captured this spring included 92 individuals above Chute Falls (median=216 mm; range = 201-346 mm), and 222 individuals in the Atomizer reach (242 mm; 200-420 mm). Forty chub were  $\geq 300$  mm, of which five were caught above Chute Falls (300-346 mm) and 35 in the Atomizer reach (301-420 mm); 12 of these chub were translocated in 2010-2013.

Some Humpback Chub have remained in our study reaches for prolonged periods of time. Above Chute Falls one chub has been annually recaptured for 5.9 years, and six chub for 4.5 years. In the Atomizer reach, one chub has been annually recaptured for 6.9 years, two chub for 5.8 years, two chub for 5.0 years, and three chub for 4.5 years. The longest known LCR resident is a 2004 translocated chub that has been recaptured each year either above Chute Falls, in the Atomizer reach, and/or the Salt reach now for 11.8 years.

**Origin of Humpback Chub.**- Two hundred and fifty of the 263 Humpback Chub (95%) captured above Chute Falls were previously translocated individuals, which included (a) 137 chub (94-172 mm) released in 2015, (b) 98 chub (165-268 mm) in 2014, (c) seven chub (207-300 mm) in 2013, (d) one chub (308 mm) in 2012, (e) six chub (266-346 mm) in 2011, and (f) one chub (286 mm) in 2010 (Fig. 3). We also captured six previously unmarked local chub (range= 117-215 mm; median= 201 mm) above Chute Falls during this sampling trip, and recaptured seven local chub from last year (168-257 mm).

Only 72 of the 282 Humpback Chub (26%) caught in the Atomizer reach in 2016 were translocated individuals, which included (a) two chub (113 mm & 130 mm) released in 2015, (b) 33 chub (198-250 mm) in 2014, (c) 24 chub (221-306 mm) in 2013, (d) eight chub (261-350 mm) in 2012, (e) three chub (257-295 mm) in 2011, and (f) two chub (339 mm & 375 mm) in 2010. We also captured 110 previously unmarked local chub (range = 121-305 mm; median = 206 mm) in the Atomizer reach this year, and recaptured 85 other local chub (186-420 mm) that were initially captured and PIT-tagged in this reach during 2009-2015 trips and one local chub (195 mm) that was initially caught last year above Chute Falls. Fifteen upriver migrant chub were captured (180-330 mm), most of which were originally PIT-tagged in the pool just below Lower Atomizer Falls; however, one 275 mm individual was initially tagged at RKM 1.50 (105 mm) on July 6, 2013.

Our captures this year of 116 unmarked local chub (117-305 mm), along with recaptures of 92 local chub (168-420 mm) that were first captured during 2009-2015 trips, suggests that some successful reproduction and recruitment has occurred in the vicinity of the Atomizer reach, and possibly above Chute Falls over the past few years (see Fig. 3). Potentially, some unmarked subadults caught in the Atomizer reach originally hatched above Chute Falls and then migrated or were displaced downriver before being captured below Chute Falls.

Humpback Chub appeared to be spawning again in both reaches during May 2016. We captured four ripe females (range = 227-346 mm) and 51 ripe males above Chute Falls, and five ripe females (215-332 mm), one spent female (376 mm), and 52 ripe males in the Atomizer reach. This May, local chub constituted 5% and 69% of all chub captured in the reaches above and below Chute Falls, respectively.

***Retention of “2010-15” translocated Humpback Chub.-*** A mass exodus of Humpback Chub occurred in the two reaches above Lower Atomizer Falls between the summer 2009, when 890 unique Humpback Chub were captured, and the summer 2010, when only 13 unique chub were captured (Stone 2010b). However, the juveniles (68-137 mm) that were translocated after this event have shown relatively good retention and high growth rates in the study reaches. Within the combined study reaches this May, we recaptured (A) three of the 109 “2010” translocated chub (3%), (B) 9 of the 96 “2011” chub (9%), (C) 9 of the 212 “2012” chub (4%), (D) 31 of the 303 “2013” chub (10%), (E) 131 of the 305 “2014” chub (43%), and (F) 139 of the 303 chub (46%) recently translocated on November 2, 2015.

***Growth and VIE tag loss of “2013-15” translocated Humpback Chub.-*** The median daily growth rate of translocated Humpback Chub recaptured from the May 2015 trip (358-367 days prior) was (A) 0.11 mm/day for the 22 “2013” chub (range = 0.06-0.19 mm/day) and (B) 0.24 mm/day for 78 “2014” chub (range = 0.04-0.32 mm/day). Two “2013” and nine “2014” recaptured chub had possessed VIE tags when they were originally translocated, but none of these tags were still visible. Thus, indicating a 100% tag loss in the three and two years, respectively, since these fish were initially VIE marked by GCMRC personnel during mid-June of 2013 and 2014. Over 198-205 winter/spring days, the 139 chub recaptured from the November 2015 translocation grew a median of 0.19 mm/day (0.06-0.29 mm/day). Seventeen of the recaptured “2015” chub originally possessed VIE tags when translocated, of which VIE tags were still visible on 13 individuals. Hence, ~23.5% chub lost their VIE tags over the 11 months since they were originally implanted in mid-June 2015.

#### **Other native fish:**

Speckled Dace were the only other native fish captured in May 2016, which included the captures/recaptures of 6,914 dace above Chute Falls and 243 dace in the Atomizer reach for a total of 7,157 dace (Table 1).

**Nonnative fishes:**

Fishes of four and one nonnative species, respectively, were captured above Chute Falls and in the Atomizer Reach during May 2016 (Table 1). A total of 36 Fathead Minnow were caught above Chute Falls, and five fatheads in the Atomizer reach. Seven Black Bullhead (range = 87-178 mm), seven Channel Catfish (range= 97-174 mm), and one Green Sunfish (84 mm) were captured above Chute Falls. Before this trip, the last capture above Chute Falls of Black Bullhead was in May 2012 (~4 years prior), Channel Catfish was in June 2009 (~7years prior), and Green Sunfish was in July 2003 (~13 years prior).

**Fishes parasitized by *Lernaea cyprinacea*:**

The external anchorworm, *Lernaea cyprinacea*, was not detected on any fish this May.

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**Data archiving:**

Data for the monitoring trip are archived at the Grand Canyon Monitoring in an Access file entitled LC20160517\_LAtomizer.mdb.

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Table 1.- Sampling efforts and fishes captured above Chute Falls (RKM 14.24 - 17.67) and in the Atomizer reach (RKM 13.58 - 14.10) during the May 17-25, 2016 monitoring trip in the Little Colorado River, Arizona. Numbers of Humpback Chub, Black Bullhead, Channel Catfish, and Green Sunfish include only unique individuals and their range of total lengths is given, while numbers of Speckled Dace and Fathead Minnow may include recaptured individuals.

	Above Chute Falls	Atomizer reach	Total
<b>Effort</b>			
Hoop nets deployed	129	51	180
Total Hours	3,057	1,132	4,188
Mean hours/net $\pm$ SD	24 $\pm$ 4.5	22 $\pm$ 3.5	23 $\pm$ 4.3
<b>Native fishes</b>			
Cyprinidae			
Humpback Chub ( <i>Gila cypha</i> )	263 (94-346 mm)	282 (113-420 mm)	545 (94-420 mm)
Speckled dace ( <i>Rhinichthys osculus</i> )	6,914	243	7,157
<b>Nonnative fishes</b>			
Cyprinidae			
Fathead minnow ( <i>Pimephales promelas</i> )	36	5	41
Ictaluridae			
Black Bullhead ( <i>Ameiurus melas</i> )	7 (87-178 mm)	-	7 (87-178 mm)
Channel Catfish ( <i>Ictalurus punctatus</i> )	7 (97-174 mm)	-	7 (97-174 mm)
Centrarchidae			
Green Sunfish ( <i>Lepomis cyanellus</i> )	1 (84 mm)	-	1 (84 mm)

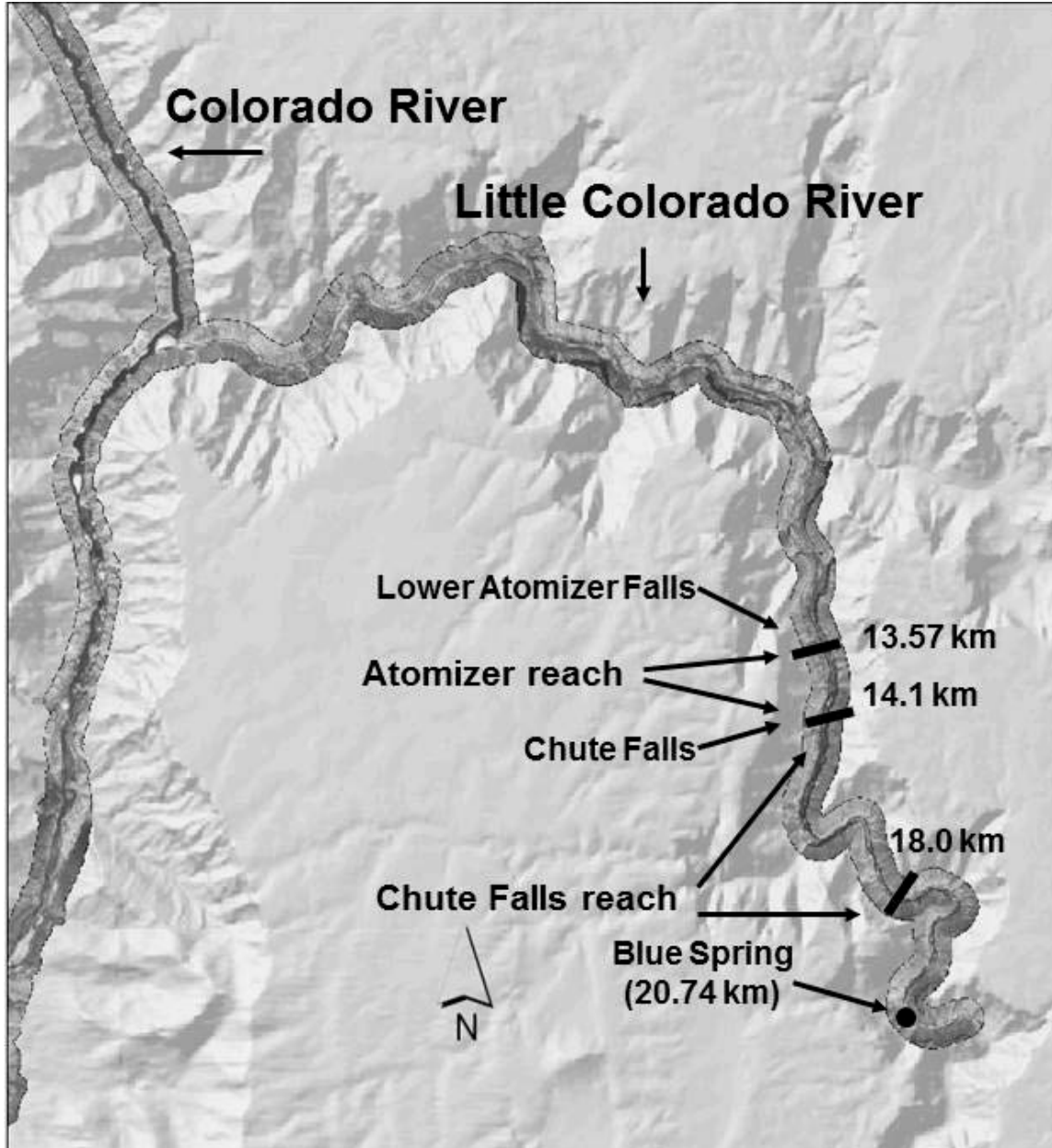


Figure 1.- Map showing the two sampling reaches surveyed for fishes in the Little Colorado River, Arizona during the May 17-25, 2016 monitoring trip. The Atomizer reach included the river corridor from the top of Lower Atomizer Falls (RKM 13.58) to below Chute Falls (RKM 14.10) and the upper reach included the corridor from the top of Chute Falls to RKM 17.67.

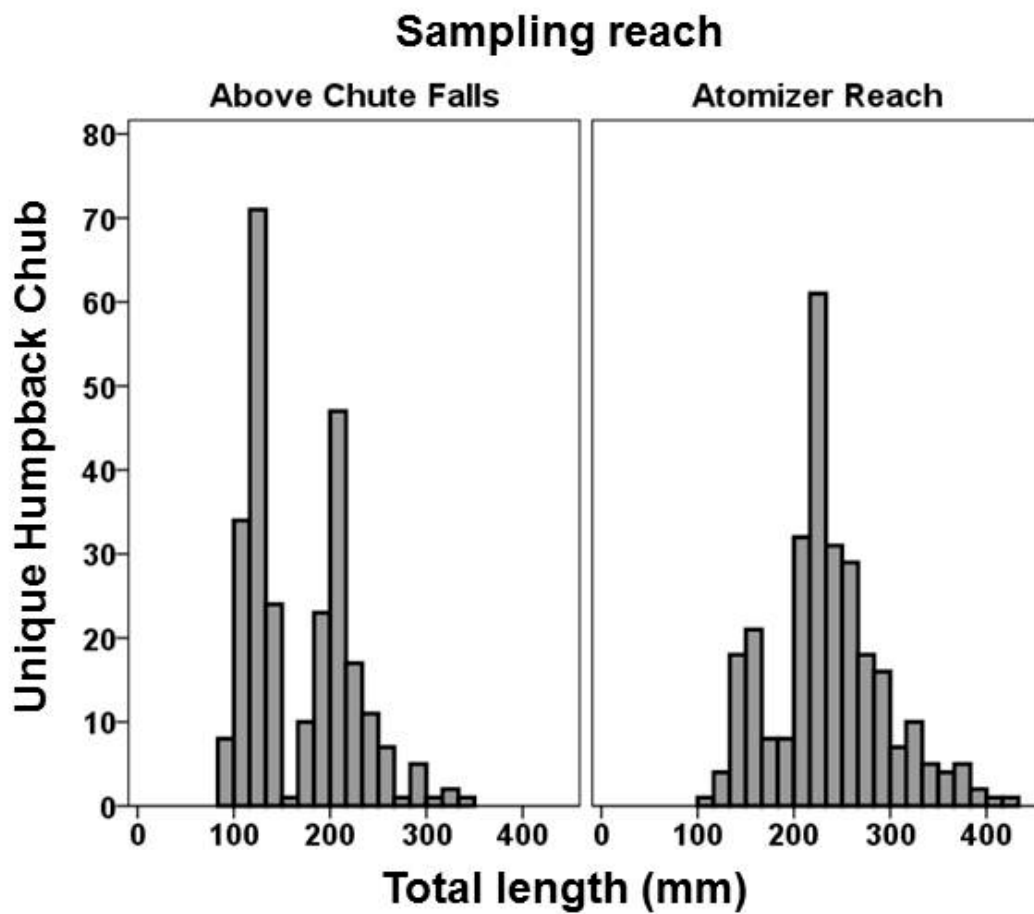


Figure 2.- Length frequency histograms of all unique Humpback Chub captured in reaches above and below Chute Falls in the Little Colorado River, Arizona during the May 17-25, 2016 monitoring trip.

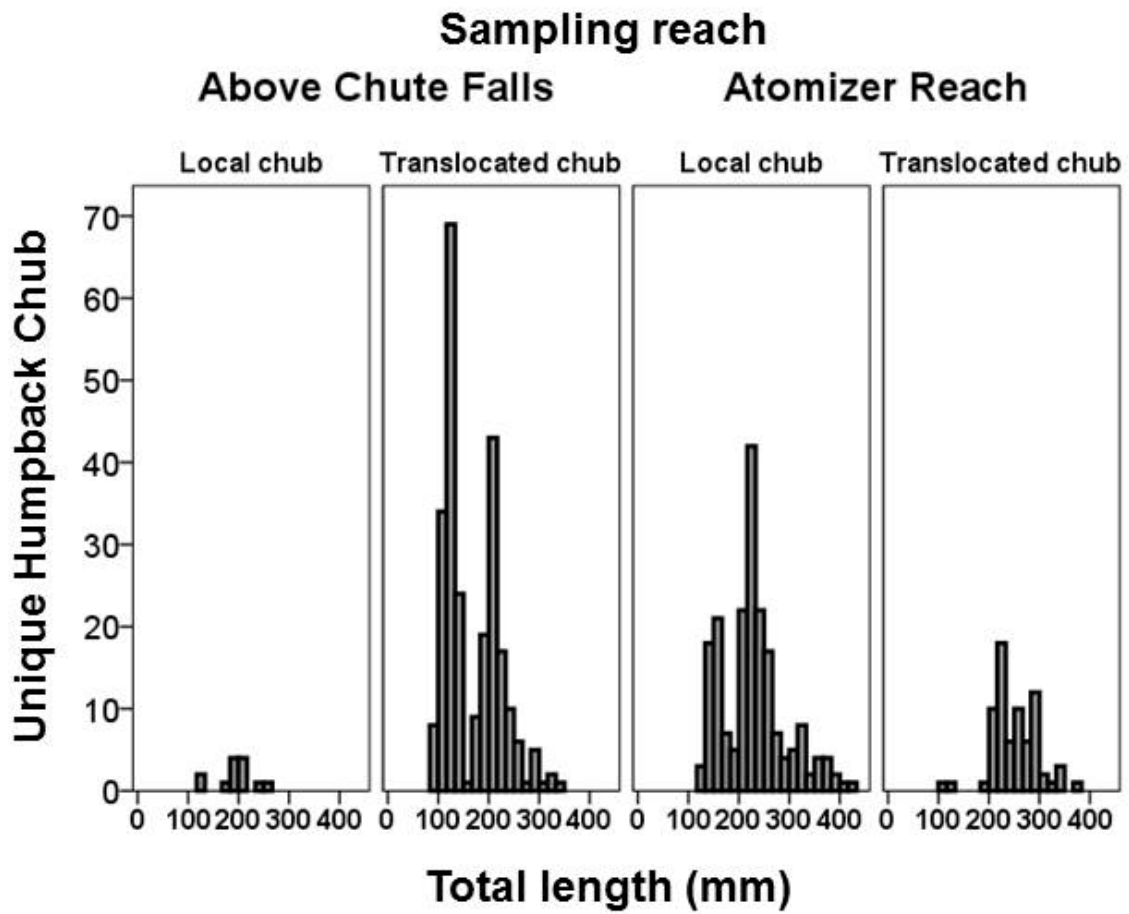


Figure 3.- Length frequency histograms of all unique local vs. translocated Humpback Chub captured in reaches above and below Chute Falls in the Little Colorado River, Arizona during the May 17-25, 2016 monitoring trip.