Blue River Fish Barrier Monitoring, 2014

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Submitted to

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Summary

Lower Blue River in Greenlee Co., Arizona was visited on October 28-29, 2014 to monitor fishes down- (Reach 1 - San Francisco confluence to barrier) and upstream (Reach 2 - barrier to Pat Mesa) of a fish barrier constructed by Reclamation and completed in June 2012. Fishes were sampled by backpack electroshocker from two fixed sites (one, 100-m site below the barrier and one, 200-m site above the barrier), two random 200-m sites above the barrier, and opportunistically. Nineteen pools > 1m deep were inspected from shore and underwater with mask and snorkel. Discharge was estimated at 10-15 cfs and water was clear. Weather conditions were ideal for both collections and snorkel surveys. Fishes overall were uncommon-to-common (30 to 144 per site) and catch rates were low (CPE 0.037 to 0.151 fish per second). Native longfin dace *Agosia chrysogaster*, Sonora sucker *Catostomus insignis*, and desert sucker *Pantosteus clarki* plus non-native red shiner *Cyprinella lutrensis*, channel catfish *Ictalurus punctatus*, and yellow bullhead *Ameiurus natalis* were captured below the barrier and native longfin dace, Sonora sucker, desert sucker, roundtail chub *Gila robusta* plus non-native red shiner and fathead minnow *Pimephales promelas* were encountered above the barrier. Longfin dace, Sonora sucker, and desert sucker were seen but not enumerated during pool surveys, and no non-natives were detected. Several adult lowland leopard frog *Lithobates yavapaiensis* were seen; non-native northern crayfish *Orconectes virilis* was present but uncommon, and all were large individuals.

Introduction

Blue River is a tributary to San Francisco River (Gila River basin) that drains mountain terrains in Apache and Greenlee cos. Arizona, and Catron Co., New Mexico. Nearly the entire watershed is within lands administered by USDA Forest Service on Apache-Sitgreaves and Gila National Forests, but private inholdings are found along certain segments. The stream historically was occupied by longfin dace *Agosia chrysogaster*, speckled dace *Rhinichthys osculus*, loach minnow *Tiaroga cobitis*, Sonora sucker *Catostomus insignis*, desert sucker *Pantosteus clarki* (Silvey et al. 1984), and a native trout *Oncorhynchus* sp. (see Minckley 1973, Minckley & Marsh 2009). Razorback sucker *Xyrauchen texanus* historically may have accessed the stream, and tens of thousands were stocked in the late 1980s (Hendrickson 1993) but failed to establish. Roundtail chub (Eagle Creek lineage) and spikedace *Meda fulgida* (Gila River, NM lineage) were stocked in 2012.

Since 1950, non-native brown trout *Salmo trutta*, brook trout *Salvelinus fontinalis*, rainbow trout *Oncorhynchus mykiss*, Apache trout *Oncorhynchus apache*, fathead minnow *Pimephales promelas*, channel catfish *Ictalurus punctatus*, flathead catfish *Pylodictis olivaris*, red shiner *Cyprinella lutrensis*, common carp *Cyprinus carpio*, largemouth bass *Micropterus salmoides*, and western mosquitofish *Gambusia affinis* have been periodically detected within the drainage (Reclamation 2010). A single green sunfish *Lepomis cyanellus* was detected in lower Blue River in late 2011 by Arizona Game and Fish Department (AZGFD), and others were captured during barrier-

associated monitoring in autumn 2012 (Marsh et al. 2012) and surveys in summer 2013 (AZGFD in litt.).

To protect native species in Blue River from non-native fishes in the San Francisco River, Reclamation constructed a fish barrier (cover photo) on Blue River approximately 0.8 km upstream from its mouth. The barrier was completed in June 2012. Immediately following closure of the barrier, roundtail chub *Gila robusta* and spikedace *Meda fulgida* were stocked in attempt to establish new populations of these two native fishes, and loach minnow was stocked to augment the existing population.

Reclamation commissioned Marsh & Associates to conduct annual, post-barrier construction fish monitoring of lower Blue River. The primary purpose of this activity is to assess the barrier's effectiveness in preventing upstream invasions of non-native fishes. This is to be accomplished by general monitoring of fish assemblage structure above and below the barrier to document presence of non-native fishes upstream of the barrier, assess effectiveness of mechanical removal of non-native fishes, and determine success or failure of introductions of new native species. This report provides results of the third post-barrier annual monitoring event, which was conducted in autumn 2014; Marsh et al. (2012, 2013) summarized the first two years of monitoring.

Methods

The constructed fish barrier on lower Blue River (Figure 1) is located near UTM 668124E 3676503N (NAD83) and is accessed from downstream by vehicle via Martinez Ranch Road to a primitive road along the San Francisco River to Blue River (obliterated by flooding in mid-September 2013 and unusable since), from upstream by 12 km hike down river from Juan Miller Crossing (Forest Service Road 475), or via helicopter. The portion of Blue River to be monitored included two segments: Reach 1 from San Francisco River to the fish barrier, and Reach 2 from the fish barrier upstream to Pat Mesa (Figure 1). Reach 2 was further subdivided into 23, 200-m long sub-reaches, consecutively numbered 1-23, upstream from the fish barrier. We visited the area on October 28-39, 2014 and followed most protocols and procedures described by Clarkson et al. (2011); we followed AZGFD (2012) with respect to site lengths in Reach 2 (200-m).

Two fixed sites, one below and one above the barrier were established during a preliminary reconnaissance and inspection on October 4-5, 2012; UTM coordinates are in Table 1. The below barrier site was 100-m long and its downstream boundary was approximately 550 m downstream from the barrier and 250 m upstream from the San Francisco confluence. The above barrier site was 200-m long and its downstream boundary was approximately 2800 m upstream from the barrier in sub-reach 15.

Two, randomly-selected 200-m monitoring sites were established in Reach 2 prior to departure for the field; these were located in sub-reaches 3 and 14, respectively beginning 400 m and 2600 m upstream from the barrier (Table 1).

All sites were previously measured along the thalweg using a standard hip chain, and up- and downstream UTM boundaries were noted. Photographs at the two fixed sites were taken with views up- and downstream from the up- and downstream boundaries (total of four photos per site). Fishes were captured from individual mesohabitats (riffle, run, pool, isolated pool) using a Smith-Root type 24-A backpack electrofisher (nominal settings I-5, 200 VDC; approximately 0.5-0.7 output amps) and species identity and number plus effort (shocking seconds real-time) were recorded into field notebooks and later transferred to standard data forms. The following procedure for measuring and processing captured fishes (AZGFD 2012, and project Statement of Work) was in place and followed in-part: all spikedace, loach minnow, and roundtail chub captured at each processing point were to be measured for total length (TL, mm) until the number measured exceeds 100; thereafter fishes were to be enumerated only. All large-bodied fishes (e.g., suckers, roundtail chub, or non-native piscivores) captured were to be enumerated and similarly measured for TL; those species observed by snorkeling (see below) but not captured were to be categorized by general size category: ≤50, 51-100 and >100 mm. With one exception, fishes captured during surveys on this trip were only categorized by size group. Native fishes were released alive downstream from the processing site and non-native fishes were dispatched and buried.

All pools within Reach 2 greater than about a meter deep were inspected by a diver from the bank and underwater using mask and snorkel. Pool location (UTM), fishes encountered, size category, disposition of fishes, and general comments were recorded.

Field data books were checked for completeness and any errors corrected prior to departing the site. Data were later transferred to standard data sheets and entered into Reclamations' Access®-based electronic database, and all entries were verified.

Results

We visited lower Blue River below the barrier on October 28, 2014 (via Martinez Ranch) and above the barrier the following day on October 29. Discharge at time of our visit was estimated at 10-15 cfs in our study area, but this was not reflected in gauged measurements at Juan Miller crossing (Figure 2). The stream channel immediately above the barrier was shallow and relatively wide with no deep reservoir-pool, and immediately downstream of the barrier apron the stream was deeper and narrower. Habitat down- and upstream was deep, swift riffles, runs, and relatively few deep pools, and substrates were largely clean and loose with few fines. There was no evidence of ash derived from the Wallow Fire that blanketed substrates two autumns previous (Marsh et al. 2012) and persisted in 2012 (Marsh et al. 2013). Weather was clear and cool, and water clarity was high, so conditions were ideal for stream sampling and visual inspection of pools. There was little evidence of flooding that exceeded 100 cfs on multiple occasions in July through September 2014 and peaked near 3,000 cfs on September 22, 2013 (Figure 2) other than cleaning and sorting substrates throughout the stream.

Fixed sites.

The 100-m below barrier fixed site was comprised of three mesohabitats: one pool, one run, and one riffle. The pool was up to 2 m deep and the bottom was silt or bedrock; it was too large to sample effectively. The run was gravel-cobble with sparse coarse woody debris and the riffle was relatively deep, swift, and had cobble substrate; fines were few. Fish were uncommon and 30 individuals among five species, native longfin dace and desert sucker (all age 0) plus non-native red shiner, channel catfish (age-0), and yellow bullhead (all age 1+), were taken in 480 seconds of electrofishing (Table 2). One adult lowland leopard frog *Lithobates yavapaiensis* was observed. Large, adult Northern crayfish *Orconectes virilis* were present in small numbers.

The 200-m above barrier fixed site was comprised of five mesohabitats: two pools (both attached, adjacent backwaters), two riffles, and one run. The pools were > 1 m deep with bottom of silt and sand. Riffles were deep and swift and substrates were loose cobble and gravel, and runs were gravel or gravel-sand. Fish were uncommon and comprised of two native species, longfin dace and desert sucker (age-0), and one non-native, fathead minnow; 30 total individuals were taken in 801 sec of electrofishing (Table 2).

Random sites.

The 200-m sub-reach 3 (lower) random site was comprised of five mesohabitats: two riffles alternating with three runs. Riffles were deep and swift and had bottoms of cobble or cobble-sand; runs were sandy-gravel with a minor component of fines. Fishes were common and 130 individuals representing four species, native longfin dace, roundtail chub, Sonora sucker, and desert sucker (the last three all age-0) were captured in 861 sec electrofishing (Table 3). Measured roundtail chub were 70, 72, and 75 mm TL (Figure 3).

The 200-m sub-reach 14 (upper) random site was comprised of five mesohabitats: two pools alternating with three riffles. The pools were > 1 m deep and substrates were sand, gravel and sparse fines; riffles were deep and swift with substrate of cobble with scattered boulders. Fishes were common and 144 individuals representing five species, native longfin dace, Sonora sucker, and desert sucker plus non-native red shiner and fathead minnow, were captured in 990 sec of electrofishing (Table 3).

Opportunistic sampling.

Additional, opportunistic sampling with the backpack shocker was performed in the 0.8-km-long reach between the fish barrier and the confluence with San Francisco River where 138 sec of electrofishing yielded one each longfin dace and age-0 Sonora sucker and two red shiner.

Pool sampling.

There were 19 pools within Reach 2 that were greater than about a meter in depth and available for examination using mask and snorkel (Table 4). Water was clear and visibility good-to-excellent. Each pool was thoroughly examined visually from the bank for fishes prior to entering the water and each was carefully examined underwater. Longfin dace was common throughout, and one adult Sonora sucker and several adult desert sucker were seen but not enumerated in the pools 16-19 (Table 4). No non-native fishes were detected.

Miscellaneous observations.

Longfin dace nests were rare and restricted to a few depressions near the barrier (Figure 4); their presence suggests ongoing reproduction that is later into autumn than is typical for this species in cooler, higher elevation streams like Blue River (Minckley 1973, Kepner 1982).

Non-native northern crayfish *Orconectes virilis* was present but uncommon throughout the sampled reaches. All crayfish seen were large adults.

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Table 1. Fish monitoring station boundaries (UTMs, NAD83, Zone 12 S), Blue River, Greenlee Co., Arizona, October 28-29, 2014. Sub-reach designations are m/200 upstream of the fish barrier + 1; meters upstream from the fish barrier in parentheses.

Location	Type	Sub-reach (m)	Lower boundary	Upper boundary
Below barrier	Fixed	---	668357E 3676074N	668163E 3676085N
Above barrier	Fixed	15 (2800)	668166E 3678367N	668236E 3678209N
Above barrier	Random	3 (400)	668129E 3676855N	668017E 3677019N
Above barrier	Random	14 (2600)	668066E 3678386N	668166E 3678367N

Table 2. Results of fish monitoring within two fixed sites, one below and one above the constructed fish barrier on Blue River, Greenlee Co., Arizona, October 28 (below barrier) and October 29 (above barrier), 2014. The below barrier site is 100-m in length and its downstream boundary is approximately 550 m downstream of the barrier; the above barrier site is 200-m long and its down-stream boundary is approximately 2800 m upstream of the barrier (sub-reach 15). Effort is seconds real-time electrofishing, and CPE is number of fish per unit effort. Native species are indicated by an asterisk (*). Proportion or CPE totals may be off in the last decimal place due to rounding.

Downstream (below barrier) 100-m fixed site; effort = 480 sec

Species	Catch	Proportion	CPE
Longfin dace*	23	0.77	0.048
Desert sucker* (age 0)	1	0.03	0.002
Red shiner	1	0.03	0.002
Channel catfish (age 0)	2	0.07	0.004
Yellow bullhead (age 1+)	3	0.10	0.006
Totals	30	1.00	0.063

Upstream (above barrier) 200-m fixed site; effort = 801 sec

Species	Catch	Proportion	CPE
Longfin dace*	22	0.73	0.027
Fathead minnow	1	0.03	0.001
Desert sucker* (age 0)	7	0.23	0.009
Totals	30	0.99	0.037

Table 3. Results of fish monitoring within two, random sites above the constructed fish barrier on Blue River, Greenlee Co., Arizona, October 29, 2014. Downstream boundaries of sites were 400 (sub-reach 3) and 2800 m (sub-reach 15) upstream of the barrier; each site was 200-m long. Effort is seconds real-time electrofishing, and CPE is number of fish per unit effort. Native species are indicated by an asterisk (*). Proportion or CPE totals may be off in the last decimal place due to rounding.

Above Barrier, lower Random Site – Sub-reach 3; effort = 861 sec

Species	Catch	Proportion	CPE
Longfin dace*	109	0.84	0.127
Roundtail chub* (age 0)	4	0.03	0.005
Sonora sucker* (age 0)	6	0.05	0.007
Desert sucker* (age 0)	11	0.08	0.013
Totals	130	1.00	0.151

Above Barrier, upper Random Site – Sub-reach 14; effort = 990 sec

Species	Catch	Proportion	CPE
Longfin dace*	106	0.74	0.107
Red shiner	2	0.01	0.002
Fathead minnow	21	0.15	0.021
Sonora sucker* (age 0 and 1+)	2	0.01	0.002
Desert sucker (age 0)*	13	0.09	0.013
Totals	144	1.00	0.145

Table 4. Location (UTMs, NAD83, Zone 12 S) of 19 pools and results of snorkel surveys, Blue River, Greenlee Co., Arizona, October 29, 2014. Pools numbers are down- to upstream above the constructed fish barrier.

Pool No.	Location		Survey Result
1	668203 E	3676733 N	No non-native fishes
2	668116 E	3676863 N	No non-native fishes
3	667762 E	3677164 N	No non-native fishes
4	667680 E	3677311 N	No non-native fishes
5	667537 E	3677316 N	No non-native fishes
6	667495 E	3677684 N	No non-native fishes
7	667608 E	3677988 N	No non-native fishes
8	668092 E	3678191 N	No non-native fishes
9	668192 E	3678386 N	No non-native fishes
10	668178 E	3678268 N	No non-native fishes
11	668423 E	3678099 N	No non-native fishes
12	668469 E	3678140 N	No non-native fishes
13	668464 E	3678199 N	No non-native fishes
14	668542 E	3678304 N	No non-native fishes
15	668541 E	3678502 N	No non-native fishes
16	668290 E	3678652 N	No non-native fishes
17	668232 E	3678912 N	No non-native fishes
18	668197 E	3679098 N	No non-native fishes
19	668114 E	3679165 N	No non-native fishes

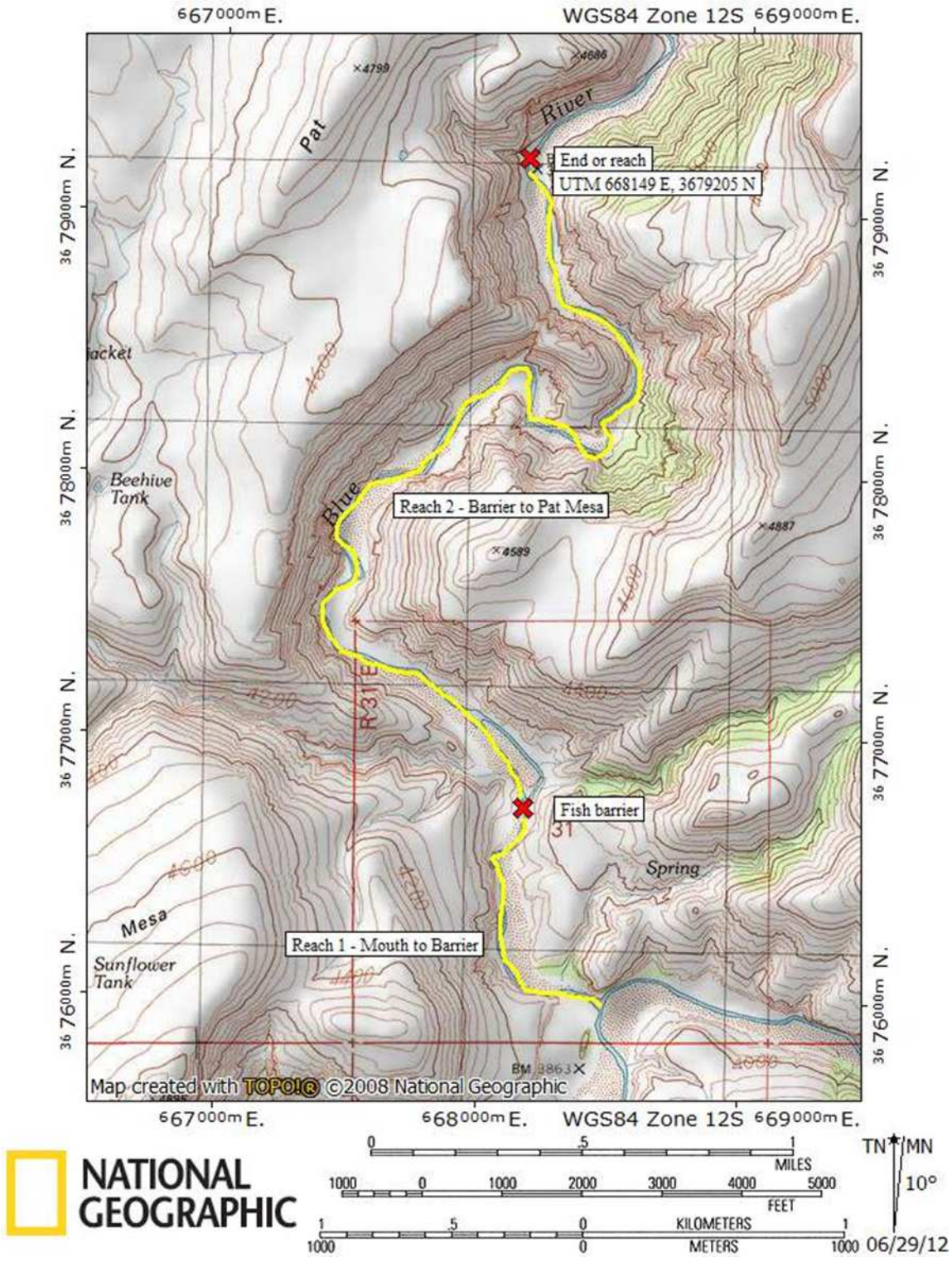

Figure 1. Map of lower Blue River, Greenlee County, Arizona, showing location of fish barrier and sampling Reaches 1 & 2. Map locations provided by Reclamation.

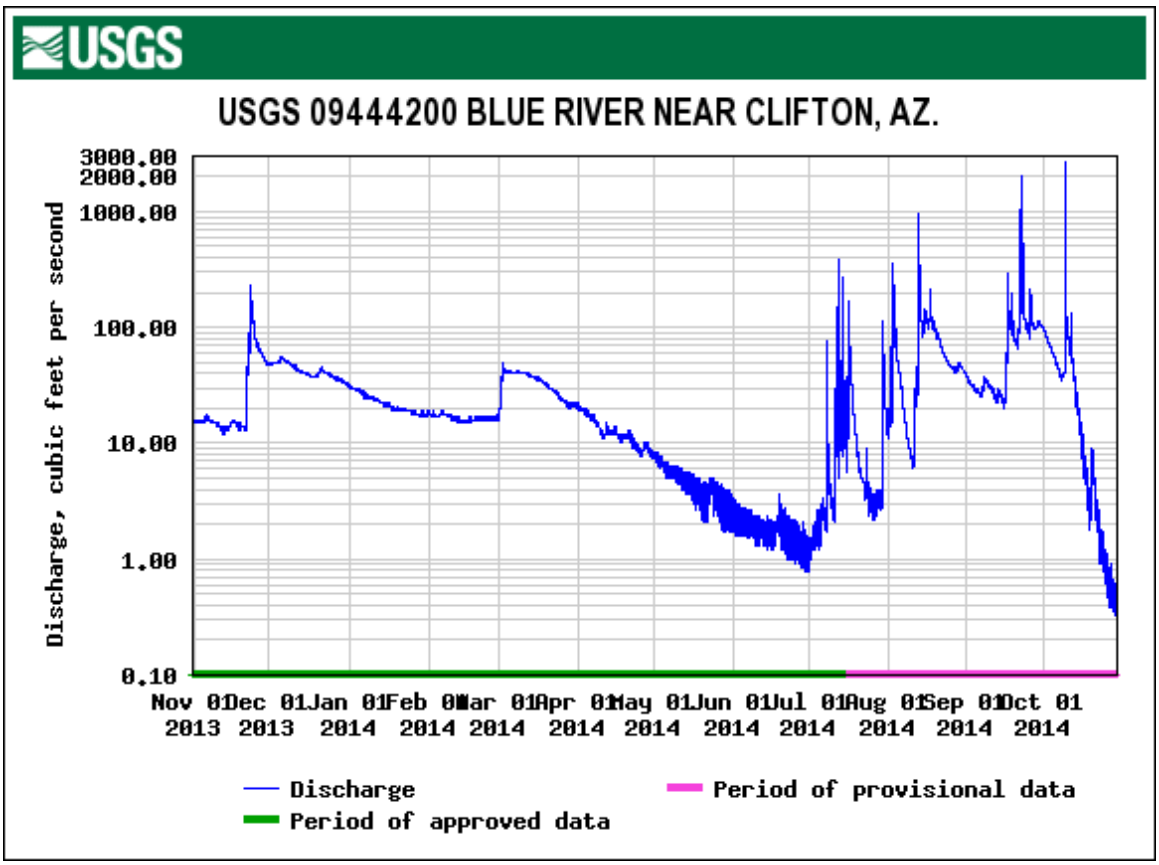

Figure 2. Discharge in Blue River, Greenlee Co., Arizona during and prior to the period of fish monitoring October 28-29, 2014. The gauge site is at Juan Miller crossing (Forest Service Road 475) is about 12 km upstream of the barrier, and measurements there were about an order of magnitude less than those observed in the study area downstream at the time of our visit.

Figure 3. Roundtail chub *Gila robusta*; 70-mm TL, juvenile (age-0) captured in sub-reach 3, 400 m upstream of the constructed fish barrier, Blue River, Greenlee Co., Arizona. Photo by RWC taken October 29, 2014.

Figure 4. Blue River, Greenlee Co., Arizona, showing longfin dace *Agosia chrysogaster* spawning depressions or "nests" in soft, sandy substrate near the constructed fish barrier. Photo by RWC taken October 29, 2014.