Aquatic Invasive Species Surveillance in the Little Colorado River Basin during 2017

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by

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INTRODUCTION

Presidential Executive Order 13112 of February 3, 1999 defined the term *invasive species* as *"an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health."* Approximately 50,000 nonindigenous species are estimated to have been introduced to the United States, of which some are considered invasive and others beneficial species (Pimentel et al. 2000). Competition and predation from invasive species are considered primary risk factors for over 400 Threatened and Endangered Species (Wilcove et al. 1998). In Arizona, dozens of aquatic invasive species have been introduced (fishes, mollusks, crustaceans, alga), have expanded distributional ranges, and pose a growing threat to myriad native aquatic species. The first line of defense for reducing the impact from invasive species is preventing their introduction and establishment. Multiple management agencies, notably state and federal wildlife agencies, maintain active invasive species prevention programs. Even the best prevention efforts cannot stop all invasive species, and thus, early detection and rapid assessment and response actions represent a critical second defense.

The Little Colorado River (LCR) is the largest tributary to the Colorado River within Grand Canyon in Arizona (Fig. 1). Although the LCR was once perennial, it now flows intermittently throughout most of its 573 km corridor below its perennial headwaters arising near Mt. Baldy, Arizona (Colton 1937; Miller 1961).The river is subject to episodic floods after spring thaws and summer monsoons that drain the 69,870 km^2 basin in eastern Arizona and western New Mexico (Johnson 1976; Stone 2010). At baseflow most perennial discharge in the lower LCR begins with Blue Spring (~2.55 m^3/s output) located about 20.74 km above the LCR's mouth, and is supplemented downriver by other springs resulting in a mean discharge of about 6.32 m^3/s near the mouth (Johnson and Sanderson 1968; Cooley 1976). Native Humpback Chub *Gila cypha* (a federally endangered species; USFWS, 1990), Speckled Dace *Rhinichthys osculus*, Flannelmouth Sucker *Catostomus latipinnis*, and Bluehead Sucker *C. discobolus* continue to successfully spawn, rear, recruit to adulthood, and maintain numerical dominance over nonnative fishes within this lower perennial corridor (Douglas and Marsh 1996, 1998; Gorman and Stone 1999, Robinson and Childs 2001; Stone and Gorman 2006). It is remarkable that nonnative fishes have consistently represented a relatively small component of the lower LCR's observed fish community over the past 36 years of studies (Kaeding and Zimmerman 1983; Van Haverbeke et al. 2013). This is despite the fact that nonnative fishes residing downriver in the Colorado River and upriver in water sources within and bordering the LCR's intermittent corridor can often invade the lower LCR (Stone et al. 2007).

Native fish populations in Grand Canyon are key resources of concern influencing decisions on operations of Glen Canyon Dam (USFWS 2002, 2011). However, in addition to population effects caused by Glen Canyon Dam operations, conservation of Humpback Chub and the native fish community in the LCR and Colorado River in Grand Canyon is vulnerable to incursion by aquatic invasive species from upstream. One need spend little time in the Grand Canyon portion of the LCR to understand the connectivity of the lower portion of the LCR below Blue Spring with the upper portions of the watershed. This connectivity is immediately evident by observing the abundant trash (plastic bottles, cans, etc.) being transported through the system. Biological connectivity is evident as well, demonstrated by captures of aquatic invasive Red Shiner *Cyprinella lutrensis*, Common Carp *Cyprinus carpio*, Fathead Minnow *Pimephales promelas*, Black Bullhead *Ameiurus melas*, and Plains Killifish *Fundulus zebrinus* in the intermittent corridor of the LCR at Grand Falls, all thought to have originated hundreds of kilometers upstream (Stone et al. 2007). Twenty two nonnative fish species from scattered locations within the LCR basin have been identified (Stone et al. 2007), and additional undocumented, illegally introduced species likely exist. Since 2002, only nine of these nonnative

species have been captured in the lower LCR, which includes the five warmwater species described above at Grand Falls, along with warmwater Channel Catfish *Ictalurus punctatus* and Green Sunfish *Lepomis cyanellus*, and coldwater Rainbow trout *Oncorhynchus mykiss* and Brown Trout *Salmo trutta*. Additional nonnative fish species could colonize the lower portions of the LCR from the approximately 95 reservoirs and 3,700 stock tanks that exist in the six major water bearing basins of the LCR watershed (ADWR 1989, 1990, 1994). These reservoirs and stock tanks are potential sources of aquatic invasive species and many can readily feed into the LCR or its tributaries.

A Reasonable and Prudent Alternative in the 1995 Final Environmental Impact Statement was to protect Humpback Chub in the LCR by development of a LCR Management Plan (USBR 1995). A LCR Watershed Management Plan was completed by Valdez and Kubly (2013) wherein invasive species surveillance in the upper LCR drainage was recommended. In 2017, the U.S. Geological Survey's Grand Canyon Monitoring and Research Center (GCMRC) contracted the U.S. Fish & Wildlife Service (USFWS) to conduct invasive species surveillance surveys in the upper LCR corridor. This report summarizes our findings from those surveys and augments the LCR Watershed Management Plan of Valdez and Kubly (2013) by providing specific information and data concerning sources of aquatic invasive species within the LCR basin. Our primary study objectives were to 1) identify surveillance sites that can provide early detection and response capacity for emerging deleterious aquatic invasive species within the LCR drainage; 2) establish and monitor these surveillance sites within the LCR drainage; and 3) if aquatic invasive species deleterious to Humpback Chub *Gila cypha* and other native fishes in Grand Canyon are detected, conduct a rapid assessment and response plan.

METHODS

Selection of Surveillance Sites.— Surveying thousands of water sources and taxonomic entities for aquatic invasive species in the LCR basin was beyond the scope of this effort. This effort focused on vertebrate and large invertebrate aquatic invasive species susceptible to commonly used fish-sampling gears and methods. Moreover, fishery information for large, permanent lakes and streams has been described in stocking and survey reports by various agencies from sporadic surveys (*see* Stone et al. 2007), although these surveys typically focus on key sport fish and may not detect invasive species. Little is known about which aquatic invasive species enter the intermittent LCR corridor during floods, survive after flows cease, and are the best candidates to invade the lower perennial LCR. Although any reservoir, tributary, stock tank, or other water source that occasionally spills into the LCR drainage is a potential source for aquatic invasive species invading the lower LCR, some are much better sources than others.

The mainstem LCR is predominantly an interrupted system wherein connections across intermittent and perennial sections are induced through precipitation runoff events, primarily spring snowmelt and summer monsoonal spates. Outside of runoff events, much of the mainstem LCR is reduced to small perennial patches that serve to concentrate aquatic species and biomass. The sites function as bio-concentrators and provide ideal locations for detection of local and upstream species richness including aquatic invasive species. Therefore, surveillance sites were assessed based on their likelihood to concentrate and harbor species, watershed/sub-watershed reference locations, accessibility, and ability to be sampled. After reviewing Stone et al. (2007) and other fishery reports on the LCR basin, and examining Google Earth Pro to locate pools of water in the intermittent LCR drainage during the dry summer months, we selected eight primary surveillance sites that were either within, nearby, or flowed into the LCR during periods of runoff, and therefore considered likely sources for aquatic invasive species invading the lower LCR (Figs. 1 & 2). We also included Cow

Springs Lake as a ninth site because little information existed for the site and it represented a potential source for aquatic invasive species during major flood events. Cow Springs Lake was sampled in coordination with Navajo Nation Department of Fish and Wildlife.

Surveillance Site Sampling.— Most surveillance sites were sampled at hydrologic minima in late June and July (summer) before monsoonal flooding occurred, but some were sampled or re-sampled in November after the LCR stopped flowing from summer floods. All sites except Cow Springs Lake were sampled with baited hoop nets (50-60 cm in diameter, 100 cm long, a single 10 cm throat, 6 mm nylon mesh netting) and/or by seining. Hoop nets were baited near their cod ends by attaching nylon mesh bags (30 x 30 cm, 6 mm mesh) filled with ~160 g AquaMaxTM Grower 600 for Carnivorous Species (Purina Mills Inc., Brentwood, MO) and typically deployed overnight to maximize fish captures (Stone 2005). A trammel net was also used to sample the Grand Falls site during November and a boat electrofisher was the sole gear used to sample Cow Springs Lake.

All captured fishes were identified to species, and large fishes ≥150 mm total length (TL) were measured to TL. Hereafter, all references to fish lengths infer TL. We typically measured a representative sample of small-bodied fishes and juveniles of large-bodied fishes and then tallied the rest to reduce time and handling stress. Adult fish were inspected for sex, spawning condition (e.g., ripe, spent) and spawning characteristics (e.g., spawning tuberculation and coloration). Channel Catfish, Black Bullhead, and Common Carp that were deemed sufficiently large enough at the Grand Falls site were also implanted with 134.2 KHz PIT Passive Integrated Transponder (PIT) tags (Biomark, Inc.) in the prospect that some could be later recaptured downriver in the lower LCR or Colorado River.

RESULTS

Descriptions and Sampling Results of Surveillance Sites

Species and numbers captured at the sampling sites are listed in Table 1. Below are sample descriptions and other summary data arranged by sample location (e.g., site locations, sampling gears used, fish lengths, etc.).

Primary sites:

(1) Silver Creek (34°44'24" N, 110°02'20" W; *see* Figs. 1 & 2). Silver Creek empties into the LCR about 0.19 km downriver of Woodruff Reservoir, which is about 6 km south of Woodruff, AZ and 19 km upriver from the Holbrook sampling site. This site is accessible just south of a bridge on the Old Woodruff Road that crosses the LCR about 0.18 km before it joins Silver Creek.

We sampled this site June 26-27, 2017 with 11 baited hoop nets (~16 hrs/set; 174 total hrs) and six seine hauls. Three hoop nets were deployed at the lower end of the reservoir just above Woodruff Falls, which captured 10 Common Carp and seven Black Bullhead. The other eight hoop nets were deployed and six seine hauls were conducted below the waterfalls in Silver Creek, LCR, and their confluence, where we collectively caught 42 Common Carp, eight Channel Catfish, one Black Bullhead, ~1,263 Fathead Minnows, and 72 Northern Crayfish *Orconectes virilis*. Total numbers (and length distributions) of nonnative fishes captured at this site included 52 Common Carp (median = 249 mm; range = 134-392 mm), eight Channel Catfish (137 mm; 123-385 mm), eight Black Bullhead (204 mm; 175-280 mm), and ~1,263 Fathead Minnows. Seven adult Common Carp were ripe males. A local angler was fishing for carp and catfish in Silver Creek below the waterfalls.

(2) Holbrook (34°52'56" N, 110°06'29" W; *see* Figs. 1 & 2). The Holbrook site is a large pool located in the LCR about 19 km downriver of the Silver Creek site, 1.55 km upriver of where the Puerco River joins the LCR, and 5.7 km from the city of Holbrook. It is easily accessible by a short trail that starts at a bridge that crosses the LCR on Hwy 180.

This site was sampled June 26-27, 2017 with eight baited hoop nets (~16 hrs/set; 128 total hrs), and five seine hauls, and by angling of a local fisherman named Charlie. Collectively, two Channel Catfish (130 & 254 mm), 23 Common Carp (median = 52 mm; range = 40-322 mm), and 799 Fathead Minnows were captured. Charlie angled two of these fish, which were the largest catfish and carp. He stated that he has been fishing this site for many years, and that the pool often becomes completely dry in the late summer before monsoons arrive.

(3) Chevelon Creek (34°57'08" N, 110°31'33" W; *see* Figs. 1 & 2). We sampled two areas within this site. The upper perennial area was located at an irrigation diversion dam and the lower intermittent area was located 2.89 km downstream at the Chevelon Creek-LCR confluence. Both areas are on Arizona Game and Fish Department's (AZGFD) Chevelon Creek State Wildlife Area, which is south of I-40 between Joseph City and Winslow, AZ and ~141 km above the Grand Falls site. Access to this area is by driving north off of McLaws Rd on a dirt road that is about 1.20 km west of the Chevelon Creek Bridge.

We sampled adjacent to the diversion dam on June 27-28, 2017 with 10 baited hoop nets (~18 hrs/set; 183 total hrs), which caught a Black Bullhead (72 mm), a Bluegill *Lepomis macrochirus* (115 mm), four Green Sunfish (81-201 mm), and 17 Largemouth Bass *Micropterus salmoides* (38-59 mm). On July 7, 2017 we sampled downriver at the Chevelon Creek-LCR confluence area with 10 seine hauls, and caught seven Black Bullheads (69-92 mm), four Green Sunfish (60-84 mm), a Largemouth Bass (46 mm), ~476 Fathead Minnows, nine Red Shiners, 72 Plains Killifish, and a Northern Crayfish. Although we also deployed 10 baited hoop nets (~21 hrs/set; 214 total hrs) around this area on July 10-11, 2017, only one Fathead Minnow was caught due to flooding and concomitant siltation from the LCR. Therefore, we deployed 16 more baited hoop nets (~23 hrs/set; 367 total hrs) on November 14-15, 2017, which captured three Black Bullheads (119-237 mm), a Bluegill (38 mm), four Green Sunfish (76-103 mm), and 22 Fathead Minnows.

Collectively, in both areas of this site, we captured 11 Black Bullheads (median = 78 mm; range = 69-237 mm), 12 Green Sunfish (84 mm; 60-201 mm), two Bluegills (38 & 115 mm), 18 Largemouth Bass (38-59 mm), ~499 Fathead Minnows, nine Red Shiners, 72 Plains Killifish, and a Northern Crayfish. All four large-bodied fishes (Bullhead and 3 Centrarchids) captured at the diversion dam area were also captured downriver in the confluence area, while the three small-bodied species were only caught in the confluence area. Most large-bodied fishes were juveniles except for a Green Sunfish (201 mm) and Black Bullhead (237 mm) caught in the diversion dam and confluence areas, respectively. No fish were identified as ripe.

(4) Clear Creek (34°58'40" N, 110°38'30" W; *see* Figs. 1 & 2). This site is located directly below Clear Creek Reservoir, which is stocked as a recreational fishery, and is located ~127 km above the Grand Falls site. Typically, numerous pools are available for sampling in the 1.55 km reach between Clear Creek Reservoir and the LCR.

We conducted nine seine hauls on July 6, 2017 and deployed 10 baited hoop nets (~18 hrs/set; 179 total hrs) from July 10-11, 2017 in various pools below Clear Creek Reservoir. Collectively, we

captured five Black Bullhead (median = 237 mm; range = 222-261 mm), 45 Green Sunfish (104 mm; 58-143 mm), 28 Bluegills (80 mm; 53-183 mm), 25 Largemouth Bass (37 mm; 20-146 mm), 16 Fathead Minnows, 28 Plains Killifish, a Northern Crayfish, and a native Flannelmouth Sucker (385 mm). No fish was identified as ripe.

(5) Homolovi (34°02'10" N, 110°39'56" W; *see* Figs. 1 & 2). This site contained several small pools connected by a shallow stream and is located near Homolovi State Park, east of Winslow, AZ, and around 8.3 km downriver of the Clear Creek site. Five seine hauls were conducted on July 7, 2017, which resulted in the estimated captures of 243 Fathead Minnows and 431 Plains Killifish. It was too shallow to deploy hoop nets, and no fish were identified as ripe.

(6) Grand Falls (35°25'41" N, 111°12'05" W; *see* Figs. 1 & 2). Grand Falls is located on Navajo tribal lands about 132 km above the perennial, lower 21 km of the LCR. Grand Falls was created by a volcanic flow from Rodin's Crater, whereby the stream of basalt effectively dammed the original river channel, causing the LCR to flow around the resulting lava tongue and drop ~56.4 m over the canyon wall back to the old river channel (Colton 1930). During dry months of most years this area contains pools of water scattered along the river bed.

We sampled isolated pools below Grand Falls with 16 baited hoop nets (~13 hrs/set; 215 total hrs) and 13 seine hauls on June 29-30, 2017, and resampled these pools with 16 baited hoop nets (~21 hrs/set; 331 total hrs) and a trammel net stretched across the main plunge pool (~100 ft long; 20 hrs) on November 2-3, 2017. Collectively, we captured 18 Channel Catfish (median = 109 mm; range = 86-420 mm), four Black Bullheads (129 mm; 111-191 mm), 173 Common Carp (61 measured; 44 mm; 25-372 mm), a Green Sunfish (75 mm), ~2,957 Fathead Minnows, and 26 Plains Killifish. All of these species were caught during the June effort, and all but Green Sunfish and Plains Killifish in the November effort. Fish identified as ripe included a female Fathead Minnow, female Plains Killifish, and a male Common Carp during the June effort, and three female and three male Common Carp in the November effort. Juveniles of all species were captured, whereby some may have hatched in this area. Four Black Bullhead (111-191 mm), 18 Channel Catfish (86-420 mm), and 15 Common Carp (180-372 mm) were PIT-tagged. During June we found a forked stick, which was used as a fishing pole rest, stuck in the bank of the plunge pool and a fishing bobber, and in November we had a conversation with two local residents who stated that they and other locals often fish these pools.

(7) Babbitt Ranch Pond (35°42'41" N, 111°18'48" W; *see* Figs. 1 & 2). Babbitt Ranch Pond was originally created to clean gravel mined on Babbitt Ranch. Imagery from Google Earth Pro shows buildings and equipment for the mining operations in 2010, which were removed by 2012. This pool is located only ~100 meters from the LCR channel, about 37 km downriver of the Grand Falls site and 22 km upriver of the Cameron site. To access this site go east off of HWY 89 on a dirt road at Mile 461 for ~10.9 miles. Although this large pool was sampled with 16 baited hoop nets (~22 hrs/set; 355 total hrs) on November 7-8, 2017, no fish were captured. It is unknown if this pool was ever stocked with fish, if the water quality is unsuitable for fish, or if it is ever inundated by floodwaters (and fishes) from the LCR.

(8) Cameron (34°52'38" N, 111°24'55" W; *see* Figs. 1 & 2). This site contained isolated pools in the LCR near the Cameron Trading Post on HWY 89. On November 7, 2017 we deployed four baited hoop nets (~3.5 hrs/set; 14 total hrs) in an isolated pool below the Cameron wastewater treatment facility and conducted four seine hauls in pools within the main LCR channel. Only one Fathead Minnow and one salamander *Ambystoma tigrinum* was caught in the pool below the treatment facility and it is unknown if there is ever a surface water connection between this pool and the LCR during

floods. The seining efforts in the main channel resulted in two Common Carp (52 & 165 mm), ~378 Fathead Minnow, 36 Plains Killifish, and a Red Shiner.

Secondary site:

(9) Cow Springs Lake (36°23'49" N, 110°52'18" W; *see* Figs. 1 & 2). Cow Springs Lake is a warmwater reservoir around 240 acres in size that is located next to Hwy 160 about 30 miles northeast of Tuba City. Potentially during large floods this reservoir could flow into Moenkopi Wash and then into the LCR. This lake was sampled with an electrofishing boat for 0.5 hrs on June 21, 2017 and for 2 hrs on September 26, 2017. Collective fish captures included: 13 Channel Catfish (median = 282 mm; range = 232-485 mm), six Largemouth Bass (204 mm; 101-380 mm), two Green Sunfish (138 & 199 mm), 259 Gizzard Shad, *Dorosoma cepedianum* (35 measured, 398 mm; 150-471 mm), 74 White Crappie, *Pomoxis annularis* (195 mm; 134-235 mm), six Smallmouth Buffalo, *Ictiobus bubalus* (2 measured, 302 & 310 mm), and one Bigscale Logperch, *Percina macrolepida* (110 mm). The Bigscale Logperch is believed to be the first documentation of this species in Arizona waters, and White Crappie, Smallmouth Buffalo and Gizzard Shad represent new records in the LCR drainage (Young and Lopez 1999).

Summary of Surveys

A total of eight primary sites and one additional site (Cow Springs) were sampled in the summer and fall of 2017. The cumulative sampling effort for the eight primary sites included 117 baited hoop-net sets (median = 18.3 hrs/set; range = 3.5-24 hrs/set; 2,159 total hrs), 52 seine hauls, one trammel net set (20 hrs), and angling by a local fisherman at the Holbrook site. Nine nonnative fish species were captured in the primary sites, except for Babbitt Ranch Pond where no fish were captured (Table 1). Collectively, the total numbers (and length distributions) of nonnative fishes captured among these primary sites were 28 Channel Catfish (median = 122 mm; range = 86-420 mm), 28 Black Bullhead (178 mm; 69-280 mm), 250 Common Carp (138 measured; 145 mm; 25-392 mm), 58 Green Sunfish (102; 58-201 mm), 30 Bluegill (80 mm; 38-183 mm), 43 Largemouth Bass (44 mm; 20-146 mm), 10 Red Shiner, ~6,206 Fathead Minnows, and ~593 Plains Killifish. All nonnative species were captured at two or more sites, but only Fathead Minnows were capture at all seven sites (Table 1). In addition, we captured a native Flannelmouth Sucker (385 mm) at the Clear Creek site and a total of 74 nonnative Northern Crayfish among three sites (i.e., Silver, Chevelon, and Clear Creeks). The Cow Springs Lake site was sampled by an electrofishing boat for 2.5 total hours. Fishes of seven nonnative species were captured in this lake (Table 1; see above for length distributions). Three of these species (Channel Catfish, Green Sunfish, and Largemouth Bass) were also caught at some primary sites, while four species (Gizzard Shad, White Crappie, Smallmouth Buffalo, and Bigscale Logperch) were not captured in any other sites.

DISCUSSION

During 2017 we identified and sampled nine surveillance sites in the LCR basin, of which eight sites were considered “primary sites” because they were likely sources for aquatic invasive species invading the lower perennial LCR, while the ninth site was considered a secondary, potential source of invasive species. Seven of the primary sites were either in or near the confluence with the intermittent LCR where fishes could move further downriver during periods of runoff (Silver Creek, Holbrook, Chevelon Creek, Clear Creek, Homolovi, Grand Falls, and Cameron) and the eighth primary site (Babbitt Ranch Pond) was located only ~100 meters from the LCR. Nonnative fishes were captured in all of these sites except for Babbitt Ranch Pond. Collectively, we captured fishes of

nine nonnative species in the primary sites, of which seven species (Channel Catfish, Black Bullheads, Common Carp, Fathead Minnow, Red Shiner, Plains Killifish, and Green Sunfish) have been captured in the lower perennial LCR since at least 2002. Largemouth Bass and Bluegill were the only nonnative species captured in some primary sites but not in the lower perennial LCR. We also surveyed Cow Springs Lake, as a secondary, ninth site because major flood events could potentially displace fishes from this lake into Moenkopi Wash and then into the lower LCR. This lake is a sport fishery that contains intentionally and unintentionally stocked fish species. Four of the seven nonnative species caught in this lake, Gizzard Shad, White Crappie, Smallmouth Buffalo, and Bigscale Logperch, were not captured in any primary surveillance sites and have never been documented in the LCR drainage (Young and Lopez 1999). Though unlikely, if fish from one of these species are captured in the lower LCR, then Cow Spring Lake should be considered a likely source.

Of all surveillance sites, we consider Grand Falls the most vital for long-term monitoring purposes of aquatic invasive species. Grand Falls is about 132 km above Blue Spring, and 127 km below the closest perennial sources containing aquatic invasive species (Stone et al., 2007). During the dry months of most years this area still contains pools of water scattered along the river bed because the underlying basalt reduces the water's percolation into the ground. Presumably, all nonnative species captured at Grand Falls, originated from upstream sources. Although the Grand Falls site has never been stocked, fishes of nine warmwater nonnative species have been collectively captured there during surveys in 1959 (Miller et al. 1962), 2005 (Stone et al. 2007), 2016 (unpublished June and July 2016 surveys, respectively, by GCMRC and USFWS), and 2017 (i.e., this study). This includes all seven warmwater nonnative species documented in the lower perennial LCR since 2002

Our fish captures of nine nonnative species at seven primary sites located within or abutting the LCR's intermittent corridor, along with Miller's (1963) captures of five nonnative species at Grand Falls in 1959 (*see* Figs 1 & 2), implicates the intermittent corridor as a source and gateway for nonnative fishes invading the lower perennial corridor for over 58 years. All seven warmwater nonnative species that were caught at both Grand Falls and the lower perennial LCR are also commonly found in other intermittent streams scattered across ten different U.S. States, and are often considered highly tolerant of variable and extreme physical conditions (Zale et al. 1989; Fausch and Bramblett 1991). Largemouth Bass and Bluegill were the only warmwater nonnative species that were captured in some primary surveillance sites but never in the lower perennial LCR. Although these two species are also present in many other intermittent streams, their abundances are usually low (Zale et al. 1989). We also caught a native Flannelmouth Sucker in the Clear Creek site during this year's survey and one at Grand Falls in 2016, which suggests that downriver immigrants occasionally supplement their lower LCR population.

Rapid Assessment and Response.—If invasive species potentially deleterious to Humpback Chub and other native fishes in the lower perennial LCR were detected, a rapid assessment would have been performed. We consider a deleterious species to be a new species identified in the lower LCR that could prey upon or compete with native fishes. It must be emphasized that these invasive species must pose a new threat to native fishes, and do not include those nonnative fishes that have been recurrently identified in the lower LCR for over 30 years. For example, Channel Catfish have preyed upon and competed with native fishes in the lower LCR for over 30 years (Kaeding and Zimmerman 1983; Marsh and Douglas 1997), yet the system still remains dominated by native fishes (Van Haverbeke et al. 2013); therefore, this species does not pose a new threat. Conversely, a species such as Flathead Catfish *Pylodictis olivaris*, considered a major piscine predator, highly tolerant of disparate abiotic conditions, and new to the LCR (Minckley 1973; Minckley et al. 2003) would be deemed a new invasive species threat to native fishes in the lower LCR. If this species or

another potentially deleterious species is caught in the future, USFWS will convene species experts and land management agency representatives and a response plan developed. Rapid assessment will include recommended actions, task owners, an estimated budget for each item and schedule for accomplishment, and then the USFWS, AZGFD, the appropriate land management authority, and other action agencies/partners would coordinate, resource, and implement the response plan.

Although three of the four new species to the drainage detected in Cow Springs Lake have the potential to be invasive, the lake is considered fairly well isolated. Nonetheless, the USFWS is working with Navajo Nation, Department of Fish (NNDFW) and Wildlife on the need and feasibility for control or eradication.

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Table 1.—Numbers of nonnative fishes caught in eight survey sites in the Little Colorado River (LCR) Basin, Arizona in 2017. Seven primary sites were either in or near the confluence with the intermittent LCR where fishes could move further downriver during periods of runoff (Silver Creek [SIL]; Holbrook [HOL]; Chevelon Creek [CHV]; Clear Creek [CLR]; Homolovi [HOM]; Grand Falls [GRF]; and Cameron [CAM]). An eighth primary site (Babbitt Ranch) is not included because there were no fish captures. The ninth "Cow Springs Lake (CSL)" site might flow into the LCR during large floods. Species with asterisks have been also caught in the lower perennial LCR.

	Connected sites							
Families and Species	SIL	HOL	CHV	CLR	HOM	GRF	CAM	CSL
Catostomidae								
Smallmouth Buffalo (*Ictiobus bubalus*)	—	—	—	—	—	—	—	6
Centrarchidae								
Green Sunfish* (*Lepomis cyanellus*)	—	—	12	45	—	1	—	2
Bluegill (*L. macrochirus*)	—	—	2	28	—	—	—	—
Largemouth Bass (*Micropterus salmoides*)	—	—	18	25	—	—	—	6
White Crappie (*Pomoxis annularis*)	—	—	—	—	—	—	—	74
Clupeidae								
Gizzard Shad (*Dorosoma cepedianum*)	—	—	—	—	—	—	—	259
Cyprinidae								
Red Shiner* (*Cyprinella lutrensis*)	—	—	9	—	—	—	1	—
Common Carp* (*Cyprinus carpio*)	52	23	—	—	—	173	2	—
Fathead Minnow* (*Pimephales promelas*)	1,263	789	499	16	293	2,957	379	—
Cyprinodontidae								
Plains Killifish* (*Fundulus zebrinus*)	—	—	72	28	431	26	36	—
Ictaluridae								
Black Bullhead* (*Ameiurus melas*)	8	—	11	5	—	4	—	—
Channel Catfish* (*Ictalurus punctatus*)	8	2	—	—	—	18	—	13
Percidae								
Bigscale Logperch (*Percina macrolepida*)	—	—	—	—	—	—	—	1

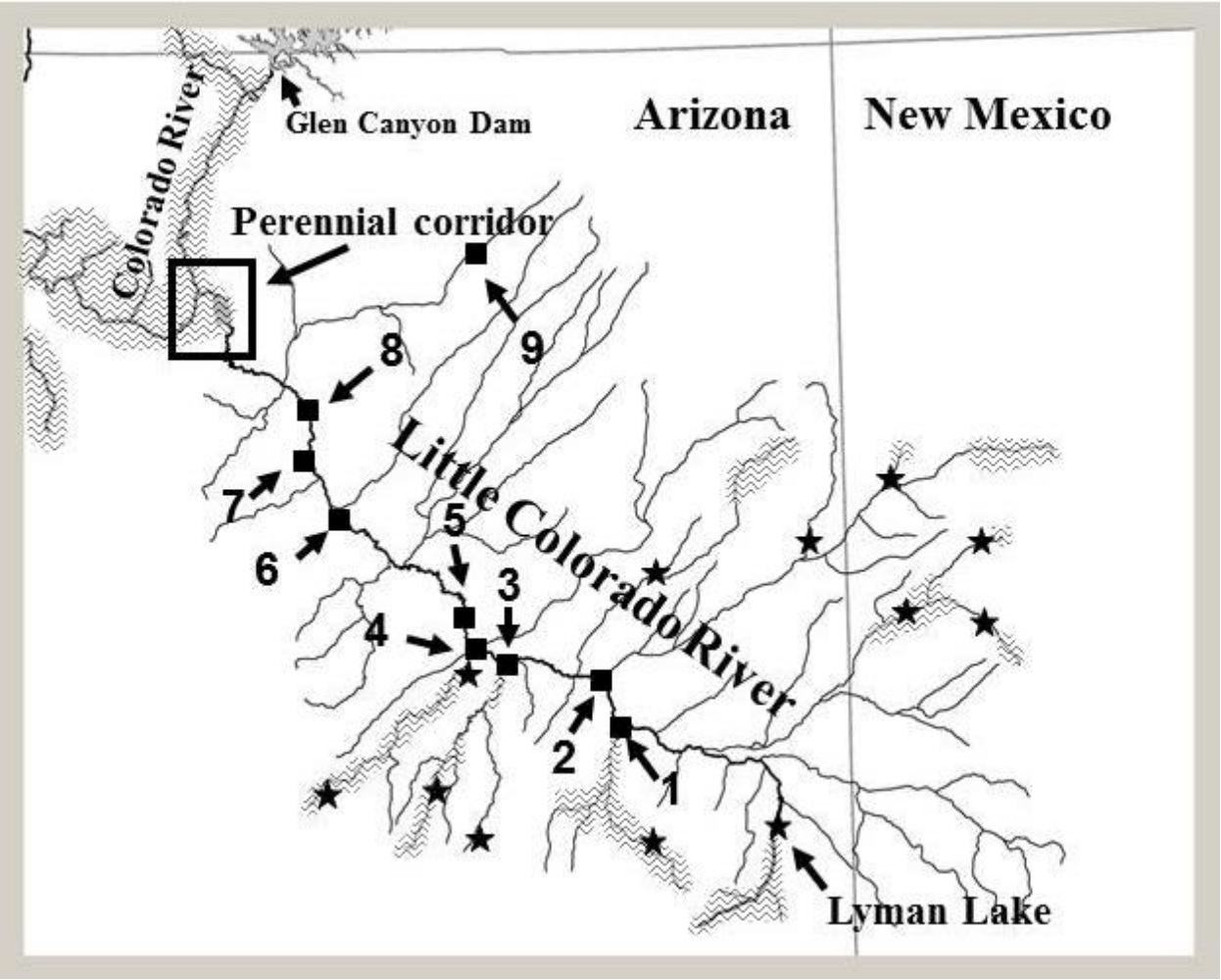

Figure 1.—Surveillance sites in the Little Colorado River (LCR) Basin, Arizona: (1) Silver Creek, (2) Holbrook, (3) Chevelon Creek, (4) Clear Creek, (5) Homolovi, (6) Grand Falls, (7) Babbitt Ranch Pond, (8) Cameron, and (9) Cow Springs Lake. Stars denote reservoirs that contain nonnative fishes and believed to commonly spill into the LCR Basin, and shading denotes perennial stream reaches.

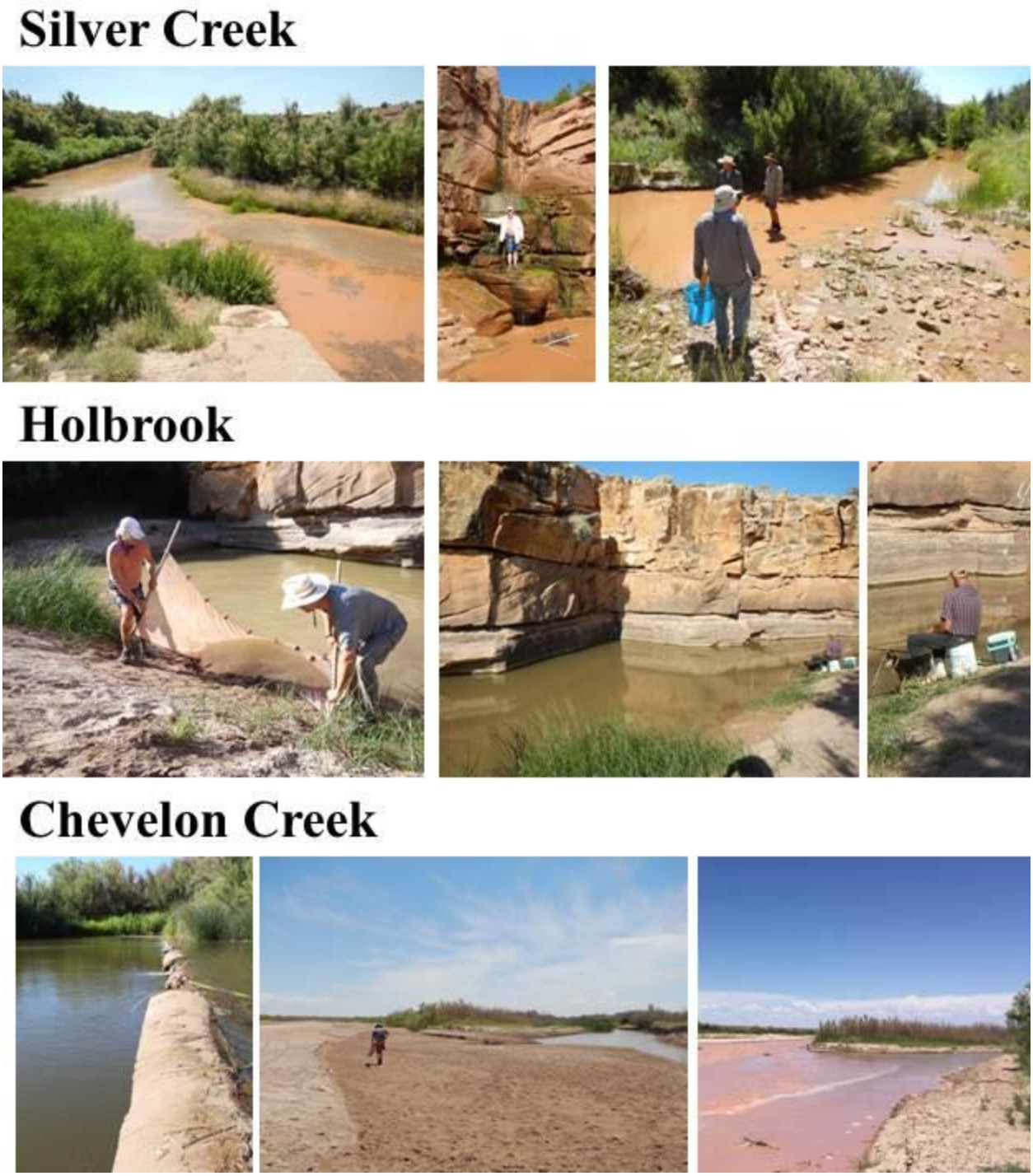

Figure 2.—Photographs of surveillance sites in the Little Colorado River (LCR) Basin, Arizona. **Silver Creek** (from left to right pics of Woodruff Reservoir, Woodruff Falls, and ~0.19 km downriver at Silver-LCR confluence); **Holbrook** (main pool and Charlie fishing with his dog Jake); **Chevelon Creek** (diversion dam and ~2.89 km downriver at Chevelon-LCR confluence when LCR was dry and flooding; **Clear Creek** (pools below reservoir); **Homolovi** (shallow stream); **Grand Falls** (main pools); **Babbitt Ranch Pond**; **Cameron (**pool in dry corridor); and **Cow Springs Lake**.

Figure 2 continued

Clear Creek

Homolovi

Grand Falls

Figure 2 continued

Babbitt Ranch Pond

Cameron

Cow Springs Lake