COLORADO RIVER RECOVERY PROGRAM
FY 2016 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 126a, 126b, 123a

I. Project Title: **Removal of Non-native Fish in the Upper Colorado River between Grand Valley Water User's Dam [Government Highline Diversion Dam] near Palisade, Colorado, and Potash, Utah.**

II. Bureau of Reclamation Agreement Number(s): R15PG400083

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IV. Abstract: The primary purpose of this study is to remove as many nonnative smallmouth bass as possible, of all size-classes, from main channel riverine habitats in two distinct sections of the Colorado River: 1) a 66-mile reach from between the Grand Valley Water User's (GVWU) dam in CO, downstream to the Westwater boat landing in eastern UT; and 2) a 45-mile reach between Rifle and Beavertail Mountain in CO. This is the thirteenth year of this study, which started in 2004. Beginning in 2015, an additional walleye removal component was fully funded. These removal efforts covered a 64-mile reach from Cisco boat landing in Eastern UT downstream to Potash boat landing. We also began experimental nonnative fish removal in a few gravel pit ponds that serve as grow out ponds for our hatchery reared endangered fish. CDOT pond (in Debeque Canyon), Beswicks pond (near Clifton, CO), and Butch Craig pond (on the Gunnison River near Whitewater, CO) were our primary focus in both 2015 and 2016.

In our riverine sections we removed 482 smallmouth bass, 1,709 largemouth bass, 53 walleye, and various amounts of other nonnative fish in 2016. Catches of age-0 smallmouth bass indicate a weak year class (< 100 mm) was produced in 2016 in the Grand Valley reaches of the Upper Colorado. However, the young-of-year (YOY) smallmouth bass that were able to survive experienced many more degree days greater than 13.9° (Celsius) prior to winter and have a good chance of surviving until next spring (Figure 9; similar to 2015). Bestgen and Hill (2016) suggest that smallmouth bass greater than 50 mm total length prior to going into the winter have a good chance of survival and 98% of our 2016 age-0 smallmouth bass were greater than 50 mm. The catch rate for YOY and juvenile size smallmouth bass < 100 mm increased (48%) from 2015. The catch rate for adult smallmouth bass > 200 mm increased (3%) from 2015. Catches of largemouth bass from 2012 through 2016 suggest that survival of juvenile largemouth bass

to adults in the river is relatively low. The walleye component of this work is now reported in a basin wide annual report.

Non-native fish removal in Grand Valley gravel pit ponds resulted in the removal of 4,852 fishes. This work was dually beneficial to the program because these ponds were grow-out facilities for the Ouray National Fish Hatchery Grand Valley Unit for razorback sucker and bonytail. These removal efforts resulted in the additional stocking of 445 razorback sucker and 4 bonytail to the Colorado and Gunnison Rivers.

V. Study Schedule: 2004-Ongoing

VI. Relationship to RIPRAP:

Colorado River Action Plan: Mainstem

III. Reduce negative impacts of nonnative fishes and sportfish management activities.

III.A. Develop and implement control programs in reaches of the Colorado River occupied by endangered fishes.

VII. Accomplishment of FY 2016 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1.

Remove all sizes of smallmouth bass, other centrarchids, and other nonnative species as deemed appropriate and described in state (Colorado and Utah) collection permits.

Task completed. The FY 2016, 126a scope of work, called for eight removal passes in the Grand Valley. We completed the eight passes in most reaches and had nine passes in the reach from Riverbend Park to Corn Lake (see methodology below). In one river reach (GVWU Dam to Riverbend Park) we completed only three passes. This was due to very low-river flows, which made this river reach impassable to electrofishing boats for most of the August through October time period. The FY 2016, 126b scope of work, called for one removal pass from Silt to Beavertail Tunnel. Colorado Parks and Wildlife (CPW) sampled the river between Rifle (RM 240.4) and Parachute (RM 222.2) as well as Debeque (RM 209.7) to Beavertail Tunnel (RM 195.7). Silt (RM 248.0) to Rifle (RM 240.4) was omitted in 2016 due to low or no captures in the previous 3 years for this reach. Additionally, Parachute to Debeque was also not sampled due to low flows creating hazardous conditions over the Bluestone Ditch water diversion structure.

All age groups of smallmouth bass (age-0, juveniles, and adults) were present in the 2016 summer/fall collections. These ranged from age-0 (42 mm) to adult (407 mm) fish with a mean of 195 mm. However, adult smallmouth bass ($\geq$ 200 mm) made up a larger proportion of our total catch when compared to the 2010-2013 period (Figure1). A total of 482 smallmouth bass were removed, including 30 considered piscivorous competitors to Colorado pikeminnow ($\geq$ 325 mm; Table 1). A weak year class of smallmouth bass (< 100 mm) was produced in 2016 in the Grand Valley reaches of the Upper Colorado, as only 184 were collected and removed (Figure 2). In fact, the catch rate for YOY/juvenile size fish < 100 mm only increased slightly from 0.28 fish/hr (2015) to 0.54 fish/hr, similar to

catch rates during 2004, 2008, 2009, 2011 and 2014 (Figure 3). During 2016, the catch rate for juvenile and adult size classes of smallmouth bass declined (≥ 200 mm {3%}, 100-199 mm {19%}) from the 2015 catch rates, most likely in response to a three year period of larger in magnitude and longer in duration spring runoffs when compared to the recent past. In 2014 and 2015, the highest rate of removing 'piscivorous sized' (> 325 mm) smallmouth bass, as defined by the Upper Colorado River Endangered Fish Recovery Program (UCRRP), occurred from Cisco, UT to Coates Creek, UT at 0.6 and 0.3 fish/hr (2014{n=11}, 2015{n=7}). In 2016, the highest rate of removing these large adults occurred upstream in the reaches from Price Stubb Dam to Riverbend Park in Palisade, CO and from Corn Lake to Redlands Parkway at .13 fish/hr (Figure 2).

A total of 1,709 largemouth bass were removed from all reaches, in 2016, a substantial decrease from 2012's catch (n=5,227, Table 2 and Figure 4), but similar to 2013 through 2015's catch. Our catch ranged from age-0 fish (39 mm) to adult fish (379 mm) with a mean of 102 mm (Figure 5). Five were of piscivore size (≥ 325 mm TL) and are considered a competitive threat to Colorado pikeminnow. Our catch was also proportionate in size classes to our 2014 and 2015 catch: 99% (n = 1,693) were less than 250 mm, 68% (n = 1,169) were less than 100 mm and only 1% (n = 16) were adults greater than 250 mm. Data from 2013 through 2016 suggest that the rate of survival for juvenile largemouth bass recruiting into adulthood in the river is relatively low, based on the very low numbers of adult largemouth bass (> 250 mm) observed in our electrofishing collections versus the comparatively high number of juvenile largemouth bass in those same collections.

Task 2. a) Analyze data; b) Prepare annual RIP reports.

B. Findings (2015 Highlights) General

Study Direction. The removal of centrachids from the Colorado and Gunnison rivers under Recovery Program guidance began in 2004. From 2004 to 2011, the Grand Valley portion of the study area encompassed a 61-mile section of the Colorado River in western Colorado from the Price-Stubb Dam downstream to the Westwater, UT BLM River Ranger Station. It also included a 2.3-mile section of the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence. Beginning in 2014, the study area was lengthened 72 miles to include river segments from GVWU dam (RMI 193.7) to Price-Stubb dam (RMI 188.3), Westwater Ranger Station, UT (RMI 127.6) to Westwater Wash (RMI 124.8), and Cisco boat launch, UT (RMI 111.0) to Potash boat launch, UT (RMI 47.2).

Upstream portions of the study area have changed over time as well. From 2004-2006, a 45-mile reach of the Upper Colorado River from the Rifle Bridge (RMI 240.4) to Beavertail Mountain in Debeque Canyon (RMI 195.7) was sampled with raft electrofishing. In 2007 and 2008, a 7.6-mile reach from Silt to the Rifle Bridge was added to assess distribution of smallmouth bass upstream of Rifle. This reach was eliminated from sampling in 2009 because only one smallmouth bass was collected in this reach in 2007 and 2008. During 2011, the number of passes in the Rifle Bridge to Beavertail Mountain reach was reduced from three to one. The only reaches sampled during 2011 were from Rifle to Rulison and Rulison to Cottonwood Park boat landing at Parachute, CO (RM 222.2). Starting in 2012 and continuing through 2014, CPW conducted all of the removal (see PPR) from Silt to

Beavertail Mountain. Starting in 2015, UDWR conducted additional removal passes from Westwater Ranger Station to Potash, UT (RMI127.7-105.7; see PPR).

Beginning in 2013, project study goals were slightly modified (from those specified for 2007-2012 sampling). An abundance estimate for juvenile (100-199 mm) and adult (≥ 200 mm) smallmouth bass in concentration areas of the Grand Valley reaches of the Upper Colorado and Lower Gunnison rivers was calculated in 2006-2012; however, an abundance estimate was not calculated from 2013-2016. Catch per effort (CPE) has been calculated for all years of the study, throughout all of the reaches, including 2016, as a metric to compare yearly fluctuations of nonnative fish populations and size classes.

Methodology

General

In 2016, up to nine removal passes were made using raft-based or aluminum jet powered Jon boat electrofishing to collect nonnative fishes in the Colorado and Gunnison Rivers in Colorado and Utah (Table 6). Colorado Parks and Wildlife (CPW) performed the removal between Rifle and Beavertail Mountain, while the U.S. Fish and Wildlife Service (FWS), Grand Junction FWCO performed all but one of the other sampling passes. Utah Division of Wildlife Resources (UDWR, Moab Field Station) completed one partial fall removal pass between Westwater Ranger Station and Fish Ford, UT. Two electrofishing boats were used in all river segments during the removal passes.

Although smallmouth bass and walleye were our target fish for removal during this project, many other nonnative fishes encountered were collected and removed. These fishes included largemouth bass, green sunfish, bluegill, black crappie, black bullhead, gizzard shad, grass carp, perch, and northern pike. Since 2013, the majority of white sucker and white sucker X native sucker hybrids encountered have also been collected and removed (Figure 7). All fishes removed were frozen and then taken to the Mesa County landfill, near Grand Junction, CO.

Number of individuals collected, total length, and weight were recorded for most non-native fishes caught and removed. Capture date and corresponding river mile for each nonnative fish collected were recorded along with effort expended (i.e., time electrofished in seconds, then converted to number of hours electrofished).

Catch Rate

Catch rate or catch/effort (CPE) is often used as an index of population size if it is consistently proportional to absolute abundance (Ricker 1975). Unfortunately, CPE can be highly variable and is not the most reliable metric for population analyses or comparing trends in population abundance densities among years (Hangsleben et al. 2013). It is more likely that unexplained variations in capture probability or "catchability" (not catch per unit of effort per se) preclude the use of catch per unit of effort as an abundance estimate. However, it was determined during the UCRRP 2012 Nonnative Workshop that CPE will suffice as an index of population size during most years (starting in 2013), and that during a yet to be determined interval (e.g., every third or every fifth year) a mark-recapture

abundance estimate will be performed to track actual abundance of smallmouth and largemouth bass in the Colorado River. The initial study objective (during 2004 and 2005) was to lethally remove as many smallmouth bass and other centrarchids as possible; as such, fish were not marked nor released and a population estimate was not possible. For those years' data, effort was recorded, CPE was calculated, and CPE was used to monitor increases and declines in centrarchid populations. To determine if densities of smallmouth bass and largemouth bass were being depleted as a result of the removal effort, catch effort indices (e.g., fish/hr) over time (i.e., by pass) in each river sub-reach were calculated and interpreted. Since population estimates for smallmouth bass were not available for 2004, 2005, and now 2013-2016, CPE was computed for use as a trend to compare annual abundance of smallmouth bass and other centrarchids during the entire 2004-2013 time period. This was possible because effort expended was recorded during all sampling years. Where abundance estimates were not performed for a population statistic, CPE was a useful metric in comparing relative abundance and interpreting year class strengths among years, particularly for juvenile smallmouth and largemouth bass (< 100 mm, Tables 1-3; Figures 3-6).

Results and Conclusions

Results presented herein are a compilation of the efforts of the FWS in the Grand Valley reaches, Ruby-Horsethief reaches, and Cisco to Potash reaches of the Upper Colorado River during 2016. Removal passes performed by the CPW in the Upper Colorado River between Silt and Beavertail Mountain are also reported here. UDWR results can be found in their appended PPR. Data are presented for main channel habitats only. This includes backwaters that are hydrologically connected to the mainstem river. Integration and comparison of results from earlier years (2004-2015) of this study are provided where appropriate.

Size Distribution–Length Frequency:

Smallmouth Bass

Length frequency distribution of all sizes of smallmouth bass collected, by CPW and FWS, with electrofishing during 2016 between Rifle, CO and Potash, UT were plotted (Figure 1). All age groups of smallmouth bass (age-0, juveniles, and adults) were present in the 2016 summer/fall collections. These ranged from age-0 (42 mm) to adult (407 mm) fish with a mean total length of 195 mm. A total of 482 smallmouth bass were removed, including 30 considered to be piscivourous competitors to Colorado pikeminnow (≥ 325mm). A weak year class of smallmouth bass (< 100 mm) was produced in 2016 in the Grand Valley reaches of the Upper Colorado, when considering only 184 were collected and removed (Figure 2). However, adult smallmouth bass (≥ 200 mm) made up a larger proportion of our total catch in 2015 and 2016 when compared to 2013 and 2014 (Figure 1).

In 2009, age-0 smallmouth bass were first detected in the Grand Valley reaches starting in mid-August (39 mm TL). Length frequency comparison between 2008 (see 2008 annual report no. 126(a)) and 2009 suggest that the 2009 year class may be stronger than 2008. However, overall catch rates for juvenile smallmouth bass (< 100 mm) in the Grand Valley sections of the Upper Colorado and Lower Gunnison rivers are almost identical during these

two years (Figure 3). However, in 2010, there was some reason for concern. The highest number of juvenile smallmouth bass (< 100 mm) from the Grand Valley reaches of the Upper Colorado and Lower Gunnison rivers during this eight-year study was collected in 2010. The catch rate for this juvenile size class of fish (C/E=5.82fish/hr, n=2,054) exceeded catches during the 2007 removal passes (C/E=4.15fish/hr, n=1,358) (Table 1). A strong year class of smallmouth bass was produced in 2007 which was documented throughout upper Colorado River basin rivers. During the 2010 marking pass in the Grand Valley reaches, age-0 smallmouth bass were first detected during the last week of July (31 mm).

During the period from 2014 through 2016, the catch rate for juvenile size fish < 100 mm declined precipitously (80%) from 2013 from 3.33 fish/hr to 0.17 to 0.54 fish/hr, similar to catch rates during 2004, 2008, 2009, 2011 and 2014 (Figure 3). The hypothesized reason for this decline was the prolonged large (magnitude) discharge from the 2014 and 2015 spring runoff. Elevated discharge extended into July, which delayed the warming of river waters. Decreased and prolonged cooler river temperatures may have resulted in delayed smallmouth bass spawning, later hatching of larvae, or even weak, young smallmouth bass being swept away from nests or quiet near-shore habitat resulting in high mortality. This in turn probably led to a shorter growing season and, ultimately, reduced growth for age-0 smallmouth bass. In any event, these environmental conditions probably led to a shorter growing season and a weak year class of smallmouth bass in 2014. However, spring 2016's run-off matched the median statistic; yet, our catch of YOY smallmouth bass suggests a weak year class being produced (Figure 8). In both 2015 and 2016, the river temperatures stayed elevated above 13.9° (Celsius) well into late fall (late October) and the few age-0 smallmouth that successfully survived after hatching may have benefited from a long growing season (Figure 9). Additionally, Bestgen and Hill (2016) suggest that smallmouth bass greater than 50 mm total length prior to going into the winter have a good chance of survival and 98% of our 2016 age-0 smallmouth bass were greater than 50 mm.

In 2012, a smaller (magnitude) and shorter (duration) than average peak runoff season and lower (magnitude) and longer (duration) base flows, that began earlier in the season hypothetically produced an increase in our catch rate for juvenile and age-0 size fish < 100 mm from 0.55 fish/hr (2011) to 2.62 fish/hr (2012). 2013 was a similar hydrologic year to 2012 with the exception of a few rain spikes in late summer and throughout the fall. Once again, hypothetically two years of drought that aided increasing our juvenile and age-0 size fish < 100 mm catch rate even more to 3.92 fish/hr (third highest catch rate since project inception, Figure 3).

In the 15-mile reach (GVIC Diversion Dam to the Colorado/Gunnison River confluence) and 18-mile reach (Colorado/Gunnison River confluence to the Loma Boat Landing), smallmouth bass reproduced during 2011 as they did between 2004 and 2010. It is unknown whether these fish were produced in the river, or in off-channel habitats (e.g., ponds or irrigation returns that connect to the main river) and later escaped to the river. In the Grand Valley reaches, the numbers of smallmouth bass within the 2008 and 2009 year classes (< 50 mm or < 100 mm) were noticeably less than those of the three previous years (2005, 2006, and 2007) as shown by catch rate data. Catch rates for smallmouth bass < 100 mm declined significantly from the high in 2007 (4.15 fish/hr) to 0.63 fish/hr in 2008 and 0.55 fish/hr in 2009 (Table 1; Figure 3). Except for the 2007 and 2010 year classes, YOY smallmouth bass (< 100mm) had demonstrated poor survival to age-1. The strong 2012 year

class (age-0) coupled with the strong 2013 year class (age-0) have produced enough individuals to provide concern as to how many adults (> 200 mm) may have survived (Figures 1 & 5). However, the reduced 2015 and 2016 adult catch (Figure 3) suggests that both our removal and recent river hydrological conditions have helped suppress the 2011 and 2012 age classes.

Largemouth Bass

A total of 1,709 largemouth bass were removed from all reaches, in 2016, a substantial decrease from the 2012 catch (n = 5,227, Table 2), but similar to the 2013 through 2015 catch. Our catch ranged from age-0 fish (39 mm) to adult fish (379 mm) with a mean of 102 mm (Figure 5). Five were of piscivore size ($\geq$ 325 mm TL) and are considered a competitive threat to Colorado pikeminnow. Our catch was also proportionate in size classes to our 2014 and 2015 catch: 99% (n = 1,693) were less than 250 mm, 68% (n = 1,169) were less than 100 mm and only 1% (n = 16) were adults greater than 250 mm.

Data from 2013-2016 suggest that survival of juvenile largemouth bass into adulthood in the river is relatively, based on the very low number of adult fish (i.e., >250 mm) in our electrofishing collections versus the comparatively high number of juvenile size fish in those same collections.

Actual Numbers:

From 2004-2006 the number of removal passes were identical (4) and direct comparison of actual numbers of fish removed was justified. However, starting in 2007 and continuing through 2010, four additional removal passes were added. In 2011, two additional removal passes were added to bring the total number of passes to ten. In 2012 and 2013 passes were reduced to six. Beginning in 2014 passes increased from seven to eleven depending upon the river reach (Table 6). Therefore, comparing actual numbers of fish removed per pass or by combining passes and river reaches with the earlier sampling years is not warranted. Actual numbers of smallmouth bass removed are provided among the various figures and tables by major river section and year in the attached appendices.

There is one location that could be consistently used to compare total number of fish captured to establish annual trends. This is the fish trap at the Redlands Diversion Dam fish passageway on the Lower Gunnison River. The number of smallmouth bass collected in the fish trap of the Redlands Diversion Dam passageway has been recorded for 18 years. From 1996–2001, only one smallmouth bass was captured. However, 13 were collected in 2002, 6 in 2003, 9 in 2004, and 21 in 2005. Keeping with the pattern of lower smallmouth bass catches in main channel habitats, no smallmouth bass were found in the Redlands fish trap during 2006 or 2007. In 2008, 4 smallmouth bass were collected in the Redlands fish trap, 0 in 2009, and 3 in 2010. No smallmouth bass were collected at Redlands in 2011. 2012 produced the third largest total of smallmouth bass (n = 14) collected at Redlands. The largest annual catch of smallmouth bass in the Redlands fish trap was 2013 (n = 22). Only 2 smallmouth bass were collected in 2014 and 1 in both 2015 and 2016.

Catch/Effort:

General

Mean catch/effort (fish/hr) was computed separately for smallmouth bass and largemouth bass for each of the 13 sampling years, 2004-2016 (Tables 1 & 2; Figures 3 through 6). To view the "big picture," for some analyses, river reaches and removal passes were consolidated. Catch rates were computed separately for Rifle to Beavertail Mountain, the Grand Valley River reaches (Government Highline Dam to Westwater Wash, UT, plus the Lower Gunnison River), and Cisco to Potash, UT.

Effort Fished

Electrofishing effort in 2004 (168.665 hours) was similar to 2005 (174.560 hours) between Price-Stubb dam and the Westwater, UT, ranger station and the Lower Gunnison River. In 2006, electrofishing effort in these reaches was 161.906 hours. The electrofishing effort increased to 327.101 hours in 2007 because of the addition of four removal passes. The total effort (1 marking and 8 removal passes) during 2008 was 349.889 hours. In 2009, the total effort (1 marking and 8 removal passes) was 416.851 hours. A 3.9-mile reach between Government Highline Dam (GVWU) and the Cameo XCEL Bridge was added in 2009 which accounts for some of the increased effort in 2009 over earlier years. In 2010, the total effort was (1 marking and 8 removal passes) was 413.555 hours. In 2011, the total effort was (1 marking and 10 removal passes) was 449.934 hours. Effort was decreased in 2012 because low water levels in certain reaches (2.3-mile section of the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence, the additional reach between the Government Highline Dam and the Cameo Bridge, and from Cameo Bridge to GVIC) made them impassible by electrofishing craft. In addition, no passes were conducted from Loma boat landing to Westwater Ranger Station. Three pre-marking passes, one marking pass, and six post-marking passes expended 290.326 hours of electrofishing effort. In 2013, six removal passes between GVWU dam and Loma boat launch and three removal passes from Loma to Westwater Ranger Station expended 364.39 hours of electrofishing effort. An additional 2.8 mile reach (Westwater Ranger Station to Westwater Wash) and eight to eleven passes per reach significantly increased our effort by 29% to 511.19 hours of electrofishing effort in 2014. Electrofishing effort, in 2015, was 442.278 hours and 341.1 hours in 2016 (Figure 10).

Between Rifle and Beavertail Mountain, the effort expended in 2004 was 19.750 hours compared to 39.799 hours during 2005 and 37.512 hours during 2006. During 2007, electrofishing effort increased to 86.84 hours which was related to adding the river reach from Silt to Rifle and an additional removal pass from Silt to Beavertail Mountain. In 2008, the total effort was 86.038 hours, which was almost identical to 2007. The total effort during 2009 was 62.321 hours and in 2010, 78.985 hours. During 2011, the total effort (12.626 hours) was much less than former years due to only one pass being performed and some reaches not being sampled. In 2012 and 2013, CPW conducted two passes; one pass included two boats electrofishing both banks in all reaches except the reach between Parachute and DeBeque, and the second included electrofishing all backwaters and slack water sloughs in the same reaches this pass also included experimental gill netting effort. In total, CPW expended 45.68 electrofishing hours in 2012, 54.58 hours in 2013, 44.2 hours in 2014, 43.21 hours in 2015, 37.06 hours in 2016; and 10.8 gill net hours in 2012, 5.2 hours in 2013, and 0 gill net hours in 2014 through 2016. The increased effort was in response to the increase in northern pike catch in this reach in 2011 (Figure 10).

In response to an elevated catch of walleye (n = 268) by our crews during our spring 2013 Colorado Pikeminnow abundance collections from Cisco, Utah to the confluence of the Green River (Table 3), 73.6 hours of electrofishing effort was expended in 2013 and 146.77 hours of effort was expended in 2014 experimentally to target walleye from Cisco to Potash, Utah. Four complete passes were completed in 2015, and our crews expended 222.54 hours of electrofishing. In 2016, three to five passes were completed (dependent on the reach) and crews expended 243.27 hours of electrofishing (Figure 10).

Smallmouth Bass

For the Grand Valley river reaches, the trend for smallmouth bass relative abundance from 2006-2009 was downward. Overall mean catch rate was highest for smallmouth bass juveniles (100-199 mm) and adults (≥ 200 mm) during 2004 (6.37 fish/hr) and 2005 (6.36 fish/hr). However, a 51% decline in catch rate was detected from 2005 to 2006. In 2007, the catch rate dropped even lower to a 4-year low (2.27 fish/hr; 27 % decline from 2006; Figure 3). Again in 2008 and 2009, the overall catch rate continued to decline to 1.19 and 0.9 fish/hr, respectively. This catch effort decline is consistent with the decline observed with the population estimate between 2006 and 2007, and between 2007 and 2008 (Table 3). During 2010, the catch rate for smallmouth bass > 99 mm (0.98 fish/hr) increased slightly from 2009. During 2011 and 2012, another increase in catch per effort occurred from the juvenile and adult size classes to 1.83 and 2.55 fish per hour, respectively. A large recruiting class of smallmouth < 100 mm collected in 2012 represented the third highest catch rate of juvenile and adults, in 2013 (5.57 fish/hr). During 2014, the catch rate for all size classes of smallmouth bass declined 46% to 95% (≥ 200 mm = 46%, 100-199mm = 78%, > 100 mm = 95%) most likely in response to a larger (magnitude) and longer (duration) spring runoff. 2015 (0.85 fish/hr) marked another decline (55%) in smallmouth bass > 99 mm catch rate when compared to 2014 (1.89 fish/hr) and 2016 was similar to 2015 (0.79 fish/hr; Table 1, Figure 3).

During the summer of 2010, for the Grand Valley river reaches, overall mean catch rate for smallmouth bass < 100 mm total length was the highest in this eight-year removal study (5.82 fish/hr). Formerly, 2007 had the highest catch rate (4.15 fish/hr) and the lowest two years were 2014 (0.17 fish/hr) and 2015 (0.28 fish/hr; Table 1, Figure 3). Initially, it appeared that the 2007 cohort was one of the strongest in five years of sampling between 2004 and 2009. However, the 2010 cohort exceeded the strong year class of 2007. These young life stages can be subject to high mortality to age-1 due to a myriad of environmental factors over the winter. Small age-0 smallmouth bass going into winter may be susceptible to higher overwinter mortality because their relatively small body size limits energetic reserves that may run out before spring arrives. Therefore, overwinter survival is not known until the following summer sampling season. The 2011 catch rates for the juvenile size class (100-199 mm) increased from 0.45 fish/hr in 2010 to 1.47 fish/hr in 2011, a 3.3 fold increase. The 2012 catch for juvenile smallmouth bass was 1.09 fish/hr. The juvenile catch for 2013 was second in size only to 2004 (2013 was 3.52 fish/hr, and 2004 was 3.66 fish/hr; Table 1). Both 2012 and 2013 were moderately strong cohorts that were well documented in our recent years catch data (Figure 3). The strong year classes produced in 2007, 2010, 2012 and 2013 recruited to the adult smallmouth bass population which may contribute to the persistence of this species in the Grand Valley reaches of the Upper Colorado and Lower Gunnison Rivers.

It also appeared that weaker year classes of YOY (< 100 mm) smallmouth bass were produced in 2014 through 2016 (0.17 to 0.54 fish/hr; Table 1, Figure 3). The high spring flows experienced during the 2014 and 2015 runoff and moderate flows in 2016 in the Upper Colorado River could have swept weak swimming young smallmouth bass away from nests or quiet near-shore habitat resulting in high mortality (Figure 8).

The hydrologic conditions of 2008-2009, 2011, 2014-2016 in the Upper Colorado River were similar, with 2011, 2014 and 2015 being the most dramatic because of the prolonged high discharge extending into July. These five years have been characterized as average or moderately wet with sustained runoff compared to former years (2003-2007, 2010, 2012 and 2013) that were dryer with shorter runoff magnitude and duration. The five wetter years with accompanying prolonged cooler water temperatures may have disrupted or delayed spawning resulting in slower growth of early-life stages (i.e., age-0) of smallmouth bass, and ultimately reducing survival and recruitment. However, the 2012 catch of juvenile (100-199 mm) smallmouth bass (1.09 fish/hr) suggests that 2011 recruitment may have been negatively impacted, but a mild winter may have allowed for better survival of the few fish that were still alive after the high run-off. In addition, YOY smallmouth bass produced in 2015 and 2016 that survived coming off of the nests, experienced many more degree days greater than 13.9° (Celsius) prior to winter and may have had a good chance of surviving into the next spring (Figure 9). Coble (1975) suggests that smallmouth bass growth does not occur until water temperatures reach 10-14° (Celsius). The Edwards et al. (1983) models suggest that optimal temperature for smallmouth bass fry first peaks at 13.9° C.

Survival of smaller age-0 fish entering the winter period could be reduced under these hydrologic scenarios. The timing or detection of the first captures of age-0 smallmouth bass may provide one means to predict recruitment success into later years. For example, the first date age-0 smallmouth bass were detected in wetter years (2008, 2009) in which weak year classes were produced was 8 and 14 of August, respectively. It appears that smallmouth bass spawned later in 2011 than any previous years of this eight-year study. In 2011, age-0 smallmouth bass were first detected on 24 August (n = 3; 22, 35, and 46 mm). Other age-0 smallmouth bass (n = 12; 25-32 mm) were collected between 5 October and 11 October. Compared to dryer years, 2007, in which a strong year class was produced, age-0 fish were first detected on 23 July, some 2-3 weeks earlier than 2008 and 2009. In 2010, age-0 smallmouth bass were first detected on 28 July. In 2012, the earliest detection of age-0 fish (n = 6; 36-56 mm) occurred on 21 June, a full month earlier than the strong year class detected in 2007. In 2013, crews were not out in the field in June. However, they were out in early July and had an early first detection of age-0 fish (n = 15; < 70 mm) on 9 July. Anomalies for this theory occurred in 2014 through 2016, wet or moderate years that still had age-0 smallmouth bass collected 1 July (in 2014; 86 mm) , 22 July (in 2015; 79 mm) and 14 July (in 2016; 68 mm) however; these fish may have been produced in an off channel source and entered the river at a later time or were the result of a late spawn from the previous season.

Catch rates for all size classes of smallmouth bass, in the reaches between Rifle and Beavertail Mountain, decreased from 0.62 in 2013 to 0.44 in 2014 and again to 0.18 in 2015. 2016 produced similar catch rates to 2015 at 0.27 smallmouth bass per hour. These values are an increase following a drop in mean catch per effort in 2012 (0.09 fish/hr), the

lowest value was achieved during 2009 (0.24 fish/hr) compared to 2011 (0.49 fish/hr), 2010 (0.92 fish/hr), 2008 (0.95 fish/hr), 2007 (1.04 fish/hr), 2006 (2.11 fish/hr), and highest during 2005 (5.75 fish/hr; Table 1). Spawning success in these reaches appears to be less than that found in the Grand Valley reaches. Age-0 (< 100 mm) smallmouth bass catches have been less than that of the Grand Valley reaches throughout the eight-year project. Only 57 age-0 smallmouth bass (0.72 fish/hr) were collected in these upper reaches during 2010. No age-0 smallmouth bass were collected in these upper reaches during 2009, 2011 and 2016. One age-0 smallmouth bass was collected in 2012, four were collected in 2013, eight were collected in 2014, and two were collected in 2015. During 2013 and 2014, the catch rate for smallmouth bass < 100 mm was 0.07 fish/hr and 0.14 fish/hr, respectively. The 2015 catch rate for smallmouth bass < 100 mm was 0.05 fish/hr.

Catch rates for all size classes of smallmouth bass in Ruby-Horsethief Canyon (Loma to Westwater Ranger Station, UT) were consistently low from 2004 to 2012 ranging from a low in 2007 and 2008 of 0.07 fish/hr to a high in 2011 of 2.65 fish/hr. Budget constraints for 2012 necessitated a reduction in work and the decision was made to drop this reach. However, large numbers of largemouth bass caught in Black Rocks during our fall humpback chub (*Gila cypha*) work, in 2012, prompted restored effort in these reaches in 2013. The largest catch rate of smallmouth bass, in any of the reaches covered by projects 126a and 126b during the ten year study period, occurred in 2013 and 2014 in Ruby Horsethief Canyon at 6.53 fish/hr and 3.94 fish/hr (Figure 2 & 4). Late summer and fall rain events may have washed a portion of this population downstream in 2013 and 2014. In 2015, our catch of all size classes of smallmouth bass in Ruby Horsethief Canyon (0.87 fish/hr) decreased 78% from our 2014 catch (3.94 fish/hr; Figure 2 & 4). Our catch of all size classes of smallmouth bass decreased again, in 2016, to 0.48 fish/hr.

New effort was expended experimentally, in 2013 and 2014, from Cisco to Potash, Utah. This effort was fully funded in 2015. While the primary species being targeted was walleye, juvenile and adult smallmouths were removed from these reaches in 2013 at a rate of 0.48 fish/hr which decreased to a rate of 0.42 fish/hr (2014), 0.21 fish/hr (2015) and 0.10 fish/hr in 2016 (Table 2; Figure 2). In 2014 and 2015, the highest rate of removing UCRRB defined 'piscivorous sized (> 325 mm)' smallmouth bass occurred from Cisco, UT to Dewey Bridge, UT at 0.9 fish/hr (2014, n=20) and 0.37 fish/hr (2015, n = 9; Figure 2).

Largemouth Bass

Unlike the downward trend in catch rate for smallmouth bass juveniles and adults, for the Grand Valley river reaches, overall mean catch rate for largemouth bass juveniles (100-199 mm) and adults (> 200 mm) steadily increased from 2004-2007 and peaked in 2007 (4.2 fish/hr; n = 1,375; Table 2). This was 6.7 times greater than the catch rate for 2004 (0.63 fish/hr). During 2008, this trend was reversed for largemouth bass ≥ 100 mm. The catch rate declined to 1.3 largemouth bass/hr (n = 383). In 2009, the catch rate increased slightly to 1.83 fish/hr. The catch rate increased to 3.31 fish/hr in 2010. Juvenile and adult largemouth bass catch rates declined in 2011 to 1.96 fish/hr. 2012 produced the largest catch of juvenile and adult largemouth bass to date at 6.0 fish/hr (n = 1,743). We hypothesize that the large (magnitude) extended peak flows in 2011 inundated off channel gravel pits and ponds and fish from these sources made it into the river and available to our catch in 2012. An 83% decrease in our juvenile and adult largemouth bass catch rate

occurred from 2012 (6.0 fish/hr) to 2013 (1.06 fish/hr, n = 293) and the catch rate continued to decline in 2014 (0.5 fish/hr, n = 255). Our juvenile and adult largemouth catch rate increased 50% in 2015 (1.01 fish/hr, n = 447) when compared to 2014. Our 2016 juvenile and adult catch rate increased another 26% in 2016 (1.32 fish/hr, n = 449) when compared to 2015 (Table 2, Figure 7).

Perhaps enough adults escaped from off channel spawning and nursery areas during the high flows in 2011, and were removed from the population by unfavorable river conditions and our efforts so that a large reduction in production occurred from 2013 through 2016 largemouth bass < 100 mm (1.28 fish/hr {2013}, 2.1 fish/hr {2014}, 1.8 fish/hr {2015}, 2.88 fish/hr {2016}; Figure 7). This reduction follows the 2012 (12 fish/hr) year class which has been the second strongest in this twelve-year study. In 2011, catch rate for largemouth bass < 100 mm (6.05 fish/hr) declined 50 % from 2010 (12.13 fish/hr). Overall mean catch rate for largemouth bass < 100 mm total length steadily increased since 2004 from 1.03 fish/hr to a high of 12.13 fish/hr in 2010 (Table 2; Figure 7). The 2008 year class of largemouth bass was only slightly less (4.32 fish/hr) than 2007 and 2009. So, where the 2008 high spring runoff flows reduced the spawning success of smallmouth bass, it did not appear that largemouth bass young were as negatively impacted. This may be attributed to differences in spawning habitat and/or timing (temperature conditions) between smallmouth bass and largemouth bass spawning. In the Upper Colorado River, largemouth bass may be spawning in off main channel riverine habitats (e.g., gravel pit ponds) that may shelter young fish from the high velocities during runoff, thus increasing survival, whereas young smallmouth bass, which are typically spawned in main channel riverine habitats, may suffer higher mortality during such high flow events. The high abundance of largemouth bass found during summer removal passes in main channel habitats may be due to young fish that have moved out of off-channel habitats into main channel habitats following high spring runoff.

There has been no definite trend in largemouth bass abundance (all length sizes) for the Rifle to Beavertail Mountain reaches. The highest catch rate was recorded during 2008 (7.6 fish/hr; Table 2). The second highest year was in 2006 (5.6 fish/hr), the third highest in 2013 (5.5 fish/hr); lowest in 2015 (0.72 fish/hr). The 2016 catch effort for all sizes of largemouth bass was 1.49 fish/hr. Prior to 2008, spawning success in these reaches appeared not to be as successful as that in the Grand Valley reaches. Mean catch rate for largemouth bass < 100 mm was lowest in 2005 (0.25 fish/hr); the highest during 2008 (6.05 fish/hr). The 2016 catch rate for largemouth bass < 100 mm was 0.92 fish/hr.

New effort was expended experimentally, in 2013 and 2014, from Cisco to Potash, Utah. In 2015, this effort was fully funded. While the primary species being targeted was walleye, juvenile and adult largemouth bass were removed from these reaches at a rate of 0.29 fish/hr in 2013, 0.05 fish/hr in 2014, 0.75 fish/hr in 2015, and 1.01 fish/hr in 2016 (Table 2).

Population Size.

Increased effort is needed to achieve exploitation rates that the UCRRP has adopted as necessary to achieve smallmouth and largemouth bass population failure. However, a limited amount of funding coupled with logistical constraints (e.g. length of field season, amount of equipment, and staffing) has limited how we can achieve extra effort. From 2014

through 2016, GJ FWCO had an increase in crew and equipment because of the Colorado pikeminnow estimate and/or razorback sucker monitoring in Lake Powell; thus, increased effort was volunteered outside of the 2014 through 2016 SOW budget. Certainly, this additional effort helped us move nearer to the exploitation rates UCRRP has adopted. During the 2012 nonnative workshop, it was determined appropriate to have smallmouth bass removal years (from the Gunnison and Colorado Rivers), set at a predetermined interval (e.g., 2 or 3 years) coupled with abundance estimate years to track population size in an effort to reduce the number of nonnatives being collected and returned to the river with a mark and to increase removal effort. Therefore, 2013 through 2016 were removal years and no abundance estimates were calculated. However, for reference purposes, abundance estimate text and results were included in this report from past years (Table 3).

Smallmouth Bass

In 2016, we removed 198 adult smallmouth bass (≥ 200mm) in the Grand Valley reaches. We completed 3 to 9 passes in these reaches (Table 6). Our average p-hat calculated for adult smallmouth bass collected in previous population estimates (7 years; 2006-2012; Table 3) was 0.051 per pass. We averaged 8 passes in the Grand Valley reaches (2016) and could estimate (from previous years calculated p-hat) that 0.41 (41%) of the population may have been removed (or exploited). The pre-removal estimate would have been around 485 adults and the post removal estimate would be around 287 adults. This adult estimate would be lower than most of the years (2006, 2007, 2009, 2010, and 2012) where we conducted abundance estimation (Table 3).

During the marking pass performed in July 2012, a total of 132 smallmouth bass (50 juvenile size [100-199 mm], 82 adult size [≥ 200 mm]) were marked and released alive. Seventeen (9 juvenile, 8 adult) of these marked fish were later recaptured during six removal passes (Table 4). Since a 'batch' mark was employed and smallmouth bass were not marked with a serially numbered tag, movements of individual fish were not possible. Eight marked fish (six juvenile, two adult) were recaptured in removal pass 1. One marked fish (one adult) was captured during pass 2, four marked fish (two juvenile, two adult) were captured during pass 3, one marked adult was captured during pass 4, two marked fish (one juvenile, one adult) were captured during pass 5, and one marked adult was captured during pass 6. Crews were instructed to look for marked fish during all six removal passes. Starting in 2010, a different mark was employed and it appeared that this new mark could be more reliably detected throughout all removal passes than previous batch marks employed (e.g., fin punches) which extended from early-August through late-October. All 17 marked smallmouth bass were recaptured within the original marking reaches. The total number of smallmouth bass removed over six removal passes after the marking pass was 201 juveniles (100-199 mm) and 233 adults (≥ 200 mm; Table 3). During the three pre-marking passes, 70 juveniles and 78 adult smallmouth bass were removed.

The 2012 population point estimate (95% C.I. in parenthesis) was 232 ± 133 (99 –365) for smallmouth bass 100-199 mm and 1,853 ± 1,748 (105 – 3,601) for smallmouth bass ≥ 200 mm. The weighted probability of capture (p-hat) was computed as 0.159 and 0.037, respectively, for these two length groups. The CV was 29.2 % and 48.0 %, respectively, for these two length classes. The CV can be used as a measure of estimate precision and Pollock et al. (1990) suggests a good 'rule of thumb' is to achieve a CV of 20% or less.

The proportion or percentage of smallmouth bass of these sizes removed during the first removal pass or the exploitation rate for this first pass based on the population estimate was as few as 10 % (37/365) for juvenile fish 100-199 mm which computes to about an average of 6.6 juvenile smallmouth bass/mile. For smallmouth bass ≥ 200 mm, the proportion or percentage of smallmouth bass of these sizes removed annually or the exploitation rate for this first pass based on the population estimate was a few as 2 % (68/3,601) or an average of 52.5 adult smallmouth bass/mile.

The 2011 population point estimate (95% C.I. in parenthesis) was 1,718 ± 1,115 (603 – 2,833) for smallmouth bass 100-199 mm and 110 ± 108 (2 – 218) for smallmouth bass ≥ 200 mm. The weighted probability of capture (p-hat) was computed as 0.056 and 0.071, respectively, for these two length groups. The CV was 10.4 % and 50.0 %, respectively, for these two length classes. The CV can be used as a measure of estimate precision and Pollock et al. (1990) suggests a good 'rule of thumb' is to achieve a CV of 20% or less. The proportion or percentage of smallmouth bass of these sizes removed during the first removal pass or the exploitation rate for this first pass based on the population estimate was as few as 4 % (117/2,833) for juvenile fish 100-199 mm which computes to about an average of 48.7 juvenile smallmouth bass/mile. For smallmouth bass ≥ 200 mm, the proportion or percentage of smallmouth bass of these sizes removed annually or the exploitation rate based on the population estimate was a few as 7 % (16/218) or an average of 3.1 adult smallmouth bass/mile.

The 2010 population point estimate (95% C.I. in parenthesis) was 255 ± 196 (59-451) for smallmouth bass 100-199 mm and 823 ± 671 (152-1,494) for smallmouth bass ≥ 200 mm. The weighted probability of capture (p-hat) was computed as 0.097 and 0.053, respectively, for these two length groups. The CV was 39.3 % and 41.6 %, respectively. The proportion or percentage of smallmouth bass of these sizes removed during the first removal pass or the exploitation rate for this first pass based on the population estimate was as few as 7 % (31/451) for juvenile fish 100-199 mm which computed to about an average of 7.2 juvenile smallmouth bass/mile. For smallmouth bass ≥ 200 mm, the proportion or percentage of smallmouth bass of these sizes removed annually or the exploitation rate based on the population estimate was a few as 4 % (60/1,494) or an average of 23.3 adult smallmouth bass/mile.

The 2009 population point estimate (95% C.I. in parenthesis) was 2,044 ± 2,238 (- 194-4,282) for smallmouth bass 100-199 mm and 755 ± 802 (- 471-1,557) for smallmouth bass ≥ 200 mm. The weighted probability of capture (p-hat) was computed as 0.014 and 0.017, respectively, for these two length groups. The CV was 55.9% and 54.2%, respectively. The proportion or percentage of smallmouth bass of these sizes removed during the first removal pass or the exploitation rate for this first pass based on the population estimate was as few as 1% (46/4,282) for juvenile fish 100-199 mm which computes to about an average of 57.9 juvenile smallmouth bass/mile. For smallmouth bass ≥ 200 mm, the proportion or percentage of smallmouth bass of these sizes removed annually or the exploitation rate based on the population estimate was a few as 1 % (20/1,557) or an average of 21.4 adult smallmouth bass/mile.

The low number of recaptured marked juvenile and adult smallmouth bass during the first

removal pass compared to earlier years obviously contributed to very poor capture probabilities, abundance estimates, and exploitation rates for 2009. The same could be said for the 2011 and 2012 adult smallmouth abundance estimate where only one and two (respectively) adult fish were recaptured in the first removal pass to compute the abundance estimate. This low precision of the abundance estimate was reflected in the high CVs (50 % and greater) for 2009 and 2010 (adults; Table 3). In 2009 as in 2008, declining catch rates reflected a downward trend in relative abundance. The 2009 abundance estimate did not correlate well with the calculated catch effort indices for juvenile and adult smallmouth bass (≥ 100 mm; see Figure 3) during 2009 in the Grand Valley reaches of the Upper Colorado and Lower Gunnison rivers. Therefore, the abundance estimates for 2009, as well as the adult abundance estimate for 2011 and 2012, should be viewed with caution with earlier and future year comparisons.

The 2008 population point estimate (95% C.I. in parenthesis) was 804 ± 423 (381-1,227; Table 4) for juvenile smallmouth bass (100-199 mm). The weighted probability of capture (p-hat) was computed as 0.10; the CV: 26.9%. The proportion or percentage of smallmouth bass of these sizes removed during the first removal pass or the exploitation rate for this first pass based on the population estimate was as few as 6.7 % (82/1,227) or as many as 21.5% (82/381). This computes to an average of about 22.8 fish/mile. For adult smallmouth bass (≥ 200 mm) the population point estimate (95% C.I. in parenthesis) was 393 ± 276 (117-669). The weighted probability of capture was computed as 0.07; the CV: 35.9%. The proportion or percentage of smallmouth bass of these sizes removed during the first removal pass or the exploitation rate for this first pass based on the population estimate was as few as 4.2 % (28/669) or as many as 23.9% (28/117). This computed to an average of about 11.1 fish/mile.

The 2007 population point estimate (95% C.I. in parenthesis) was 1,007 ± 686 (321-1,693; Table 4) for adult smallmouth bass ≥ 200 mm. The weighted probability of capture (p-hat) was computed as 0.06; the CV: 34.8%. The proportion or percentage of smallmouth bass of these sizes removed during the first removal pass or the exploitation rate for this first pass based on the population estimate was as few as 6.4 % (109/1,693) or as many as 3.4% (109/321). This computed to an average of approximately 28.5 fish/mile.

The 2006 population point estimate (95% C.I. in parenthesis) was 2,295 ± 1,500 (795-3,795; Table 4) for adult smallmouth bass ≥ 200 mm. The weighted probability of capture (p-hat) was computed as 0.04; the CV: 33.3%. The proportion or percentage of smallmouth bass of these sizes removed during the first removal pass or the exploitation rate for this first pass based on the population estimate was as few as 4.3 % (163/3,795) or as many as 20.5% (163/795). This computed to an average of about 65 fish/mile.

A weak year class of fish produced in 2011 produced a small abundance estimate (232 fish) for juvenile smallmouth bass (100-199 mm). Abundance estimates for juvenile (100-199 mm) smallmouth bass peaked in 2011 (1,718 fish) due to a strong year class of smallmouth bass being produced in 2010. Juvenile smallmouth abundance was most similar in 2010 (255 fish) to 2012 in the 35.3 miles of the Upper Colorado and Lower Gunnison rivers in the Grand Valley reaches. Abundance of adult smallmouth bass (≥ 200 mm) slowly decreased from a high of 2,295 fish in 2006, 1,007 in 2007, 393 in 2008, but increased to 823 during 2010. The adult abundance increase in 2010 could be attributed to the strong year class of smallmouth bass produced in 2007. Abundance estimates for both juvenile

and adult smallmouth bass in 2009 and adult smallmouth bass in 2011 and 2012 were not included here because of the low number of recaptures necessary to generate a reliable estimate.

Exploitation Rates.

Exploitation rates were computed for two length groups (100-199 mm and ≥ 200 mm) of smallmouth bass from the Upper Colorado and Lower Gunnison rivers for 2006-2012 (Table 3). Exploitation rates by year and length class were:

2006 (fish ≥ 200 mm): 27.9
2007 (fish ≥ 200 mm): 39.1
2008 (fish 100-199 mm): 57.0 (fish ≥ 200 mm): 44.0
2009 (fish 100-199 mm): 10.7 (fish ≥ 200 mm): 12.8
2010 (fish 100-199 mm): 55.7 (fish ≥ 200 mm): 35.2
2011 (fish 100-199 mm): 42.0 (fish ≥ 200 mm): 52.1
2012 (fish 100-199 mm): 64.7 (fish ≥ 200 mm): 20.1

This method attempts to reduce bias from fish moving outside the sampling area, mortality during the sampling period, and growth (personal communication, Bruce Haines, USFWS [ret.], Vernal, Utah). This method attempts to extrapolate the exploitation rate over the number of removal passes for the six years abundance estimates have been computed.

Largemouth Bass

The first year attempting at a mark-recapture population estimate for largemouth bass was 2012. During the marking pass performed in July 2012, a total of 41 largemouth bass (32 juvenile size [100-199 mm], 9 adult size [≥ 200 mm]) were marked and released alive. Fifteen (10 juvenile, 5 adult) of these marked fish were later recaptured during six removal passes. Since a 'batch' mark was employed and largemouth bass were not marked with a serially numbered tag, movements of individual fish were not possible. Ten marked fish (7 juvenile, 3 adult) were recaptured in removal pass 1. Three marked fish (2 juvenile, 1 adult) were captured during pass 3, and two marked fish (1 juvenile, 1 adult) were captured during pass 4. All 15 marked largemouth bass were recaptured within the original marking reaches. The total number of largemouth bass removed over six removal passes after the marking pass was 1,616 juveniles (100-199 mm) and 47 adults (≥ 200 mm). During the three pre-marking passes, 17 juveniles and 10 adult largemouth bass were removed.

The 2012 population point estimate (95% C.I. in parenthesis) was 399 ± 219 (180-618) for largemouth bass 100-199 mm and 34 ± 20 (14-54) for largemouth bass ≥ 200 mm. The weighted probability of capture (p-hat) was computed as 0.258 and 0.471, respectively, for these two length groups. The CV was 27.9 % and 30.1 %, respectively, for these two length classes. The CV can be used as a measure of estimate precision and Pollock et al. (1990) suggests a good 'rule of thumb' is to achieve a CV of 20% or less. The proportion or percentage of largemouth bass of these sizes removed during the first removal pass or the exploitation rate for this first pass based on the population estimate was as few as 17 % (103/618) for juvenile fish 100-199 mm which computes to about an average of 11.3 juvenile largemouth bass/mile. For largemouth bass ≥ 200 mm, the proportion or percentage of largemouth bass of these sizes removed annually or the exploitation rate for this first pass

based on the population estimate was as large as 30% (16/54) or an average of 1.5 adult largemouth bass/mile.

Exploitation Rates. Exploitation rates were computed for two length groups (100-199 mm and ≥ 200 mm) of largemouth bass from the Upper Colorado and Lower Gunnison rivers for 2012. Exploitation rates by year and length class were:

2012 (fish 100-199 mm): 83.3 (fish ≥ 200 mm): 97.8

These rates are perplexing considering more fish were actually removed than what were estimated to be in the population, a strong indication that simple closed population models are not suitable to a large complex riverine system.

Other Nonnative Game Fishes Captured in the Main-stem River (Figure 7):

Northern pike are another large bodied predator that is known to cause severe impacts to endangered fish populations (Zelasko et al. 2014) and is therefore removed when encountered in the Colorado River. Northern pike are not common in river removal efforts. Seven adult northern pike were removed by CPW and USFWS crews in 2016 (Figure 7). Three (737, 742, and 839 mm TL) northern pike were collected between Rifle and Rulison. In addition, three northern pike (694, 800, and 900 mm TL) were removed from the Grand Valley reaches. One northern pike (821 mm TL) was removed from just above Cisco, UT. All otoliths have been preserved from these fish for future aging and natal origin microchemistry research. Such analyses can help in determining their possible origin.

Gizzard shad (*Dorosoma cepedianum)* were unintentionally introduced to the Colorado River basin in 1998, when they were stocked into Morgan Lake in the San Juan River basin. Gizzard shad have invaded the Colorado River since this initial introduction. Captures of adult gizzard shad in the Upper Colorado and Lower Gunnison rivers exploded during 2007 (n = 179), and increase from 15 in 2006.
Young-of-year, juvenile and adult gizzard shad were collected in all reaches sampled in 2016 from the Grand Valley downstream to Potash (n = 710; 42-475 mm). This is the second largest (second to 2015) number of gizzard shad removed in project 126a's history. In 2016, eight gizzard shad were collected at Redlands fish trap and four gizzard shad were collected at GVWUs fish trap. It appears that drought years may be favorable to the upstream expansion of gizzard shad range in the Colorado and Gunnison rivers.

White sucker are an additional nonnative species of concern because of their ability to hybridize with native sucker species. In 2012, 614 white sucker and white sucker hybrids were removed from the Grand Valley reaches. Their total length ranged from 53-519 mm with a mean total length of 255 mm. Our effort in 2013 removed 2,627 white sucker and white sucker hybrids (80-510 mm TL), our effort in 2014 removed 3,787 white sucker and white sucker hybrids (34-518 mm TL), our effort in 2015 removed 1,425 (40-527 mm TL), and our effort in 2016 removed 1,277 (55-552 mm TL) from all sampled reaches. These fish were removed opportunistically when white sucker catch wouldn't overwhelm the crew's primary focus of centrarchid, esocid and percid removal.

Management of off-channel nonnative fish populations

Many off-channel ponds and gravel pits in the upper Colorado River sub-basin harbor populations of nonnative fish. Some of these ponds are illegally stocked and some are colonized through river connection. These off-channel habitats provide more suitable conditions for nonnative species (i.e. warmer and clearer) to reside.

Nonnative fish removal in these ponds was pursued recently in order to reduce the risk of emigration of fish from these ponds during a river connection. New for 2016, one month's worth of non-native fish removal from streamside gravel pit ponds was funded under 126a and the creation of a Merwin trap for targeted removal was funded under 126b. In years past, crews would opportunistically sample these ponds to further augment the Colorado and Gunnison River's razorback sucker and bonytail populations. During 2016 work, crews discovered large numbers of undesirable non-native fishes. In 2016, Grand Junction FWCO crews completed 38 total days of removal efforts in three different ponds and CPW crews completed 120 total days in three different ponds.

Snyder Pond: In coordination with the private land owner, CPW began an effort to remove nonnative fishes from one such gravel pit pond between Rifle and Silt, Colorado now referenced as Snyder Pond (a.k.a. Mamm Creek Pond, LaFarge Pond, or United Pit Pond). While these fish do have opportunities to escape into the river during certain peak flows, they are isolated from the river during lower water years. Therefore, these efforts and results are included in the PPR section at the end of this report. It is possible that the elevated peak flows experienced in 2011, which did connect Snyder Pond with the river, contributed to the increase in catch of northern pike experienced in the main stem in both 2011 and 2012. In 2015 and 2016, CPW sampled Snyder Pond while the inlet was inundated and kept fish from being able to emigrate and immigrate into and out of the pond by installing a Merwin trap. In the fall of 2016, CPW also sampled and removed non-native fishes from two other ponds that can connect to Snyder Pond. CPW has had great success, in terms of CPE, removing largemouth bass, northern pike, green sunfish, and yellow perch for a total of 3,208 non-native fishes removed in 2016.

Beswick's Pond: Beswick's Pond (managed by CPW) is an old gravel pit pond that has been historically used for razorback sucker grow-out. This pond is located on the north side of the Colorado River at RMI 174.9 and will connect with the river during high spring runoff. In 2016, we sampled this pond sporadically between 8 April and 7 October. We used a combination of gears which included electrofishing, fyke nets, trammel nets, and cast nets. In 2016, we collected PIT-tagged and stocked 177 razorback sucker with a mean total length of 443 mm (range 365 to 421 mm). We also removed 716 invasive fishes. We removed 16 black bullhead (mean TL 194, range 46-295 mm), 350 black crappie (mean TL 164, range 44-293 mm), 68 bluegill (mean TL 100, range 54-160 mm), 4 common carp (mean TL 343, range 320-364 mm), 110 green sunfish (mean TL 94, range 55-181 mm), 80 gizzard shad (mean TL 348, range 103-425 mm), 88 largemouth bass (mean TL 223, range 43-454 mm; Figure 12), and 3 yellow bullhead (262-328 mm TL; Figure 11).

Butch Craig Pond: Butch Craig Pond (managed by BLM) is an old gravel pit pond that has been historically used for razorback sucker and bonytail grow-out. This pond has had two notches installed in the berm so that during high flow years this pond would be a flow through wetland. This pond is located on the west side of the Gunnison River at RMI 12.7. In 2016,

we sampled this pond sporadically from 20 April to 14 October. We used a combination of gears which included electrofishing, fyke nets, trammel nets, and cast nets. In 2016, we collected 33 previously PIT-tagged razorback sucker, 25 bluehead sucker, and 45 roundtail. We also collected and PIT-tagged 4 bonytail and 5 razorback sucker. We also removed 3,830 invasive fishes. We removed 536 black bullhead (mean TL 220, range 71-370mm), 13 bluegill (mean TL 118, range 104-141 mm), caught and released 4 brown trout, 16 common carp (mean TL 225, range 135-307 mm), 146 green sunfish (mean TL 104, range 40-167 mm), 2,140 largemouth bass (TL range 60-399 mm {most < 100 mm TL}; Figure 12), and 853 white sucker X native sucker hybrids (mean TL 336, range 90-558 mm; Figure 11). Largemouth bass had to have been illegally introduced into this pond sometime between late fall 2013 and the end of 2014, as multiple year classes were present in our 2015 and 2016 sampling (indicating obvious reproduction). When we sampled this pond during the fall 2013, no largemouth bass were present in our catch.

CDOT Pond: CDOT Pond (managed by Colorado Department of Transportation) is an old gravel pit pond that is located on the South side of the Colorado River at RMI 204.5 between the east- and west-bound lanes of Interstate 70. This pond connects with the river during high spring runoff. In 2016, we sampled this pond sporadically from 25 April to 21 October. We used a combination of gear types which included fyke nets, trammel nets, cast nets, and hoop nets. In 2016, we collected, PIT-tagged, and stocked 263 razorback sucker (mean TL 436, range 360-560 mm). We also removed 712 invasive fishes. We removed 58 black crappie (mean TL 184, range 162-231 mm), 383 bluegill, green sunfish or hybrids (mean TL 146, range 27-184 mm), 7 largemouth bass (mean TL 224, range 165-263 mm; Figure 12), and 3 white sucker (all ~ 330 mm; (Figure 11).

Task completed. Report submitted to the Program Office in November, 2016.

VIII. Additional noteworthy observations:

During most years, Colorado pikeminnow aren't collected during the smallmouth bass removal project. However for FY 2016, USGS requested that muscle plugs be collected throughout the upper Colorado River basin to assess bioaccumulation of mercury. Of the 103 Colorado pikeminnow collected, 59 were previously untagged juvenile or adult fish. During 2016, 418 individual razorback sucker, 105 bonytail, 7 flannelmouth sucker X razorback sucker hybrids, 1 humpback chub, and 1 tagged roundtail chub were collected by CPW and USFWS crews while working on projects 126a and 126b. For endangered fish tag histories see Tables 4 & 5.

IX. Recommendations:

1. Continue to collect and lethally remove all centrarchids from the Colorado and Gunnison rivers during all Grand Junction FWCO field station activities that include sampling on the Colorado and Gunnison rivers and adjacent habitats (e.g., CDOT, Beswick's, and Butch Craig Pond).

2. During years when we're conducting a population estimate for smallmouth bass, continue using three electrofishing boats during the marking pass in an attempt to capture, mark,

and release as many smallmouth bass as possible that are ≥ 100 mm.

3. Investigate and implement management measures to prevent escapement of smallmouth bass and other piscivorous fishes into riverine areas from bodies of water known to be occupied by species that could negatively impact native riverine fishes. In support of this concept, the Recovery Program began funding additional removal efforts in streamside gravel PIT ponds in FY-16.

4. Target specific in-river features that provide habitat for centrarchid fishes. These include but are not limited to beaver lodges, tree stumps and logs, rock piles, and concrete rip-rap. Using targeted sampling on these instream features with electrofishing may increase our catch of centrarchid fishes.

5. Continue having CPW sample the Upper Colorado reaches from Silt to Beavertail Mountain in DeBeque Canyon.

6. Continue with two nonnative fish removal passes in river reach between the Loma Boat Landing and Westwater Ranger Station, Utah.

7. Evaluate the feasibility of sampling floodplain ponds in addition to Snyder's (specifically those tied to gravel pit operations and others that have hydrologic connections directly to the Colorado River) in the Silt and Rifle areas to determine fish species presence and abundance/density. In support of this concept, the Recovery Program began funding additional removal efforts in streamside gravel PIT ponds in FY-16.

8. Complete otolith microchemistry analyses to determine the origin of northern pike and walleye collected in the Colorado River, and evaluate other potential habitable locations these fish may have occupied beyond their origination. In support of this concept, USGS was funded to begin analyzing Colorado River basin wide otolith samples in FY-16.

9. Suspend all electrofishing operations when it is determined that Colorado pikeminnow show signs of preparing to spawn (e.g., mid- to late-June). Electrofishing will be suspended during this period to eliminate the likelihood of harassment, interference, and injury to spawning Colorado pikeminnow.

10. Downstream from Price-Stubb fish passage, electrofishing should commence following cessation of spawning of Colorado pikeminnow which should be sometime in mid- to late-July.

11. In future years, keep the number of removal passes at eight (or more) to further exploit a smallmouth bass population that currently appears to be in decline in the Upper Colorado River.

X. Project Status: On track and ongoing.

XI. FY 2016 Budget Status

A. Funds Provided: 126a = $236,358

B. Funds Expended: $236,358
C. Difference: -0-
D. Percent of the FY 2016 work completed, and projected costs to complete: 100%
E. Recovery Program funds spent for publication charges: -0-

XII. Status of Data Submission (Where applicable): Will be submitted to UCRRP database by January 2017.

XIII. Signed: Travis Francis 11/18/2016
Principal Investigator Date

APPENDIX:

A. References

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Attachments include:
6 Tables
12 Figures
2 PPRs

Table 1. Catch/effort (CPE, fish/hr) comparison by year for four different length classes (total length) of smallmouth bass (< 100mm = age-0; 100–199 mm = juveniles; > 200 mm = adults; > 325 mm = piscivore) for the Upper Colorado River Silt to Beavertail Mountain reaches (river miles 248.0– 195.7), the Upper Colorado River from Government Highline Dam to the Westwater Wash, Utah (river miles 193.7.7 – 124.8) and the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence (river miles 3.0 – 0.7), and the Upper Colorado River from Cisco to Potash, Utah (river miles 111.0 – 47.2) from 2004 – 2016. Note: a) all removal passes and all reaches were combined within years for the Silt to Beavertail Mountain and Government Highline Dam to Westwater, Utah, plus the Lower Gunnison River reaches, and the Cisco to Potash reaches b) Silt to Rifle reach sampled only during 2007, 2008, 2014, and 2015, and c) Government Highline to Cameo XCEL Bridge reach added in 2009, d) in 2011, some reaches were not sampled which included Black Rocks to Westwater Ranger Station, Government Highline to Cameo, and Cottonwood Park boat landing to Beavertail Mountain, e) some reaches not sampled in 2012 include the 2.3- mile section of the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence, the additional reach between the Government Highline Dam and the Cameo Bridge, from Cameo Bridge to GVIC, and Parachute to Debeque , f) Cisco to Potash, Utah reaches were added in 2013, and g) Westwater Ranger Station to Westwater Wash was added in 2014.

			Smallmouth Bass												
River	Length		Year												
Section	Class		2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
		No. of fish	0	2	8	4	1	0	57	0	21	17	36	58	3
	< 100	C/E	0	0.05	0.14	0.07	0.02	0	0.72	0	0.25	0.2	0.96	1.46	0.15
		No. of fish	2	1	5	29	1	6	0	3	29	28	2	54	4
Rifle															
Beavertail	100-199														
Mountain		C/E	0.05	0.02	0.08	0.53	0.02	0.48	0	0.05	0.34	0.32	0.05	1.36	0.2
		No. of fish	7	4	13	1	3	5	39	12	32	45	41	118	14
	> 200	C/E	0.19	0.09	0.22	0.02	0.05	0.01	0.49	0.19	0.37	0.52	1.09	2.96	0.71
		No. of fish	1	1	2	0	NC	NC	NC	NC	NC	NC	NC	NC	NC
	> 325	C/E	0.03	0.02	0.03	0									
		No. of fish	184	123	86	1,213	761	226	2,054	191	185	1,358	261	254	93
	< 100	C/E	0.54	0.28	0.17	3.33	2.62	0.55	5.82	0.55	0.63	4.15	1.61	1.46	0.55
Government															
Highline Dam															
Westwater, Utah		No. of fish	59	93	399	1,281	316	611	159	137	214	250	54	345	618
+															
Lower Gunnison River	100-199	C/E	0.17	0.21	0.78	3.52	1.09	1.47	0.45	0.39	0.73	0.76	0.33	1.98	3.66
		No. of fish	211	283	566	754	423	147	188	177	135	429	449	768	456
	> 200	C/E	0.62	0.64	1.11	2.07	1.46	0.35	0.53	0.51	0.46	1.31	2.77	4.39	2.7
		No. of fish	27	14	31	41	NC	NC	NC	NC	NC	NC	NC	NC	NC
	> 325	C/E	0.08	0.03	0.06	0.11									
		No. of fish	5	3	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	< 100	C/E	0.02	0.01	0	0									
		No. of fish	4	5	3	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cisco															
Potash	100-199														
Utah		C/E	0.02	0.02	0.02	0.04									
		No. of fish	10	28	38	21	NA	NA	NA	NA	NA	NA	NA	NA	NA
	> 200	C/E	0.05	0.13	0.26	0.29									
		No. of fish	2	10	20	5	NC	NC	NC	NC	NC	NC	NC	NC	NC
	> 325	C/E	0.01	0.05	0.14	0.07									

Table 2. Catch/effort (CPE, fish/hr) comparison by year for four different length classes (total length) of largemouth bass (< 100mm = age-0; 100–199 mm = juveniles; > 200 mm = adults, > 325 = piscivore) for the Upper Colorado River Silt to Beavertail Mountain reaches (river miles 248.0 – 195.7), the Upper Colorado River from Government Highline Dam to the Westwater Wash, Utah (river miles 193.7.7 – 124.8) and the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence (river miles 3.0 – 0.7), and the Upper Colorado River from Cisco to Potash, Utah (river miles 111.0 – 47.2) from 2004 – 2016. Note: a) all removal passes and all reaches were combined within years for the Silt to Beavertail Mountain and Government Highline Dam to Westwater, Utah, plus the Lower Gunnison River reaches, and the Cisco to Potash reaches b) Silt to Rifle reach sampled only during 2007 and 2008, 2014 and 2015, and c) Government Highline to Cameo XCEL Bridge reach added in 2009, d) in 2011, some reaches were not sampled which included Black Rocks to Westwater Ranger Station, Government Highline to Cameo, and Cottonwood Park boat landing to Beavertail Mountain, e) some reaches not sampled in 2012 include the 2.3- mile section of the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence, the additional reach between the Government Highline Dam and the Cameo Bridge, from Cameo Bridge to GVIC, and Parachute to Debeque , f) Cisco to Potash, Utah reaches were added in 2013, and g) Westwater Ranger Station to Westwater Wash was added in 2014.

			Largemouth Bass												
River Section	Length Class (mm)		Year												
			2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
	< 100	No. of fish	34	17	24	232	37	9	24	36	462	122	125	10	53
		C/E	0.92	0.39	0.4	4.25	0.66	0.71	0.3	0.58	6.05	1.4	3.33	0.25	2.68
Rifle Beavertail Mountain	100-199	No. of fish	17	12	18	53	35	13	31	29	90	109	71	10	11
		C/E	0.46	0.28	0.3	0.97	0.62	1.03	0.39	0.47	1.05	1.26	1.89	0.25	0.56
	> 200	No. of fish	4	2	14	15	0	5	13	5	43	56	15	17	2
		C/E	0.11	0.05	0.24	0.28	0	0.4	0.16	0.08	0.5	0.64	0.4	0.43	0.1
	> 325	No. of fish	1	0	1	2	NC	NC	NC	NC	NC	NC	NC	NC	NC
		C/E	0.03	0	0.02	0.04									
	< 100	No. of fish	982	797	1,071	467	3,484	2,463	4,281	1,952	1,272	1,507	573	465	173
Government Highline Dam		C/E	2.88	1.8	2.1	1.28	12	6.05	12.1	5.58	4.32	4.61	3.54	2.66	1.03
Westwater, Utah + Lower Gunnison River	100-199	No. of fish	414	332	188	323	1,674	712	1,141	609	344	1,332	487	86	85
		C/E	1.21	0.75	0.37	0.89	5.766	1.72	3.23	1.74	1.17	4.07	3.01	0.49	0.5
	> 200	No. of fish	35	102	67	62	69	102	29	32	39	43	36	38	21
		C/E	0.1	0.23	0.13	0.17	0.24	0.25	0.08	0.09	0.13	0.13	0.22	0.22	0.12
	> 325	No. of fish	4	13	20	5	NC	NC	NC	NC	NC	NC	NC	NC	NC
		C/E	0.01	0.03	0.04	0.01									
	< 100	No. of fish	153	47	3	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.69	0.21	0.02	0.01									
Cisco Potash Utah	100-199	No. of fish	62	106	5	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.28	0.48	0.03	0.05									
	> 200	No. of fish	8	10	1	13	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.04	0.05	0.01	0.23									
	> 325	No. of fish	0	3	0	2	NC	NC	NC	NC	NC	NC	NC	NC	NC
		C/E	0	0.01	0	0.03									

Table 3. Population estimate with 95% confidence intervals (CI) and other statistics for smallmouth bass (100-199 mm and > 200 mm) for the 15- and 18-mile reaches (river miles 185.6 to 152.6) of the Upper Colorado River and 2.3 miles of the Lower Gunnison River (Redlands Diversion Dam to the Colorado/Gunnison River confluence) for the summers of 2006 - 2016. Note: length of the area for the population estimate was 35.3 miles.

Year	Fish Length Size (mm)	Pop Estimate with 95% CI	SE	SM Bass/ mile	Number Marked; No. Removed 1st Removal	Number Recaptured on 1st Removal Pass	Total Number Recaptured on all removal passes	Total Number of Removal Passes	Total Number of SM Bass Removed on all removal passes	Percentage Removed on all removal passes	CV (%)	p-hat (weighted)
2004/2005	NO POPULATION ESTIMATE PERFORMED											
2006	100-199	No Pop Est.	- - -	- - -	25; 18	0	0	4	54	- - -	- - -	- - -
	≥ 200	2,295 ± 1,500	765	65	97; 163	6	8	4	449	19.6	33.3	0.043
2007	100-199	No Pop Est.	- - -	- - -	13; 16	0	0	8	250	- - -	- - -	- - -
	≥ 200	1,007 ± 686	350	28.5	54; 109	5	14	8	429	42.6	34.8	0.06
2008	100-199	804 ± 423	216	22.8	96; 82	9	10	8	214	26.6	26.9	0.101
	≥ 200	393 ± 276	141	11.1	67; 28	4	17	8	135	34.4	35.9	0.073
2009	100-199	2,044 ± 2,238	1,142	57.9	86; 46	1	6	8	138	6.8	55.9	0.014
	≥ 200	755 ± 802	409	21.4	71; 20	1	4	8	178	23.6	54.2	0.017
2010	100-199	255 ± 196	100.2	7.2	31; 31	3	11	8	159	62.4	39.3	0.097
	≥ 200	823 ± 671	342	23.3	53; 60	3	9	8	188	22.8	41.6	0.053
2011	100-199	1,718 ± 1,115	569	48.7	101; 117	6	10	10	611	35.6	10.4	0.056
	≥ 200	110 ± 108	55.1	3.1	12; 16	1	3	10	147	135	50	0.071
2012	100-199	232 ± 133	67.7	6.6	50; 37	6	9	6	201	86.6	29.2	0.159
	≥ 200	1,853 ± 1,748	889	52.5	82; 68	2	8	6	233	12.6	48	0.037
2013 to 2016	NO POPULATION ESTIMATE PERFORMED											

Table 4. 2016 razorback sucker captured during nonnative fish removal projects 126a & b stock event histories.

Stock or Tagged in the Field Year	# Captured during 126a & b 2016	Source Hatchery or Field Station	Stock or Capture River	Stock or Capture RMI	Location Description	Notes
1999	1	Grand Jct.	GU	57.1	Delta, CO	
2000	3	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	1 was recaptured 2008, 2009 and 2014; 1 was recaptured 2007, 2014 and 2015; 1 was recaptured 2008
2002	4	Grand Jct.	CO	152.6	Loma Boat Launch	1 was recaptured in 2014 and 2015; 1 was recaptured 2015
2003	1	Grand Jct.	CO	152.6	Loma Boat Launch	
2004	1	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	
2004	6	Grand Jct.	CO	152.6	Loma Boat Launch	1 was recaptured 2014; 2 were recaptured 2014 and 2015; 1 was recaptured 2015; 1 was recaptured 2008;1 was recaptured 2010
2006	1	Grand Jct.	CO	184.9	Palisade, CO	
2006	1	Grand Jct.	GU	12.7	Butch Craig Wetland	
2007	2	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	1 was recaptured 2009
2007	1	Grand Jct.	CO	166.7	Redlands Parkway boat launch	
2007	1	Grand Jct.	CO	157.1	Fruita State Park Launch	
2007	1	Grand Jct.	GU	57.1	Delta, CO	recaptured 2010
2007	1	Grand Jct.	GU	42.6	Escalante Boat Ramp	
2008	2	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	1 was recaptured 2009
2008	2	Grand Jct.	CO	166.7	Redlands Parkway boat launch	1 was recaptured 2014
2008	1	Grand Jct.	GU	42.6	Escalante Boat Ramp	
2008	1	Vernal	GR	262	Ouray National Wildlife Refuge	recaptured 2013
2008	1	Vernal	GR	120	Green River State Park	
2009	3	Grand Jct.	CO	185.1	Palisade, CO	1 was recaptured 2011 and 2013; 1 was recaptured 2010
2009	3	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	2 were recaptured 2014
2009	3	Grand Jct.	CO	166.7	Redlands Parkway boat launch	1 was recaptured 2013
2009	1	Vernal	GR	262	Ouray National Wildlife Refuge	recaptured 2013
2009	3	Vernal	GR	120	Green River State Park	
2010	3	Grand Jct.	CO	183.6	Palisade, CO	
2010	2	Vernal	GR	255.4	Ouray National Wildlife Refuge near Wyasket Bottom	1 recaptured 2014
2010	4	Vernal	GR	120	Green River State Park	1 recaptured 2014
2011	1	Grand Jct.	CO	240.7	Rifle, CO	recaptured 2013
2011	5	Grand Jct.	CO	227.6	Battlement Mesa, CO	1 recaptured 2012, 2013 and 2014; 1 recaptured 2014; 1 recaptured 2015
2011	8	Grand Jct.	CO	184.7	Palisade, CO	2 recaptured 2014; 1 recaptured 2012 and 2013
2011	5	Grand Jct.	CO	177.3	Corn Lake Boat Launch near Clifton	1 recaptured 2014
2011	3	Grand Jct.	CO	170.7	Jarvis Wetland	
2011	2	Grand Jct.	GU	57.1	Delta, CO	
2011	4	Grand Jct.	GU	12.7	Butch Craig Wetland	
2011	2	Vernal	GR	120	Green River State Park	1 recaptured 2014

Table 4. Cont.

Stock or Tagged in the Field Year	# Captured during 126a & b 2015	Source Hatchery or Field Station	Stock or Capture River	Stock or Capture RMI	Location Description	Notes
2012	10	Grand Jct.	CO	240.7	Rifle, CO	1 recaptured 2015; 1 recaptured 2014; 1 recaptured 2013
2012	4	Grand Jct.	CO	183.6	Palisade, CO	1 recaptured 2013 and 2015; 1 recaptured 2013, 1 recaptured 2014
2012	10	Grand Jct.	GU	12.7	Butch Craig Wetland	
2012	1	Vernal	GR	120	Green River State Park	
2013	13	Grand Jct.	CO	240.7	Rifle, CO	3 recaptured 2015; 2 recaptured 2014 and 2015; 1 recaptured 2014; 1 recaptured 2013
2013	4	Grand Jct.	CO	183.6	Palisade, CO	3 recaptured 2014; 1 recaptured 2014 and 2015
2013	1	Grand Jct.	CO	169	Below Broadway Bridge	Tagged in the Field
2013	1	Grand Jct.	CO	161.9	Upstream of Fruita	Tagged in the Field
2013	12	Grand Jct.	CO	157.1	Fruita State Park Launch	2 recaptured 2014; 2 recaptured 2015
2013	1	Grand Jct.	CO	138.9	Ruby Horsethief Canyon	Tagged in the field and recaptured 2015
2013	16	Grand Jct.	GU	57.1	Delta, CO	3 recaptured 2015; 1 recaptured 2014
2014	17	Grand Jct.	CO	240.7	Rifle, CO	2 recaptured 2015
2014	1	Grand Jct.	CO	204.5	CDOT Pond	recaptured 2014
2014	55	Grand Jct.	CO	183.6	Palisade, CO	9 recaptured 2015
2014	1	Grand Jct.	CO	174.9	Beswick Pond	
2014	1	Grand Jct.	CO	171.9	Near Gunnison River Confluence	Tagged in the Field
2014	1	Grand Jct.	CO	167.6	Above Redlands Pkwy	Tagged in the field
2014	6	Grand Jct.	CO	166.7	Redlands Parkway boat launch	1 recaptured 2015
2014	1	Grand Jct.	CO	163.6	Walter Walker	Tagged in the field and recaptured 2015
2014	1	Grand Jct.	CO	96.3	Near Dolores River Confluence	Tagged in the Field
2014	1	Grand Jct.	CO	55.5	Above Potash, UT	Tagged in the Field
2014	1	Grand Jct.	CO	45.4	Below Potash, UT	Tagged in the Field
2014	16	Grand Jct.	GU	57.1	Delta, CO	
2015	14	Grand Jct.	CO	240.7	Rifle, CO	1 recaptured 2015
2015	3	Grand Jct.	CO	174.9	Beswick Pond	
2015	55	Grand Jct.	CO	166.7	Redlands Parkway boat launch	8 recaptured 2015
2015	1	Grand Jct.	CO	148.8	Ruby Horsethief Canyon	Tagged in the Field
2015	1	Grand Jct.	CO	88.5	Above Hittle Bottom	Tagged in the Field
2015	10	Grand Jct.	GU	57.1	Delta, CO	
2016	7	Grand Jct.	CO	204.5	CDOT Pond	
2016	18	Grand Jct.	CO	174.9	Beswick Pond	
2016	5	Grand Jct.	CO	185.4	Palisade, CO	
2016	7	Grand Jct.	CO	157.1	Fruita State Park Launch	
2016	2	Grand Jct.	GU	57.1	Delta, CO	
2016	25	Grand Jct.				Fish tagged in the Field during 2016
??	12	Grand Jct.				Missing Stock Data; 2 recaptured 2014; 3 recaptured 2015
Total	418					

Table 5. 2016 rare fish captures (excluding razorback sucker) captured during nonnative fish removal projects 126a & b stock event histories. Note: BT = bonytail, CS = Colorado pikeminnow, FR = flannelmouth X razorback sucker hybrid, HB = humpback chub, RT = roundtail chub.

Species	# Captured during 126a & b	Field Tagging Year	Stocking Year	River	RMI	Notes
BT	1		2014	GU	57.1	At large for two years!!
BT	1		2015	CO	184	
BT	2		2015	CO	167	
BT	2		2015	CO	94	
BT	14		2016	CO	183.6	
BT	11		2016	CO	166.7	
BT	49		2016	CO	157.1	
BT	7	2016		CO	57.3-185.8	Tagged during 126a
BT	18	???	???			Missing stock data
CS	1	1992		CO	151.3	recaptured 1994, 2004, 2005
CS	2	1995		CO	163.6, 163.3	1 recaptured 1996, 2004, 2010, 2013, 2015; 1 recaptured 1999, 2000, 2004, 2005, 2014
CS	1	1996		CO	63.8	recaptured 2004 and 2008
CS	1	1997		CO	163.5	recaptured 1999, 2014, 2015
CS	2	1998		CO	63.9, 58.2	1 recaptured 2003, 2005, 2010, 2013; 1 recaptured 2004 and 2005
CS	1	1999		CO	162.6	recaptured 2000, 2001, 2005
CS	1	2005		CO	138	recaptured 2009
CS	1	2003		CO	58.3	recaptured 2004, 2005, 2009, 2013
CS	2	2004		CO	162.8, 45.4	1 recaptured 2005 and 2010
CS	1		2004	GU	57.1	WOW A STOCKED CS THAT MADE IT!!
CS	1	2009		CO	67.2	
CS	2	2012		GU	3	
CS	3	2013		CO	167.4, 107.2, 100.2	2 recaptured 2014 and 2015
CS	13	2014		CO	85.8, 69.5, 59.2, 58.4, 57.5, 52.4, 48.1, 45.8, 44.3, 28.5, 26.7, 31.5, 10.4	4 were recaptured 2015
CS	11	2015		CO	52, 60.2, 61.3, 63.9, 66.8, 73.1, 82.3, 99, 104, 152.8	
CS	59	2016		CO	47.2-185.4	Tagged during 126a
CS	1	???		???	???	Missing tagging data; 1 recaptured 2014 and 2015
FR	1	2013		CO	34.4	
FR	5	2016		CO	58.6-103.9	Tagged during 126a
FR	1	???		???	???	problem tag
HB	1	2011		CO	123.4	
RT	1	2007		CO	136	

Table 6. Nonnative fish removal effort on the Colorado and Gunnision Rivers in 2016.

River Reach	CO River Miles	# of passes	Dates fished	Agency
Rifle to Beavertail Tunnel (skipped Parachute to Debeque)	248.0 to 195.7	1 partial	18 July to 21 July	CPW
GVWU Dam to Riverbend Park	193.7 to 184.6	3	5 July to 29 July	FWS
Riverbend Park to Corn Lake	184.6 to 177.4	9	6 July to 14 September	FWS
Corn Lake to Redlands Parkway	177.4 to 166.7	8	18 July to 11 October	FWS
Redlands Diversion Dam to Redlands Parkway	3.0 (Gunnison River) to 0.8 and 170.9 (Colorado River) to 166.7	8	19 July to 12 October	FWS
Redlands Parkway to Fruita State Park	166.7 to 157.1	8	7 July to 25 September	FWS
Fruita State Park to Loma Boat Launch	157.1 to 152.6	8	11 July to 23 September	FWS
Loma Boat Launch to Mee Corner	152.6 to 139	2	20 July to 28 September	FWS
Mee Corner to Westwater Ranger Station	139 to 127.6	2	21 July to 29 September	FWS
Westwater Ranger Station to Westwater Wash	127.6 to 124.8	3	13 July to 10 August	FWS
Westwater Ranger Station to Potash	127.6 to 105.7	mini reaches	7 September to 26 October	UDWR
Cisco to Coates Creek	111.0 to 104	5	24 March to 31 October	FWS
Coates Creek to Dewey Bridge	104 to 94.6	5	25 March to 1 November	FWS
Dewey Bridge to Takeout Beach	94.6 to 74.2	5	21 March to 26 October	FWS
Takeout Beach to Potash	74.2 to 47.2	3	11 April to 14 October	FWS

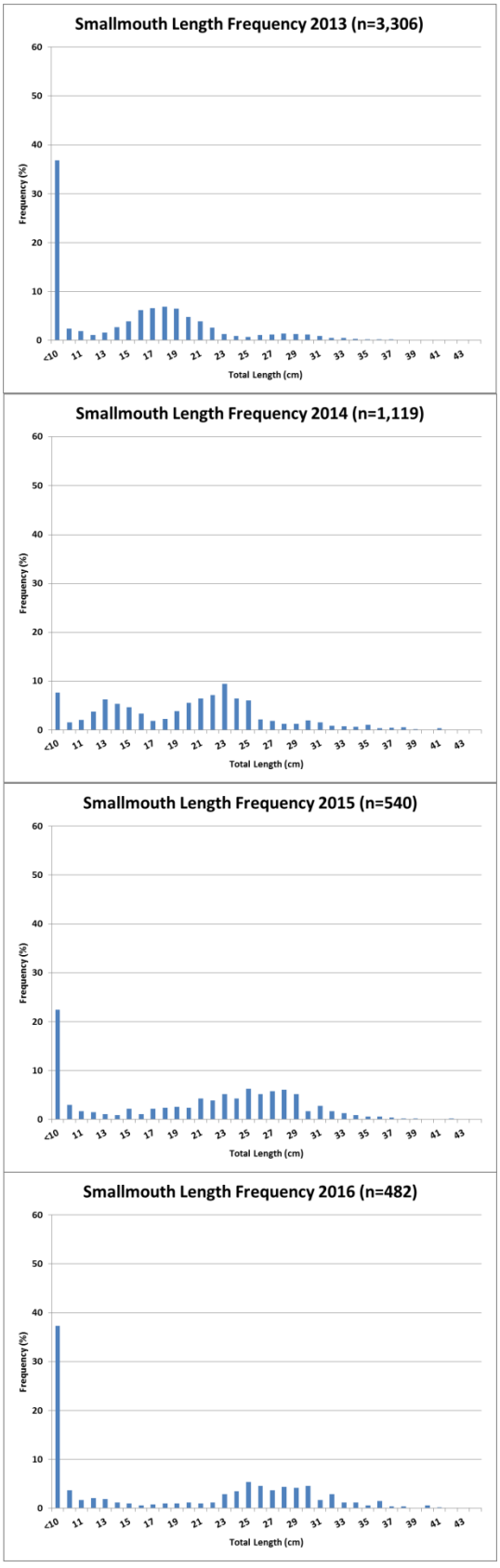


Figure 1. Length frequency histograms for smallmouth bass removed from the Colorado River from Silt, CO to the confluence of the Green River (RMI 0.0), UT from 2013 through 2016.

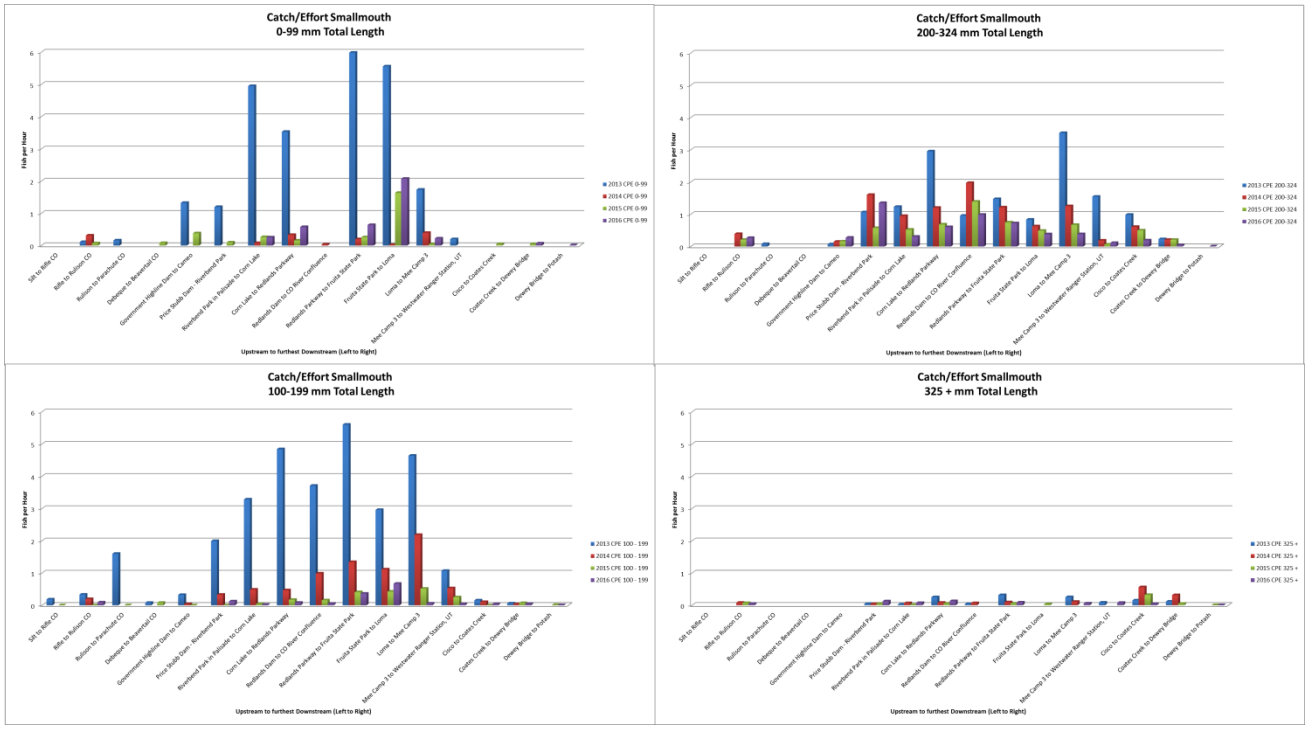


Figure 2. Catch/Effort (number of fish caught per hour electrofishing) by reach for smallmouth bass removed from the Colorado River from Silt, CO (RMI 248.0) to Potash, UT (RMI 47.2), UT during 2016. Smallmouth less than 100 mm are young-of-year, 100-199 mm are juvenile fish, > 200 mm are adults, and >325 mm are 'piscivorous'.

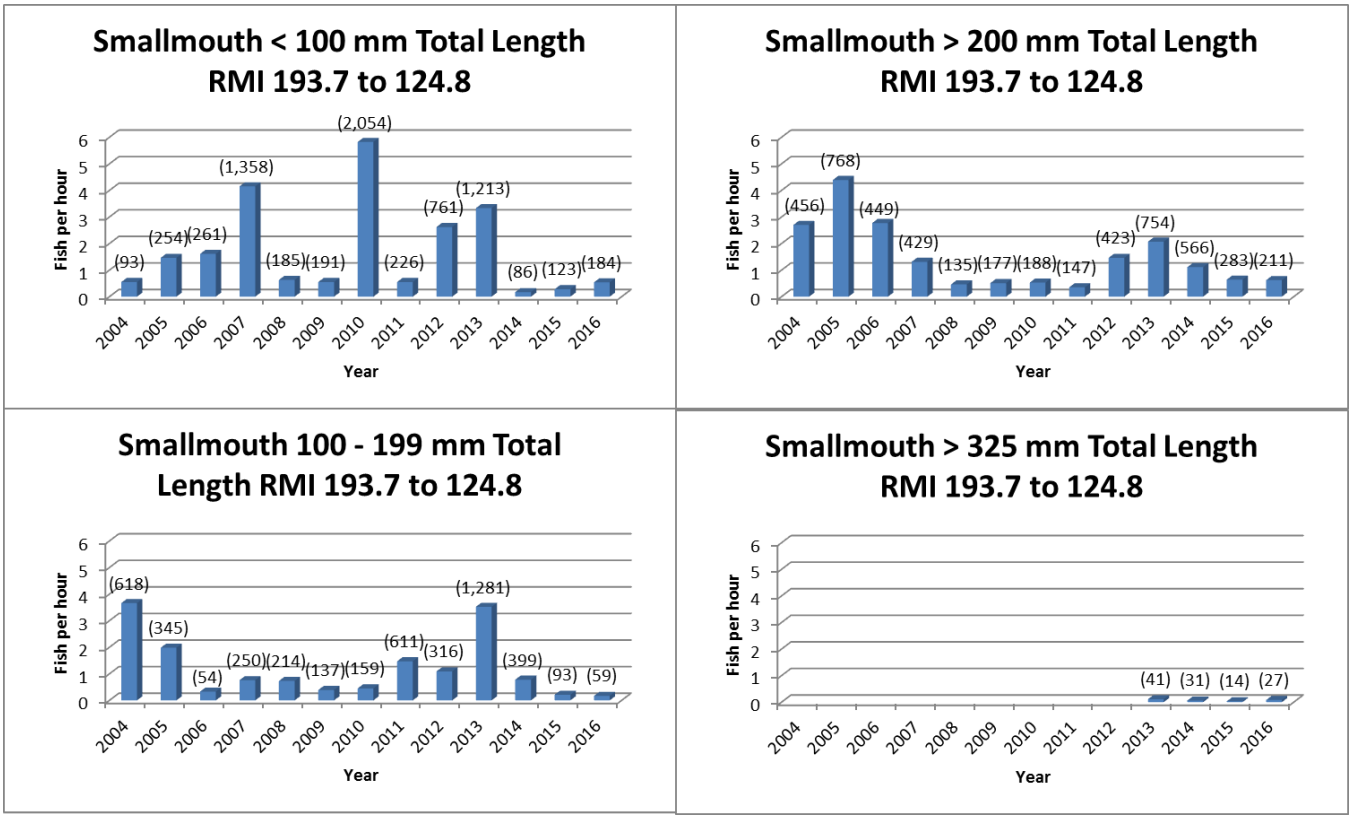


Figure 3. Catch/Effort (number of fish caught per hour electrofishing) by year for smallmouth bass removed from the Colorado River from Government Highline Dam, CO (RMI 193.7) to Westwater Wash, UT (RMI 124.8), UT from 2004 to 2016. Smallmouth less than 100 mm are young-of-year, 100-199 mm are juvenile fish, > 200 mm are adults, and > 325 mm are 'piscivorous'.

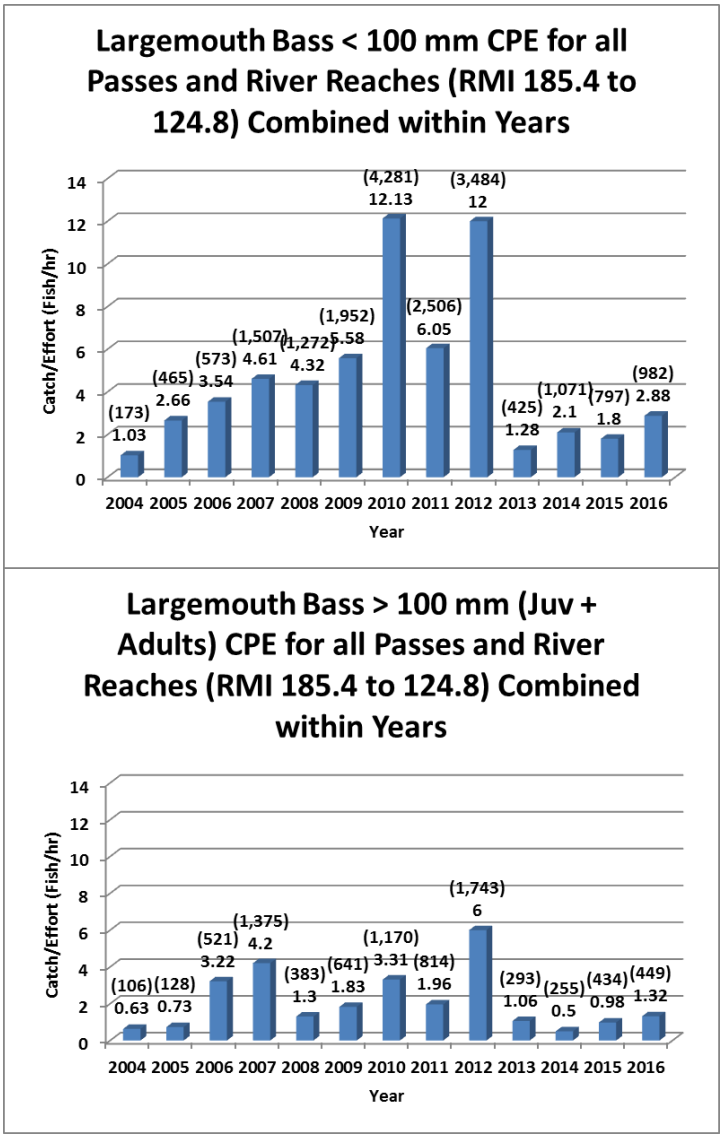
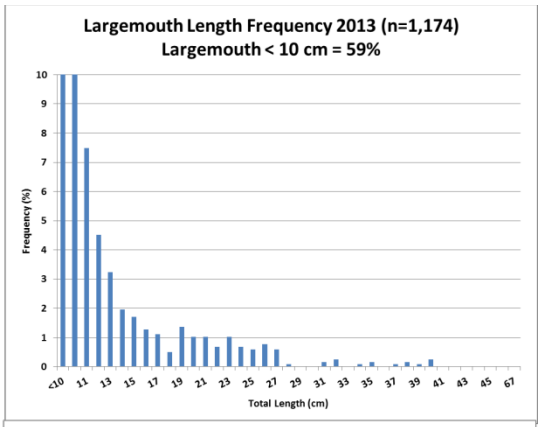
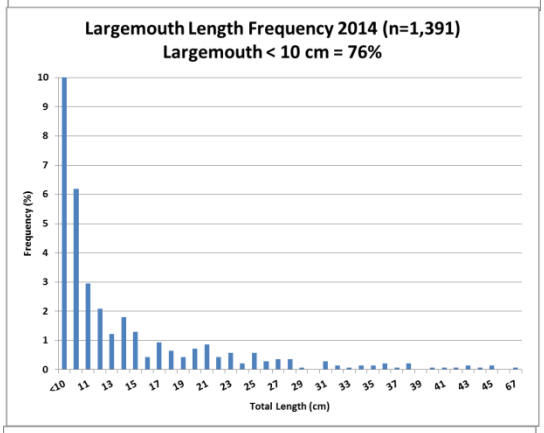
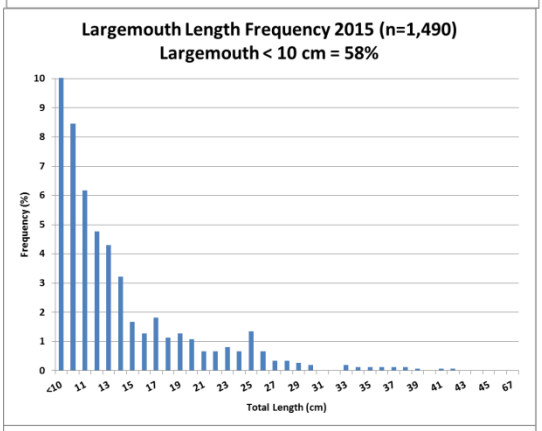


Figure 4. Thiteen year comparison of catch/effort (fish/hr) for largemouth bass (< 100 mm) (upper) and juvenile and adult largemouth bass (≥ 100 mm) (lower), 2004-2016, for the Grand Valley reaches of the Upper Colorado and Lower Gunnison rivers. Note: numbers of largemouth bass collected in parentheses.







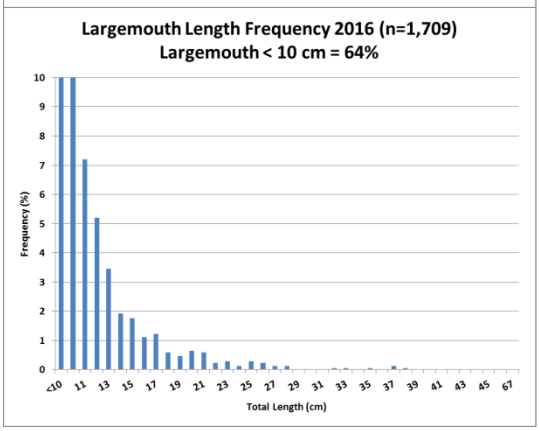


Figure 5. Length frequency histograms for largemouth bass removed from the Colorado River from Silt, CO to the confluence of the Green River (RMI 0.0), UT from 2012 through 2016.

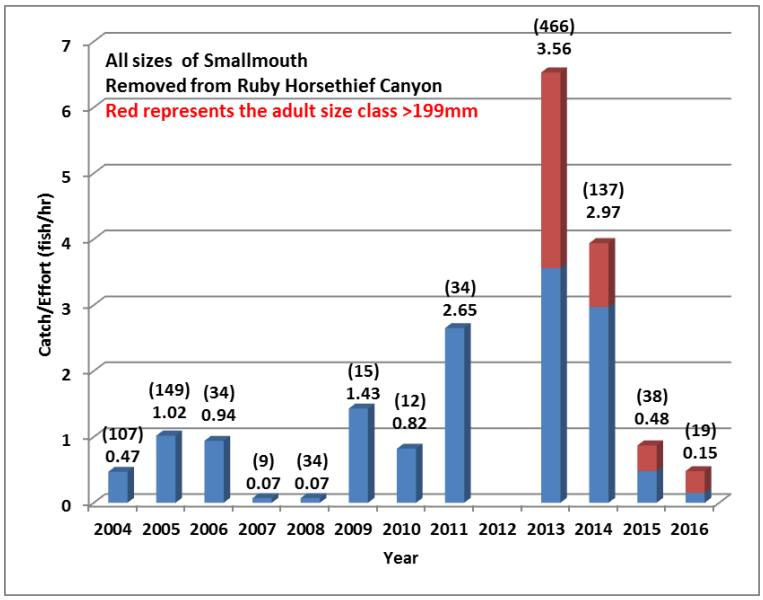


Figure 6. Thirteen year comparison of catch/effort (fish/hr) for young-of-year, juvenile and adult smallmouth bass, 2004-2016, for Ruby Horsethief Canyon of the Upper Colorado River. Note: numbers of smallmouth bass collected in parentheses.

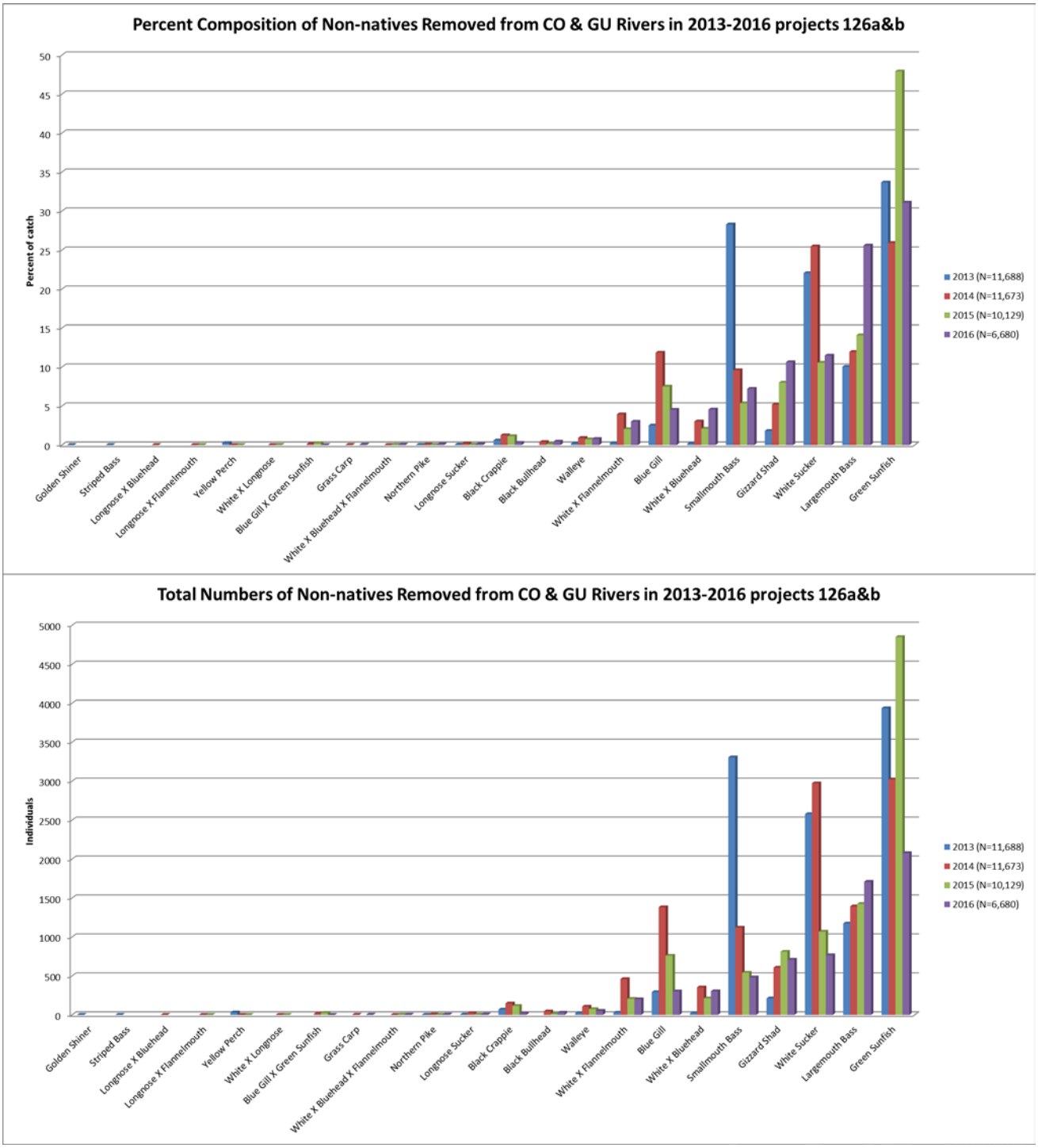


Figure 7. Percent composition and total numbers of nonnative fish removed from the Colorado (river mile 240.7 to 47.2) and Gunnison (river mile 3.0 to 0.0) rivers from 2013 through 2016.

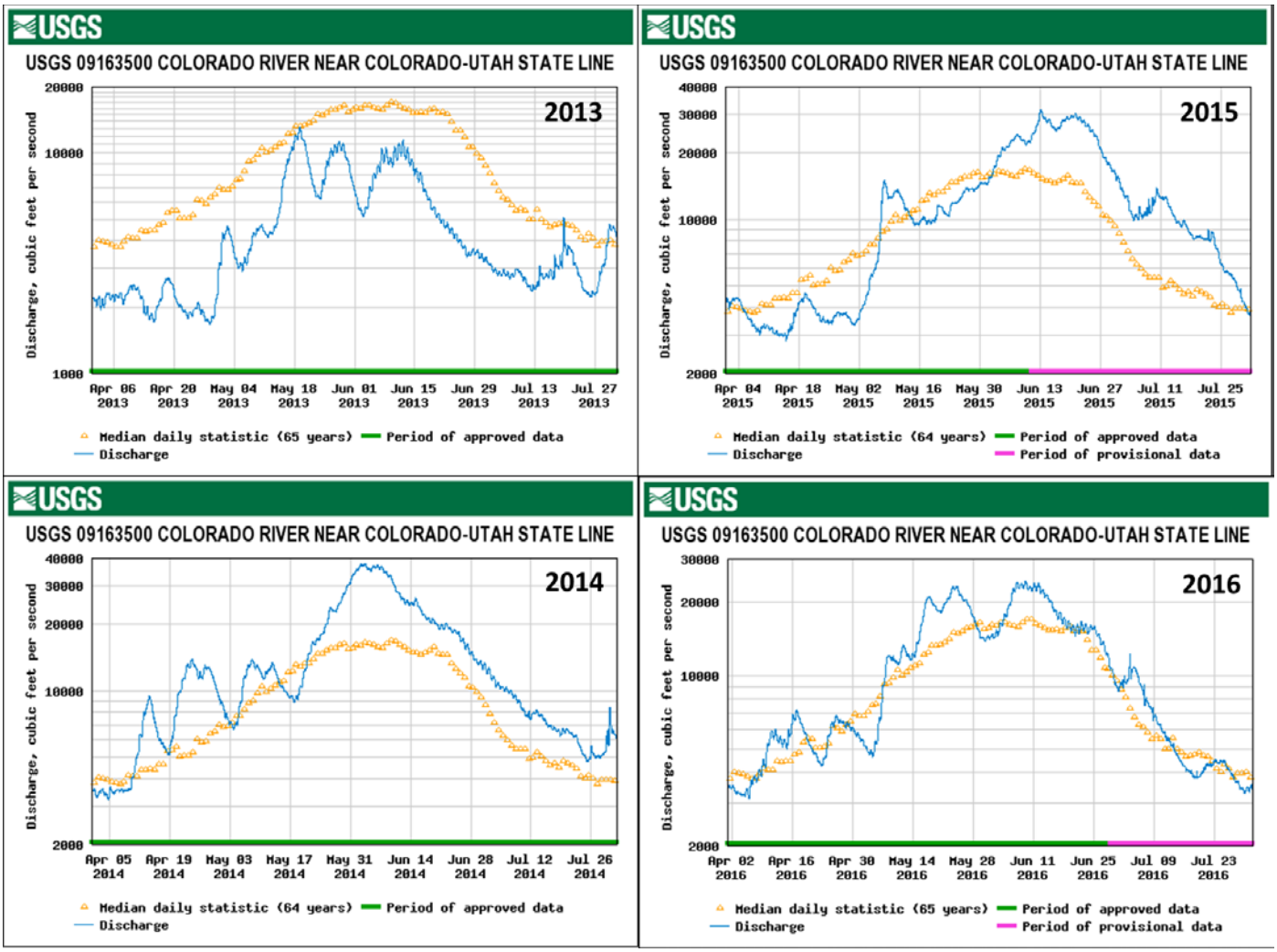


Figure 8. Spring Colorado River discharge as measured at the USGS gauge (09163500) near the CO/UT state-line; 2013-2016. Note: Notice the value change on the Y axis.

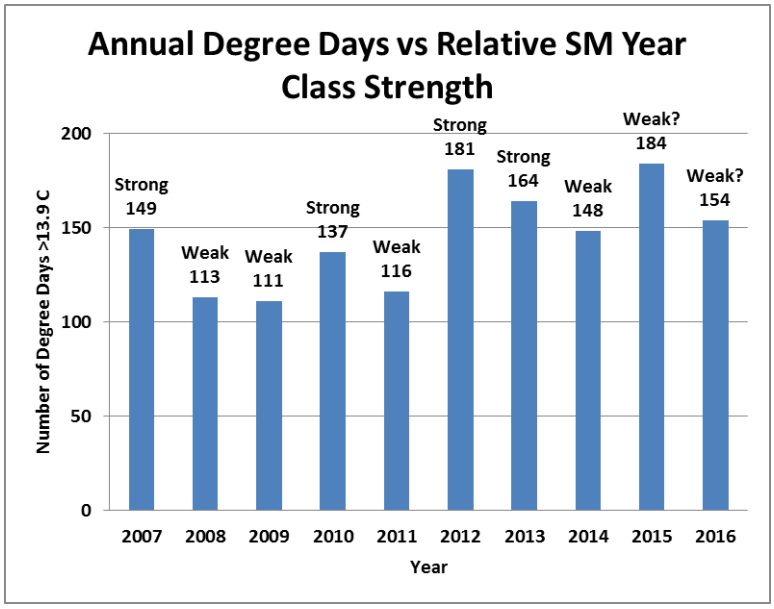


Figure 9. Annual degree days exceeding 13.9° (Celsius) as measured at the USGS 09163500 Colorado River near Colorado- Utah state line gauge.

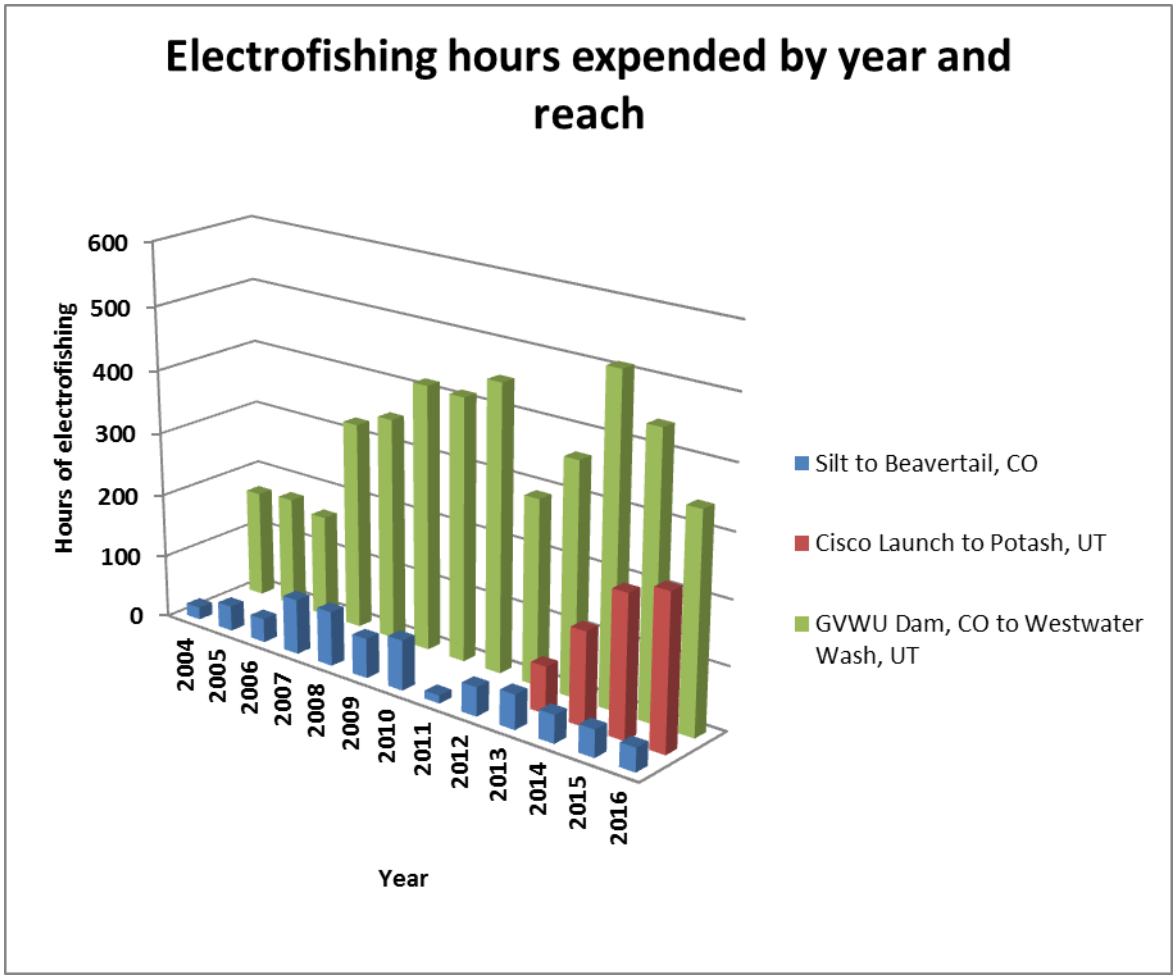


Figure 10. Electrofishing effort for 126a & 126b by year and reach.

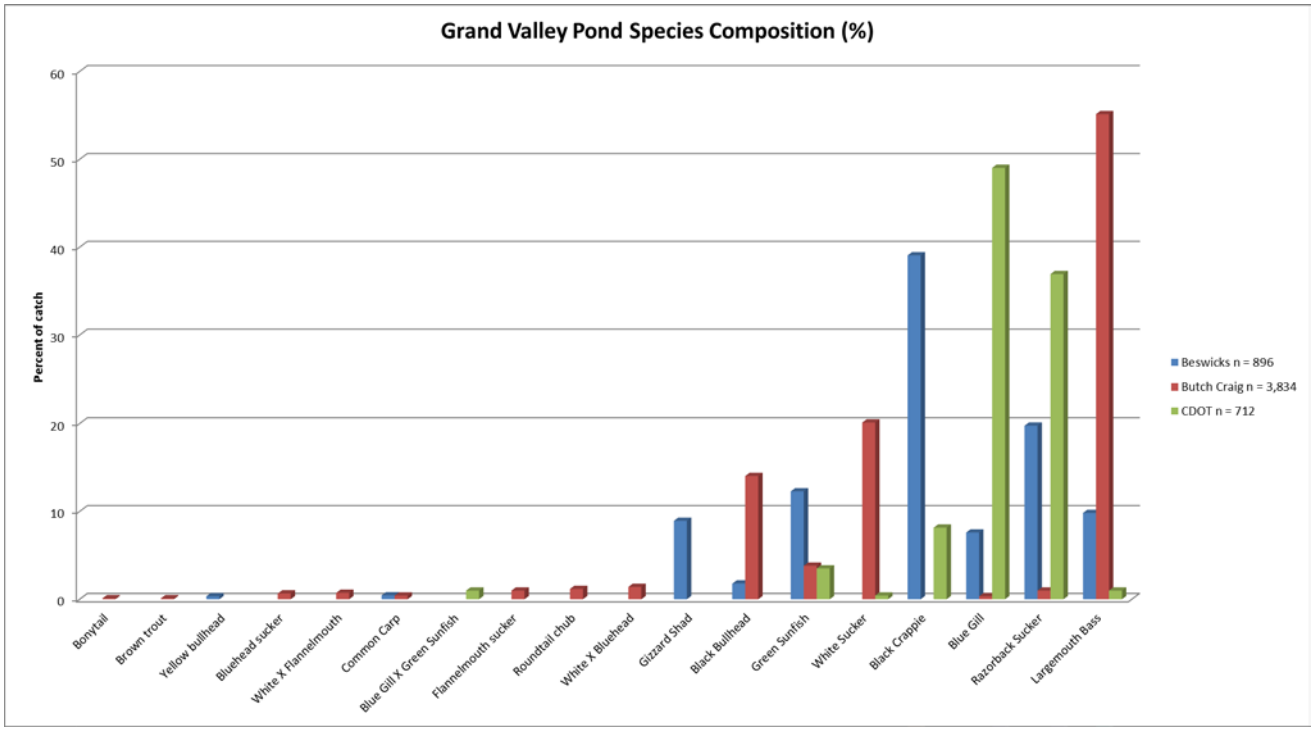


Figure 11. Species composition of fishes handled in Beswicks, Butch Craig and CDOT pond 2016.

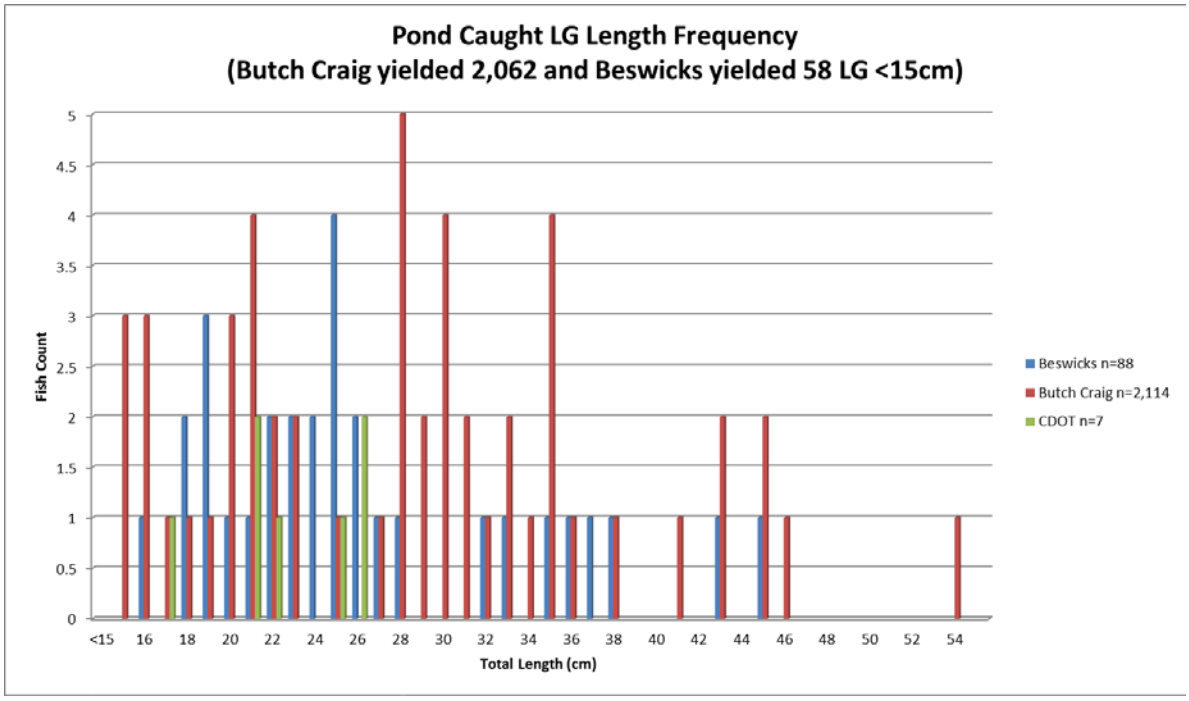


Figure 12. Beswicks, Butch Craig and CDOT ponds largemouth bass length frequency histogram 2016.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R13AP40028

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 126b

Project Title: **Colorado River and White River Supplemental lethal removal of smallmouth bass and northern pike**

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Project/Grant Period: Start date (Mo/Day/Yr): July 7, 2013
End date: (Mo/Day/Yr): September 30, 2017
Reporting period end date (Mo/Day/Yr): September 30, 2015
Is this the final report? Yes No _X_

Performance:

Summary of CPW's Project 126b: Colorado River Non-native Removal for 2016

- The Colorado River was sampled between Rifle (RM 240.4) and Parachute (RM 222.2) as well as Debeque (RM 209.7) to Beavertail Tunnel (RM 195.7) by CPW crews as part of Project 126b. Silt (RM 248.0) to Rifle (RM 240.4) was omitted in 2016 due to low or no captures in the previous 3 years for this reach. Additionally, Parachute to Debeque was also not sampled due to low flows creating hazardous conditions over the Bluestone Ditch. Crews used two 16' rafts equipped with ETS mounted electrofishing gear to complete the project. Rafts electrofished downstream along both shorelines within the main channel, and utilized experimental gill nets at the mouths of backwaters to complete "block and shock" sampling. Fish captured were measured in length to the nearest millimeter and weighed to the nearest gram. Non-native, non-salmonid fish captured were lethally removed, with the exception of common carp. In 2016, non-native catostomids and hybrid catostomids were removed opportunistically. Otoliths will be extracted from the northern pike collected to assist in determination of fish origination.

- One electrofishing pass was completed from Rifle (RM 240.4) to Parachute (RM 222.2) and from Debeque (RM 209.7) to Beavertail Tunnel (RM 195.7), where the main channel and backwaters were electrofished. Additional efforts were expended in 3 backwaters downstream of Rifle utilizing block and shock tactics. All northern pike were captured within a single backwater at RM 236.6. In general, black bullheads and most centrarchids were captured within backwater, slackwater, and eddy habitats.

- Total Number of Fish Removed = 811 (352 of these fish were removed from a backwater at RM 236.6)

  Total Number of Black Bullhead = 15 (Total length ranged from 96 mm- 197 mm)
  Total Number of Black Crappie= 1 (Total length= 119 mm)
  Total Number of Bluegill= 34 (Total length ranged from 42 mm- 111 mm)
  Total Number of Green Sunfish = 577 (Total length ranged from 32 mm-189 mm);
  471 < 100 mm; 104 fish > 100 mm and <150 mm; 2 fish $\geq$ = 150 mm
  Total Number of Largemouth Bass = 55 (Total length ranged from 50 mm-365mm);
  35 fish $\leq$ 100 mm; 14 fish > 100 mm and < 150mm; 6 fish $\geq$ 150 mm
  Total Number of Northern Pike = 3 (Total length = 737 mm – 839 mm)
  Total Number of Smallmouth Bass = 9 (Total length ranged from 136 mm-371mm);
  0 fish $\leq$ 100 mm; 1 fish > 100 mm and <150 mm; 8 fish $\geq$ = 150 mm
  Total Number of Non-native sucker/hybrid sucker= 116 (Total Length ranged 75mm-467 mm)
  Total Number of Grass Carp=1 (Total length 770 mm)

- Total Electrofishing Effort Expended = 37.06 hours

  (3.17 hours expended in backwater at RM236.6)

- Centrarchid CPUE = 18.24 fish/hour (94.95 fish/hour within RM 236.6 backwater, n=301);

  -Green Sunfish = 15.57 fish/hour
  -Largemouth Bass = 1.48 fish/hour
  -Bluegill= 0.92 fish/hour
  -Smallmouth Bass = 0.24 fish/hour
  -Black Crappie= .03 fish/hour

- Northern Pike CPUE = 0.08 fish/hour

  (Northern Pike CPUE= 0.95 fish/hour for RM 236.6 backwater, n=3)

Summary of CPW's Project 126b: Snyder Ponds Nonnative Removal for 2016

Mamm Creek Pit #1

- The 37 surface acre Mamm Creek/Lafarge/United Pit (Mamm Creek Pit #1) was sampled by CPW crews using both active (16' hard bottom jet boats equipped with ETS mounted electrofishing gear) as well as passive (fyke nets, gill nets, and Merwin trap) sampling gears. Mamm Creek Pit #1 is the furthest upstream pit in this series of 4 gravel pit ponds and is the pit in which northern pike were first documented in November 2012. Electrofishing was completed during the day in the spring and early summer of 2016. In the spring and concurrent with electrofishing, fyke nets were strategically placed along the shorelines, and used to capture fish throughout the day and night hours. In addition, three to six gill nets were deployed during daylight hours while concurrently electrofishing. A Merwin Trap (large trap typically used to collect kokanee salmon during the spawning season in Colorado) was deployed in the pond on March 17th in the pike spawning area on the eastern shore and was then set across the downstream breach (outlet) on April 12th prior to runoff to prevent non-native fish from escaping the pond and entering the Colorado River during runoff. This trap passively caught fish until July 13th, when the trap was removed from the pond. CPW crews visited the pond on 23 occasions between March 18th and July 13th to check the Merwin trap. On most of those visits, CPW crews also day electrofished and set gill nets. Fish captured were measured in length to the nearest millimeter and weighed to the nearest gram. Non-native, non-salmonid fish captured were lethally removed.

- The Colorado River breached the pond inlet notch during high flows in early summer 2016. As a result, water level within the pond rose high enough to spill back into the Colorado River through the outlet notch. The Merwin trap likely effectively blocked the vast majority of fish from leaving the pond, in addition to passively capturing non-native fishes within the pond across the four months the trap was deployed. The Merwin Trap will need to be repaired prior to re-deployment in the spring of 2017 in order to effectively capture fish and prevent escapement during high flows.

- Total Number of Fish Removed = 3,061 fish

  Total Number of Largemouth Bass = 1923 (Total length ranged from 56mm- 393mm):
  1890 fish ≤ 100mm
  30 fish > 100mm and ≤ 200mm
  0 fish > 200mm and ≤ 300mm
  3 fish > 300mm and ≤ 400mm
  Total Number of Northern Pike = 292 (Total length ranged from 241mm-912mm):
  0 fish <200mm
  46 fish ≥ 200mm and < 400mm
  72 fish ≥ 400mm and < 500mm
  126 fish ≥ 500mm and < 600mm
  38 fish ≥ 600mm and < 700mm
  8 fish ≥ 700mm and < 800mm
  2 fish ≥ 800mm
  Total Number of Common Carp = 48 (Total length ranged from 67mm-810mm)
  Total Number of Fathead Minnow = 6 (Total length ranged from 62mm-78mm)

Total Number of Green Sunfish = 689 (Total length ranged from 35mm-115mm)
Total Number of Yellow Perch = 37 (Total length ranged from 68mm-195mm)
Total Number of White Sucker and Hybrids = 66 (Total length ranged from 54mm-450mm)

- Total Effort Expended (Electrofishing = 7.5 hours; Fyke Net Sets = 166.5 hours; Gill Net Sets = 265.8 hours; Merwin Trap Set = 2,830.1 hours) = 3,270.4 hours overall

- Centrarchid (Green Sunfish and Largemouth Bass, combined) CPUE across all methods = 0.80 fish/hour
  Electrofishing CPUE = 56.93 fish/hour
  Fyke Nets CPUE = 0.04 fish/hour
  Gill Nets CPUE = 0.05 fish/hour
  Merwin CPUE = 0.76 fish/hour

- Green Sunfish CPUE
  Electrofishing =42.93 fish/hour
  Fyke Nets = 0.03 fish/hour
  Gill Nets = 0.02 fish/hour
  Merwin Trap = 0.13 fish/hour

- Largemouth Bass CPUE
  Electrofishing = 14.00 fish/hour
  Fyke Nets = 0.01 fish/hour
  Gill Nets = 0.03 fish/hour
  Merwin Trap = 0.64 fish/hour

- Northern Pike CPUE across all methods = 0.09 fish/hour
  Electrofishing CPUE = 2.27 fish/hour
  Fyke Nets = 0.04 fish/hour
  Gill Nets = 0.73 fish/hour
  Merwin Trap = 0.03 fish/hour

- Common Carp CPUE
  Electrofishing CPUE = 1.2 fish/hour
  Fyke Nets = 0 fish/hour
  Gill Nets = 0 fish/hour
  Merwin Trap = 0.01 fish/hour

- Yellow Perch CPUE
  Electrofishing CPUE = 4.8 fish/hour
  Fyke Nets = 0 fish/hour
  Gill Nets = 0 fish/hour
  Merwin Trap = 0 fish/hour

- White Sucker (and hybrid) CPUE

  Electrofishing CPUE = 0 fish/hour
  Fyke Nets = 0 fish/hour
  Gill Nets = 0 fish/hour
  Merwin Trap = 0.02 fish/hour

Mamm Creek Pit #2

- Mamm Creek Pit #2 is a 12.5 surface acre pond located approximately 0.25 miles west of Mamm Creek Pit #1. Although Mamm Creek Pit #2 does not have a spillway or direct connection to the Colorado River, it was identified as a potential source of northern pike due to the presence of a ditch which may have connected it to Mamm Creek Pit #3 and Mamm Creek Pit #1 during high flows in 2011. Mamm Creek Pit #2 was surveyed using five overnight gill net sets on 11/08/2016 – 11/09/2016. One large (802 mm) northern pike was captured in the gill nets in addition to black bullhead, common carp, largemouth bass, white sucker, and yellow perch. Otoliths were taken from the northern pike that was captured to assist in determination of fish origination.

- Total Number of Fish Removed = 21 fish

  Total Number of Black Bullhead = 4 (Total Length ranged from 258mm - 309mm)
  Total Number of Common Carp = 1 (Total Length = 544)
  Total Number of Largemouth Bass = 7 (Total Length ranged from 142mm - 501mm)
  3 fish > 100mm and ≤ 200mm
  1 fish > 200mm and ≤ 300mm
  2 fish > 300mm and ≤ 400mm
  0 fish > 400mm and ≤ 500mm
  1 fish > 500mm and ≤ 600mm
  Total Number of Northern Pike = 1 (Total Length = 802 mm)
  Total Number of White Sucker = 6 (Total Length Ranged from 212mm – 359 mm)
  Total Number of Yellow Perch = 2 (Total length Ranged from 107mm – 108 mm)

- Total Effort Expended: Gill Net Sets = 95.83 Hours.

- CPUE in Gill Nets

  Black Bullhead: 0.04 fish/hour
  Common Carp: 0.01 fish/hour
  Largemouth Bass: 0.07 fish/hour
  Northern Pike: 0.01 fish/hour
  White Sucker: 0.06 fish/hour
  Yellow Perch: 0.02 fish/hour

Mamm Creek Pit #3

- Mamm Creek Pit #3 is a 7 surface acre pond located approximately 0.5 miles west of Mamm Creek Pit #1. Prior to the 2016 survey, Mamm Creek Pit #3 was identified as a potential source of northern pike because of its connection with Mamm Creek Pit #1 during runoff in 2011. Mamm Creek Pit #3 does have a direct connection to the Colorado River via a spillway that connects most years during spring runoff. Mamm Creek Pit #3 was surveyed using four overnight gill net sets on 11/08/2016 – 11/09/2016. Four large (total length ranged from 717 mm to 829 mm) were captured in addition to common carp, largemouth bass, common carp, largemouth bass, green sunfish, white sucker, and yellow perch. Otoliths were taken from all northern pike that were captured to assist in determination of fish origination.

- Total Number of Fish Removed = 126 fish (Total Length Ranged from 655mm - 698mm)

  Total Number of Common Carp = 2 (Total Length ranged from 258mm - 309mm)
  Total Number of Largemouth Bass = 12 (Total length ranged from 96mm - 426mm)
  1 fish ≤ 100 mm
  8 fish > 100mm and ≤ 200mm
  0 fish > 200mm and ≤ 300mm
  2 fish > 300mm and ≤ 400mm
  1 fish > 400mm and ≤ 500mm
  Total Number of Northern Pike = 4 (Total Length ranged from 717mm - 829mm)
  1 fish > 700mm and ≤ 750mm
  1 fish > 750mm and ≤ 800mm
  2 fish > 800mm and ≤ 850mm
  Total Number of Green Sunfish = 12 (Total length ranged from 76mm - 172mm)
  Total Number of White Sucker = 12 (Total Length ranged from 360mm - 458mm)
  Total Number of Yellow Perch = 84 (Total Length ranged from 97mm - 231mm)

- Total Effort Expended: Gill Net Sets = 80.53 Hours.

- CPUE in Gill Nets

  Common Carp: 0.02 fish/hour
  Largemouth Bass: 0.15 fish/hour
  Northern Pike: 0.05 fish/hour
  Green Sunfish: 0.15 fish/hour
  White Sucker: 0.15 fish/hour
  Yellow Perch: 1.04 fish/hour

Mamm Creek Pit #4

- Mamm Creek Pit #4 is the furthest downstream gravel pit and had not been surveyed at the time of this report. This pond did not exist during the high water event in 2011 but should be surveyed due to its close proximity to the other pits and because of the potential connection to the Colorado River during high flows through the pond's spillway. Work will continue to coordinate access to this site to determine if non-native fish are present.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R14AP00007

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 126a

Project Title: **Colorado River Nonnative Fish Removal.**

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Project/Grant Period: Start date (Mo/Day/Yr): 5/1/2014
End date: (Mo/Day/Yr): 9/30/2018
Reporting period end date (Mo/Day/Yr): 9/30/2015
Is this the final report? Yes No X

Performance:

Walleye removal on the Colorado River

Task 5 was completed: Utah Division of Wildlife Resources crews completed 20.9 hours of targeted walleye sampling on the Colorado River between Big Hole and Potash boat ramp (RM 115.8-47.2) in 2016. Targeted walleye removal began on 9 September and concluded on 26 October, 2016. Three walleye were encountered over the sampling period (CPUE=0.14). Crews also removed 34 largemouth bass and 42 smallmouth bass, most of which were encountered between Big Hole and Cisco boat ramp (RM 115.6-110.5).

Table 1. Ancillary fish captures for electrofishing passes on the Colorado River between Big Hole and Potash (RM116-47.2) in 2016.

Species	Number Captured	CPUE (fish/hr)	Median Total Length (mm)	Range (mm)
Black bullhead (*Ameiurus melas*)	1	0.05	210	-
Bluegill (*Lepomis macrochirus*)	15	0.72	127	93-155
Gizzard shad (*Dorosoma cepedianum*)	35	1.67	197	113-448
Green sunfish (*Lepomis cyanellus*)	9	0.43	114	77-149
Largemouth bass (*Micropterus salmoides*)	34	1.63	155	84-245
Smallmouth bass (*Micropterus dolomieu*)	42	2.01	187	68-365
White sucker (*Catostomus commersonii*)	3	0.14	262	260-266
White x bluehead sucker hybrid	7	0.33	370	284-472
White x flannelmouth sucker hybrid	5	0.24	378	365-386
Roundtail chub (*Gila robusta*)	1	0.05	362	-
Colorado pikeminnow (*Ptychocheilus lucius*)	8	0.38	356	144-607
Razorback sucker (*Xyrauchen texanus*)	4	0.19	467	417-491