COLORADO RIVER RECOVERY PROGRAM
FY 2017 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

Project/Grant Period:
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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 fourteenth 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 since 2015.

In our riverine sections we removed 1,755 smallmouth bass, 1,937 largemouth bass, 116 walleye, two northern pike, three striped bass, two grass carp and various amounts of other nonnative fish in 2017. Catches of age-0 smallmouth bass indicate a moderate year class (< 100 mm) was produced in 2017 in the Grand Valley reaches of the Upper Colorado. Small numbers of young-of-year (YOY) smallmouth bass were produced from 2014 to 2016. However, they experienced many more degree days greater than 13.9° (Celsius) prior to winter and had a good chance of surviving until next spring (Figure 9). The catch rate for juvenile smallmouth bass 100-199 mm increased (91%) from 2016 suggesting that many of these fish did survive. 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 (43%) from 2016. The catch rate for adult smallmouth bass > 200 mm decreased (57%) from 2016. Catches of largemouth bass from 2012 through 2017 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 2,669 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 271 razorback sucker and one 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 2017 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 2017, 126a scope of work, called for eight removal passes in the Grand Valley. We completed nine to eleven passes in most reaches (see methodology below). In one river reach (GVWU Dam to Riverbend Park) we completed only five passes. This was due to low catch rates of non-native piscivores so we moved the additional efforts to reaches where we were having more success. The FY 2017, 126b scope of work, called for one removal pass from Silt to Beavertail Tunnel. On alternating years sampling will occur in the reach from Silt to Rifle or Debeque to Beavertail. For FY 2017 Colorado Parks and Wildlife (CPW) sampled the river between Silt (RM 248) and Debeque (RM 209.7). Please see CPW's PPRs in the appendix for more details of their work.

All age groups of smallmouth bass (age-0, juveniles, and adults) were present in the 2017 summer/fall collections. These ranged from age-0 (36 mm) to adult (496 mm) fish with a mean of 147 mm. However, juvenile smallmouth bass (< 199 mm) made up a larger proportion of our total catch when compared to the 2014-2016 period (Figure1). A total of 1,755 smallmouth bass were removed, including 79 considered piscivorous competitors to Colorado pikeminnow (≥ 325 mm; Table 1). A moderate year class of smallmouth bass (< 100 mm) was produced in 2017 in the Grand Valley reaches of the Upper Colorado, as

454 were collected and removed (Figure 2). In fact, the catch rate for YOY/juvenile size fish < 100 mm only increased from 0.54 fish/hr (2016) to 0.94 fish/hr, similar to catch rates during 2005 and 2006 (Figure 3). During 2017, the catch rate for adult size classes of smallmouth bass declined (≥ 200 mm {57%}) from the 2016 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. Juvenile smallmouth bass (100-199 mm) catch rates increased 91%. Small numbers of YOY smallmouth bass were collected in 2014-2016; however, these fish experienced many more degree days greater than 13.9° (Celsius) prior to winter and had a good chance of surviving until the next spring perhaps leading to our increased catch of juvenile smallmouth bass (Figure 9). In 2014, 2015, and 2017 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 lower Westwater Canyon, UT to Coates Creek, UT at 0.6, 0.3, and 0.35 fish/hr (2014{n=11}, 2015{n=7}, 2017{n=30}). 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 1,937 largemouth bass were removed from all reaches in 2017, a substantial decrease from 2012's catch (n=5,227, Table 2 and Figure 4), but similar to 2013 through 2016's catch. Our catch ranged from age-0 fish (36 mm) to adult fish (456 mm) with a mean of 126 mm (Figure 5). Eleven 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 through 2016 catch: 98% (n = 1,898) were less than 250 mm, 38% (n = 743) were less than 100 mm and only 2% (n = 39) were adults greater than 250 mm. Data from 2013 through 2017 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 (2017 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). Beginning in 2016, lower Westwater Canyon (RMI 116.0) to Cisco, UT was added extending the lower reach an additional five miles.

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 2017, 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). Abundance estimates 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 were calculated in 2006-2012; however, abundance estimates were not calculated from 2013-2017. Catch per effort (CPE) has been calculated for all years of the study, throughout all of the reaches, including 2017, as a metric to compare yearly fluctuations of nonnative fish populations and size classes.

Methodology

General

In 2017, up to 11 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 the other sampling passes. Utah Division of Wildlife Resources (UDWR, Moab Field Station) completed three partial fall removal passes between Lower Westwater Canyon and Cisco, 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, striped bass, 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 2013-2017, CPE was computed for use as a trend to compare annual abundance of smallmouth bass and other centrarchids during the entire 2004-2017 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 2017. Removal passes performed by the CPW in the Upper Colorado River between Silt and Beavertail Mountain are also reported here. UDWR results are also included. Data are presented for main channel habitats only. This includes backwaters that are hydrologically connected to the main-stem river. Integration and comparison of results from earlier years (2004-2016) 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, FWS and UDWR, with electrofishing during 2017 between Silt, CO and Potash, UT were plotted (Figure 1). All age groups of smallmouth bass (age-0, juveniles, and adults) were present in the 2017 summer/fall collections. These ranged from age-0 (40 mm) to adult (496 mm) fish with a mean total length of 147 mm. A total of 1,755 smallmouth bass were removed,

including 81 considered to be piscivourous competitors to Colorado pikeminnow (≥ 325mm). A moderate year class of smallmouth bass (< 100 mm) was produced in 2017 in the Grand Valley reaches of the Upper Colorado, when considering 454 were collected and removed (Figure 2). However, juvenile smallmouth bass (100-199 mm) made up a larger proportion of our total catch in 2017 when compared to 2015 and 2016 (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 have been 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 and 2015. 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). Juvenile smallmouth bass (100-199 mm) catch rates, in 2017, increased 91% when compared to 2016 most likely the result of elevated fall water temperatures. 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 2010 and 2012 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 through 2017 adult catch (Figure 3) suggests that both our removal and recent river hydrological conditions have helped suppress the 2011 and 2012 age classes. Unfortunately, another strong cohort of juvenile smallmouth bass were collected in 2017 (Table 1; Figure 3).

Largemouth Bass

A total of 1,937 largemouth bass were removed from all reaches, in 2017, a substantial decrease from the 2012 catch (n = 5,227, Table 2), but similar to the 2013 through 2016 catch. Our catch ranged from age-0 fish (36 mm) to adult fish (456 mm) with a mean of 126 mm (Figure 5). Eleven 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 through 2016 catch: 98% (n = 1,898) were less than 250 mm, 38% (n = 743) were less than 100 mm and only 2% (n = 39) were adults greater than 250 mm. Data from 2013-2017 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 22 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 both 2014 and 2017, 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 14 sampling years, 2004-2017 (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 lower Westwater Canyon 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 (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, 341.1 hours in 2016 and 472 hours in 2017 (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, 40.14 hours in 2017; and 10.8 gill net hours in 2012, 5.2 hours in 2013, and 0 gill net hours from 2014 through 2017. 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. In 2017, two complete passes were completed in both spring and fall, and 12 additional days effort was expended in the reach from Lower Westwater Canyon to Coates Creek in response to an increased number of non-native piscivores and crews expended 255.06 hours of electrofishing (Figure 10).

Smallmouth Bass

For the Colorado 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 (6.37 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 (2.07 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 (5.59 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). Catch rates for juvenile and adult smallmouth bass increased

in 2017 to 2.22 fish per hour (Table 1, Figure 3).

During the summer of 2010, for the Colorado 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 2017 hydrograph followed the median statistic and coincidentally our YOY smallmouth bass catch was moderate (0.94 fish/hr).

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) which correlates well with 2017 juvenile smallmouth bass catch rates (1.83 fish/hr). 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 2017, wet or moderate years that still had age-0 smallmouth bass collected 1 July (in 2014; 86 mm) , 22 July (in 2015; 79 mm), 14 July (in 2016; 68 mm) and 18 July (in 2017; n=23 mean TL 78 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 and 2017 produced similar catch rates at 0.27 and 0.29 smallmouth bass per hour. These values are an increase following a drop in mean catch per effort in 2012 (0.09 fish/hr). The highest combined smallmouth bass catch rate was achieved 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, 2016 and 2017. 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). Our catch of all size classes of

smallmouth bass decreased again, in 2016, to 0.48 fish/hr. 2017 produced the third largest catch rate in this reach at 3.81 smallmouth bass per hour of electrofishing (Figures 2 & 4).

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. 2017 catch rates increased 90% to 0.99 smallmouth bass per hour (Table 2; Figure 2). In 2014, 2015 and 2017, the highest rate of removing UCRRB defined 'piscivorous sized (> 325 mm)' smallmouth bass occurred from lower Westwater Canyon, UT to Dewey Bridge, UT at 0.9 fish/hr (2014, n=20), 0.37 fish/hr (2015, n = 9) and 0.38 fish/hr (2017, n = 31; 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. Juvenile and adult catch rates increased another 24% in 2017 to 1.73 largemouth bass per hour (n=814; 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 2017 largemouth bass < 100 mm (1.28 fish/hr {2013}, 2.1 fish/hr {2014}, 1.8 fish/hr {2015}, 2.88 fish/hr {2016}, 1.32 fish/hr {2017}; 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. In 2017, all sizes of largemouth bass catch rate increased 63% to 4.04 fish/hr. This could be related to the extra time spent in large backwaters that have historically held many non-native piscivores. 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 and 2.4 fish/hr in 2017.

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, all life stages of 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, 1.01 fish/hr in 2016, and 1.32 fish/hr in 2017 (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 2017, 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 2017 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 2017 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 2017, we removed 183 adult smallmouth bass ($\geq$ 200mm) in the Grand Valley reaches. We completed 5 to 11 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 9 passes in the Grand Valley reaches (2017) and could estimate (from previous years calculated p-hat) that 0.54 (54%) of the population may have been removed (or exploited). The pre-removal estimate would have been around 399 adults and the post removal estimate would be around 216 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 Colorado River removal efforts. Two adult northern pike were removed by CPW crews in 2017 (Figure 7). Both northern pike (756 and 960 mm TL) were collected between Rifle and Rulison. 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 2017 from the Grand Valley downstream to Potash (n = 2,832; 33-475 mm). This is the largest number of gizzard shad removed in project 126a's history, in fact it was the number one species removed (Figure 7). In 2017, 16 gizzard shad were collected at Redlands fish trap and 12 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.

In 2017, two adult grass carp were removed between Fish Ford and Moab, Utah. Their eyeballs were extracted and sent to Whitney Genetics Lab – La Crosse Fish Health Center in Onalaska, WI to determine ploidy. All grass carp stocked in the basin are supposed to be triploid (sterile). Results for the 745 and 986 mm total length fish both came back as diploid (fertile).

Three striped bass were collected between Coates Creek (RMI 104) and Moab Bridge (RMI 64.2). Their total lengths were 465, 474 and 517 mm. The last time striped bass were removed from the Colorado River was 2013 (n=2).

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), our effort in 2016 removed 1,277 (55-552 mm TL), and our effort in 2017 removed 2,777 (30-512 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 since 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 2017, Grand Junction FWCO crews completed 31 total days of removal efforts in three different ponds and CPW crews completed 157 total days in three different ponds.

Mamm Creek Ponds: 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 Mamm Creek Ponds (a.k.a. Snyder 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 Mamm Creek Ponds with the river, contributed to the increase in catch of northern pike experienced in the main stem in both 2011 and 2012. From 2015 through 2017, CPW sampled Mamm Creek Ponds 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 and spring 2017, CPW also sampled and removed non-native fishes from two other ponds that can connect to Mamm Creek Pond #1. CPW has had great success, in terms of CPE, removing largemouth bass, northern pike, green sunfish, and yellow perch for a total of 1,888 non-native fishes removed in 2017. Please see appended PPR for more details.

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 2017, we sampled this pond sporadically between 20 April and 26 May. We used a combination of gears which included electrofishing, fyke nets, trammel nets, and cast nets. In 2017, we collected, PIT-tagged, and stocked 21 razorback sucker with a mean total length of 444 mm (range 375 to 495 mm). We also removed 298 invasive fishes. We removed 18 black bullhead (mean TL 97, range 45-292 mm), eight black crappie (mean TL 209, range 64-270 mm), 66 bluegill (mean TL 77, range 35-109 mm), four common carp, 150 green sunfish (mean TL 75, range 26-130 mm), 22 gizzard shad (mean TL 409, range 326-444 mm), 14 largemouth bass (mean TL 317, range 97-505 mm; Figure 12), seven smallmouth bass (mean TL 58, range 47-74 mm), and nine yellow bullhead (125-287 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 2017, we sampled this pond sporadically from 1 May to 22 June. We used a combination of gears which included electrofishing, fyke nets, trammel nets, and cast nets. In 2017, we collected 58 previously PIT-tagged razorback sucker, 23 bluehead sucker, 35 flannelmouth sucker, four hybrid flannelmouth bluehead sucker, and 118 roundtail chub. We also collected and PIT-

tagged 1 bonytail (459 mm TL) and 14 razorback sucker (mean TL 488, range 450-540 mm). We also removed 1,999 invasive fishes. We removed 601 black bullhead (mean TL 216, range 75-319mm), one bluegill (TL 109 mm), caught and released 2 brown trout, removed one common carp (TL 502 mm), one channel catfish (TL 665 mm), 81 fathead minnows, 222 green sunfish (mean TL 116, range 46-190 mm), 85 largemouth bass (mean TL 171, range 41-499 mm; Figure 12), 81 red shiners, and 924 white sucker and white by native sucker hybrids (mean TL 315, range 64-566 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 through 2017 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 2017, we sampled this pond sporadically from 24 April to 15 June. We used a combination of gear types which included fyke nets, trammel nets, cast nets, and hoop nets. In 2017, we collected, PIT-tagged, and stocked 237 razorback sucker (mean TL 446, range 337-560 mm). We also removed 372 invasive fishes. We removed two black bullhead (186 and 193 mm TL), 68 black crappie (mean TL 196, range 68-287 mm), 279 bluegill (mean TL 145, range 46-190 mm), 14 green sunfish (mean TL 135, range 22-190 mm), one carp (221 mm TL), 8 largemouth bass (mean TL 155, range 130-173 mm; Figure 11 and 12.

Task completed. Report submitted to the Program Office in November, 2017.

VIII. Additional noteworthy observations:

A total of 931 individual endangered fishes were captured in 2017. During 2017, 658 individual razorback sucker, 141 bonytail, 125 Colorado pikeminnow, 5 flannelmouth sucker X razorback sucker hybrids, and two humpback chub were collected by CPW, UDWR 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 $\geq$ 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 Mamm Creek (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 2017 Budget Status

A. Funds Provided: $241,767
B. Funds Expended: $241,767
C. Difference: -0-
D. Percent of the FY 2017 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 2018.

XIII. Signed: Travis Francis 11/17/2017
Principal Investigator Date

APPENDIX:

A. References

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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 – 2017. 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) Lower Westwater Canyon to Potash, Utah reaches were added in 2013, and g) Westwater Ranger Station to Westwater Wash was added in 2014.

	Smallmouth Bass														
River Section	Length Class		Year												
			2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
Silt to Beavertail Mountain	< 100	No. of fish	0	0	2	8	4	1	0	57	0	21	17	36	58	3
		C/E	0	0	0.05	0.14	0.07	0.02	0	0.72	0	0.25	0.2	0.96	1.46	0.15
	100-199	No. of fish	1	2	1	5	29	1	6	0	3	29	28	2	54	4
		C/E	0.03	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
	> 200	No. of fish	5	7	4	13	1	3	5	39	12	32	45	41	118	14
		C/E	0.13	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
	> 325	No. of fish	5	1	1	2	0	NC	NC	NC	NC	NC	NC	NC	NC	NC
		C/E	0.13	0.03	0.02	0.03	0									
Government Highline Dam to Westwater Wash, UT + Lower Gunnison River	< 100	No. of fish	442	184	123	86	1,213	761	226	2,054	191	185	1,358	261	254	93
		C/E	0.94	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
	100-199	No. of fish	865	59	93	399	1,281	316	611	159	137	214	250	54	345	618
		C/E	1.83	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
	> 200	No. of fish	138	211	283	566	754	423	147	188	177	135	429	449	768	456
		C/E	0.29	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
	> 325	No. of fish	45	27	14	31	41	NC	NC	NC	NC	NC	NC	NC	NC	NC
		C/E	0.1	0.08	0.03	0.06	0.11									
Lower Westwater Canyon to Potash, UT	< 100	No. of fish	12	5	3	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.05	0.02	0.01	0	0									
	100-199	No. of fish	156	4	5	3	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.61	0.02	0.02	0.02	0.04									
	> 200	No. of fish	57	10	28	38	21	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.22	0.05	0.13	0.26	0.29									
	> 325	No. of fish	29	2	10	20	5	NC	NC	NC	NC	NC	NC	NC	NC	NC
		C/E	0.11	0.01	0.05	0.14	0.07									

Table 1. See caption above.

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 – 2017. 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) lower Westwater Canyon to Potash, Utah reaches were added in 2013, and g) Westwater Ranger Station to Westwater Wash was added in 2014.

River Section	Length Class		Largemouth Bass													
			Year													
			2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
Silt to Beavertail Mountain	< 100	No. of fish	98	34	17	24	232	37	9	24	36	462	122	125	10	53
		C/E	2.4	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
	100-199	No. of fish	59	17	12	18	53	35	13	31	29	90	109	71	10	11
		C/E	1.47	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	4	2	14	15	0	5	13	5	43	56	15	17	2
		C/E	0.1	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	3	1	0	1	2	NC	NC	NC	NC	NC	NC	NC	NC	NC
		C/E	0.07	0.03	0	0.02	0.04									
Government Highline Dam to Westwater Wash + Lower Gunnison River	< 100	No. of fish	622	982	797	1,071	467	3,484	2,463	4,281	1,952	1,272	1,507	573	465	173
		C/E	1.32	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
	100-199	No. of fish	747	414	332	188	323	1,674	712	1,141	609	344	1,332	487	86	85
		C/E	1.58	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	61	35	102	67	62	69	102	29	32	39	43	36	38	21
		C/E	0.13	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	6	4	13	20	5	NC	NC	NC	NC	NC	NC	NC	NC	NC
		C/E	0.01	0.01	0.03	0.04	0.01									
Lower Westwater Canyon to Potash Utah	< 100	No. of fish	24	153	47	3	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.09	0.69	0.21	0.02	0.01									
	100-199	No. of fish	217	62	106	5	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.85	0.28	0.48	0.03	0.05									
	> 200	No. of fish	94	8	10	1	13	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.37	0.04	0.05	0.01	0.23									
	> 325	No. of fish	2	0	3	0	2	NC	NC	NC	NC	NC	NC	NC	NC	NC
		C/E	0.01	0	0.01	0	0.03									

Table 2. See caption above.

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 - 2017. 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 2017	NO POPULATION ESTIMATE PERFORMED											

Table 4. 2017 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
2001	1	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	Recaptured 2005 CO RMI 162
2003	1	Grand Jct.	CO	63.8	Near Moab	Tagged in the field
2004	6	Grand Jct.	CO	152.6	Loma Boat Launch	1 was recaptured 2005 CO RMI 99.4, 1 was recaptured 2005 at CO RMI 61.5 and 2009 CO RMI 25, 1 was recaptured 2010 at CO RMI 60.2
2005	2	Grand Jct.	GU	12.7	Butch Craig Wetland	1 was recaptured 2008 at CO RMI 147.5
2005	2	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	1 was recaptured 2010 at CO RMI 174.4
2006	1	Grand Jct.	GU	12.7	Butch Craig Wetland	
2006	2	Grand Jct.	CO	184.9	Palisade, CO	1 was recaptured 2009 at CO RMI 62.5 and 2014 at CO RMI 61.5
2007	3	Grand Jct.	GU	57.1	Delta, CO	1 was recaptured twice in 2015 in the Grand Valley, 1 was recaptured 2013 at CO RMI 92.3
2007	2	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	1 was recaptured 2013 at CO RMI 53, 1 was recaptured 2009 CO RMI 75 and 2016 at CO RMI 86.4
2007	1	Grand Jct.	CO	166.7	Redlands Parkway boat launch	Recaptured 2015 at CO RMI 70.1
2007	2	Vernal	GR	120	Green River State Park	1 was recaptured 2014 at CO RMI 52.6, 1 was recaptured 2014 at CO RMI 61.1
2008	2	Grand Jct.	CO	184.9	Palisade, CO	1 was recaptured 2009 and 2015 in the Grand Valley
2008	2	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	1 was recaptured 2008 at CO RMI 176.2 and 2014 CO RMI 147.3
2008	1	Grand Jct.	CO	166.7	Redlands Parkway boat launch	
2009	4	Grand Jct.	CO	185.1	Palisade, CO	1 was recaptured 2015 at CO RMI 65.3, 1 was recaptured 2010 and 2014 in the Grand Valley
2009	2	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	1 was recaptured 2015 at CO RMI 98.1
2009	4	Grand Jct.	CO	166.7	Redlands Parkway boat launch	1 was recaptured 2009 at CO RMI 166.7 and 2014 at CO RMI 59 and 2016 in the CO Arm of Lake Powell
2009	1	Grand Jct.	CO	52.5	Near Moab	Tagged in the field, recaptured 2013 and 2014 near Moab
2009	2	Vernal	GR	120	Green River State Park	1 was recaptured 2009 at CO RMI 48.8
2010	1	Grand Jct.	GU	57.1	Delta, CO	
2010	1	Grand Jct.	CO	227.6	Battlement Mesa, CO	
2010	3	Grand Jct.	CO	185.1	Palisade, CO	1 was recaptured 2015 at CO RMI 36.1
2010	1	Grand Jct.	CO	155.3	Near Fruita	Tagged in field, recaptured 2011 at CO RMI 162.7
2011	5	Grand Jct.	GU	12.7	Butch Craig Wetland	3 were detected 2016 in Butch Craig Wetland
2011	2	Grand Jct.	CO	240.4	Rifle, CO	1 was recaptured 2015 at CO RMI 193.7, 1 was recaptured 2013 and 2014 in the Grand Valley
2011	6	Grand Jct.	CO	227.6	Battlement Mesa, CO	1 was detected 2012 and 2013 at Price Stubb antenna, 1 was recaptured 2012 in the Grand Valley, 2 were recaptured 2014 and 2015 in the Grand Valley
2011	5	Grand Jct.	CO	185.1	Palisade, CO	1 was recaptured 2014 and 2015 near Dolores River confluence, 1 was detected in the Dolores River in 2015 and was recaptured 2016 at CO RMI 75
2011	2	Grand Jct.	CO	177.4	Corn Lake Boat Launch near Clifton	1 was recaptured twice in 2015 in the Grand Valley
2011	1	Grand Jct.	CO	163.3	Walter Walker	Tagged in field
2011	1	Vernal	GR	120	Green River State Park	
2012	17	Grand Jct.	GU	12.7	Butch Craig Wetland	8 were detected 2016 in Butch Craig Weland, 1 was recaptured 2016 in the Grand Valley
2012	7	Grand Jct.	CO	240.7	Rifle, CO	2 were recaptured 2014 in the Grand Valley, 2 were recaptured twice in 2015 in the Grand Valley, 1 was recaptured twice in 2016 near Rifle, 1 was detected 2015 at Price Stubb and recaptured twice in 2015 in the Grand Valley
2012	4	Grand Jct.	CO	185.1	Palisade, CO	1 was recaptured 2014 in the Grand Valley
2012	2	Vernal	GR	120	Green River State Park	

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
2013	7	Grand Jct.	CO	240.7	Rifle, CO	1 recaptured 2014 in Grand Valley, 1 detected 2017 at Price Stubb, 1 recaptured 2015 near Rifle
2013	6	Grand Jct.	CO	183.6	Palisade, CO	1 recaptured 2015 in Grand Valley
2013	1	Grand Jct.	CO	158.7	Near Fruita	Tagged in field
2013	22	Grand Jct.	CO	157.1	Fruita State Park Launch	1 recaptured 2015 at CO RMI 56.3, 1 was recaptured 2015 in the Grand Valley, 1 was recaptured 2013 at CO RMI 53, 1 was recaptured 2015 at CO RMI 108.8, 1 was recaptured 2016 at CO RMI 53.6
2013	13	Grand Jct.	GU	57.1	Delta, CO	4 detected 2016 in Butch Craig Wetland, 1 recaptured twice in 2014 near Delta, 1 recaptured 2013 at GU RMI 36.1 and detected 2016 in Butch Craig Wetland, 1 recaptured 2015 CO RMI 74.9
2013	1	Grand Jct.	CO	47.6	Potash, UT	No stock record just capture record
2014	26	Grand Jct.	GU	57.1	Delta, CO	1 recaptured 2016 Redlands Fish Ladder, 1 detected 2017 at Price Stubb, 1 recaptured 2015 at CO RMI 25.7, 1 recaptured 2015 at CO RMI 61.3, 1 detected 2016 in Butch Craig Wetland, 1 recaptured 2015 at CO RMI 126.2
2014	37	Grand Jct.	CO	240.7	Rifle, CO	1 detected 2016 at Price Stubb and recaptured at GVWU fish ladder, 2 recaptured twice in 2016 near Rifle, 1 recaptured 2015 at CO RMI 148.3, 3 recaptured 2015 in the Grand Valley, 1 recaptured 2015 and 2016 in the Grand Valley 1 detected 2017 at Price Stubb, 2 recaptured 2016 GVIC canal, 1 recapture 2015 GVIC canal, 1 detected 2016 Price Stubb
2014	1	Grand Jct.	CO	204.5	CDOT Pond	
2014	70	Grand Jct.	CO	183.6	Palisade, CO	1 recaptured 2015 at CO RMI 25.8, 2 recaptured 2015 and 2016 in Grand Valley, 2 recaptured 2014 in Grand Valley, 1 recaptured 2016 at CO RMI 49, 1 recaptured 2015 at CO RMI 75.3, 5 recaptured 2015 in the Grand Valley, 1 recaptured 2016 in the Grand Valley, 1 detected 2016 at Price Stubb, 1 recaptured 2015 at CO RMI 108.5, 1 recaptured 2016 at CO RMI 53.9
2014	5	Grand Jct.	CO	166.7	Redlands Parkway boat launch	1 recaptured 2015 at CO RMI 97.3, 1 recaptured 2014 at CO RMI 16.5, 1 recaptured 2014 at CO RMI 133.2, 1 recaptured 2016 at CO RMI 63.8
2014	1	Grand Jct.	CO	153.3	Near Loma	Tagged in field
2015	14	Grand Jct.	GU	57.1	Delta, CO	1 recaptured 2016 Butch Craig Wetland, 4 detected 2016 Butch Craig Wetland, 1 recaptured 2015 in the Grand Valley
2015	8	Grand Jct.	CO	240.7	Rifle, CO	2 recaptured 2016 near Rifle
2015	4	Grand Jct.	CO	174.9	Beswick Pond	1 was recaptured 2016 at CO RMI 81.9
2015	58	Grand Jct.	CO	166.7	Redlands Parkway boat launch	8 recaptured 2015 in Grand Valley, 1 recaptured 2016 in the Grand Valley, 1 detected 2017 at Price Stubb
2015	1	Grand Jct.	CO	159.3	Near Fruita	Tagged in field
2015	2	Grand Jct.	CO	157.1	Fruita State Park Launch	
2015	1	Grand Jct.	CO	153.9	Near Loma	Tagged in field
2015	1	Grand Jct.	CO	152.7	Loma Boat Launch	1 recaptured 2015 at CO RMI 63.2 and 2016 at CO RMI 49.6
2015	1	Grand Jct.	CO	112	Lower Westwater Canyon	Tagged in field
2015	1	Grand Jct.	CO	101.9	Cisco, UT	Tagged in field
2015	1	Grand Jct.	CO	101.5	Cisco, UT	No stock record just capture record
2015	1	Grand Jct.	CO	84.7	Professor Valley	Tagged in field
2015	1	Grand Jct.	CO	12.7	Canyonlands	No stock record just capture record

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
2016	20	Grand Jct.	GU	57.1	Delta, CO	3 recaptured 2015; 1 recaptured 2014
2016	1	Grand Jct.	GU	12.7	Butch Craig Wetland	No stock record just capture record
2016	34	Grand Jct.	CO	240.7	Rifle, CO	1 detected 2016 at Price Stubb
2016	4	Grand Jct.	CO	204.5	CDOT Pond	
2016	39	Grand Jct.	CO	185.4	Palisade, CO	1 detected 2016 in Westwater, 1 detected 2016 at Price Stubb
2016	11	Grand Jct.	CO	174.9	Beswick Pond	1 recaptured 2016 at GU RMI 1.2
2016	31	Grand Jct.	CO	157.1	Fruita State Park Launch	2 detected 2016 in Black Rocks, 1 detected 2016 in Westwater
2017	23	Grand Jct.	CO	204.5	CDOT Pond	
2017	22	Grand Jct.	CO	57.3-185.8		Tagged in the field
2017	1	Grand Jct.	CO			Tag missing a digit
2017	8	Grand Jct.	CO			Caught and accidentally released prior to checking for tag
2017	81					Original encounter not yet loaded into STReaMS
Total	658					

Table 5. 2017 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	4		2016	CO	183.6	
BT	2		2016	CO	166.7	
BT	6		2016	CO	157.1	1 recaptured 2016 in the Grand Valley
BT	5	2017		CO	57.3-185.8	Tagged during 126a
BT	124	???	???			Original encounter not yet loaded into STReaMS
CS	1	2003		CO	58.3	recaptured 2004 CO RMI 58.2
CS	1	2004		CO	166.2	recaptured 2008 CO RMI 159.1
CS	1	2005		CO	110.6	recaptured 2008 at CO RMI 86.6 racptured 2009 CO RMI 110 recaptured 2013 CO RMI 112
CS	1	2007		CO	123.4	
CS	1	2008		CO	183.2	recaptured 2009 and 2013 in Grand Valley
CS	1	2011		GR	14.3	recaptured 2011 GR RMI 14.2 and detected 2016 Dolores River
CS	2	2013		CO	98.7, 62.5	
CS	9	2014		CO	60, 54.5, 63.9, 74.5, 50.7, 9.9, 69.5, 59.2, 42.6	1 recaptured 2015 CO RMI 105.1, 1 recaptured 2014 and 2015 and 2016 between CO RMI 48.1-53.9, 1 detected 2016 Price Stubb, 1 recaptured 2016 CO RMI 69.5, 1 recaptured 2016 CO RMI 60.1 detected 2017 Price Stubb
CS	1	2015		CO	70.1	recaptured 2016 CO RMI 65
CS	3	2016		CO	150.7, 136, 52	
CS	90	2017		CO	47.2-185.4	Tagged during 126a
CS	7	???		???	???	To small to tag
CS	7	???		???	???	Original encounter not yet loaded into STReaMS
FR	5	2017		CO	58.6-103.9	Tagged during 126a
HB	1	2007		CO	123.4	
HB	1	2016		CO	136	

Table 6. Nonnative fish removal effort on the Colorado and Gunnison Rivers in 2017.

River Reach	CO River Miles	# of passes	Dates fished	Agency
Silt to Rifle	248 to 240.1	1	20 July	CPW
Rifle to Rulison	240.1 to 230	3	25 April to 14 August	CPW
Rulison to Parachute	230 to 222.2	1	19 July	CPW
Parachute to Una	222.2 to 216.6	1	20 July	CPW
Una to Debeque	216.6 to 209.7	1	19 July	CPW
Debeque to Beavertail Tunnel	209.7 to 195.7	0		CPW
GVWU Dam to Riverbend Park	193.7 to 184.6	5	5 July to 26 July	FWS
Riverbend Park to Corn Lake	184.6 to 177.4	10	24 July to 6 October	FWS
Corn Lake to Redlands Parkway	177.4 to 166.7	10	1 August to 12 October	FWS
Redlands Diversion Dam to Redlands Parkway	3.0 (Gunnison River) to 0.8 and 170.9 (Colorado River) to 166.7	9	3 August to 27 September	FWS
Redlands Diversion to Colorado River Confluence	3.0 to 0.8 (Gunnison River only)	6	5 July to 27 July	FWS
Redlands Parkway to Fruita State Park	166.7 to 157.1	11	25 July to 25 October	FWS
Fruita State Park to Loma Boat Launch	157.1 to 152.6	11	26 July to 20 October	FWS
Loma Boat Launch to Fault Line 2	152.6 to 139	2	18 July to 22 August	FWS
Additional Loma Boat Launch downstream	152.6 to 145	3	2 August to 3 October	FWS
Fault Line 2 to Westwater Ranger Station	139 to 127.6	2	19 July to 23 August	FWS
Westwater Ranger Station to Westwater Wash	127.6 to 124.8	3	24 July to 18 August	FWS
Westwater Ranger Station to Potash	116 to 113.8	3 mini reaches	4 October to 12 October	UDWR
Additional Bighorn Camp to Coates Creek	114 to 104	9 mini reaches	25 July to 13 October	FWS
Bighorn Camp to Coates Creek	114.0 to 104	4	4 May to 23 October	FWS
Coates Creek to Dewey Bridge	104 to 94.6	4	5 May to 24 October	FWS
Dewey Bridge to Takeout Beach	94.6 to 74.2	4	26 April to 12 October	FWS
Takeout Beach to Potash	74.2 to 47.2	4	1 May to 12 October	FWS

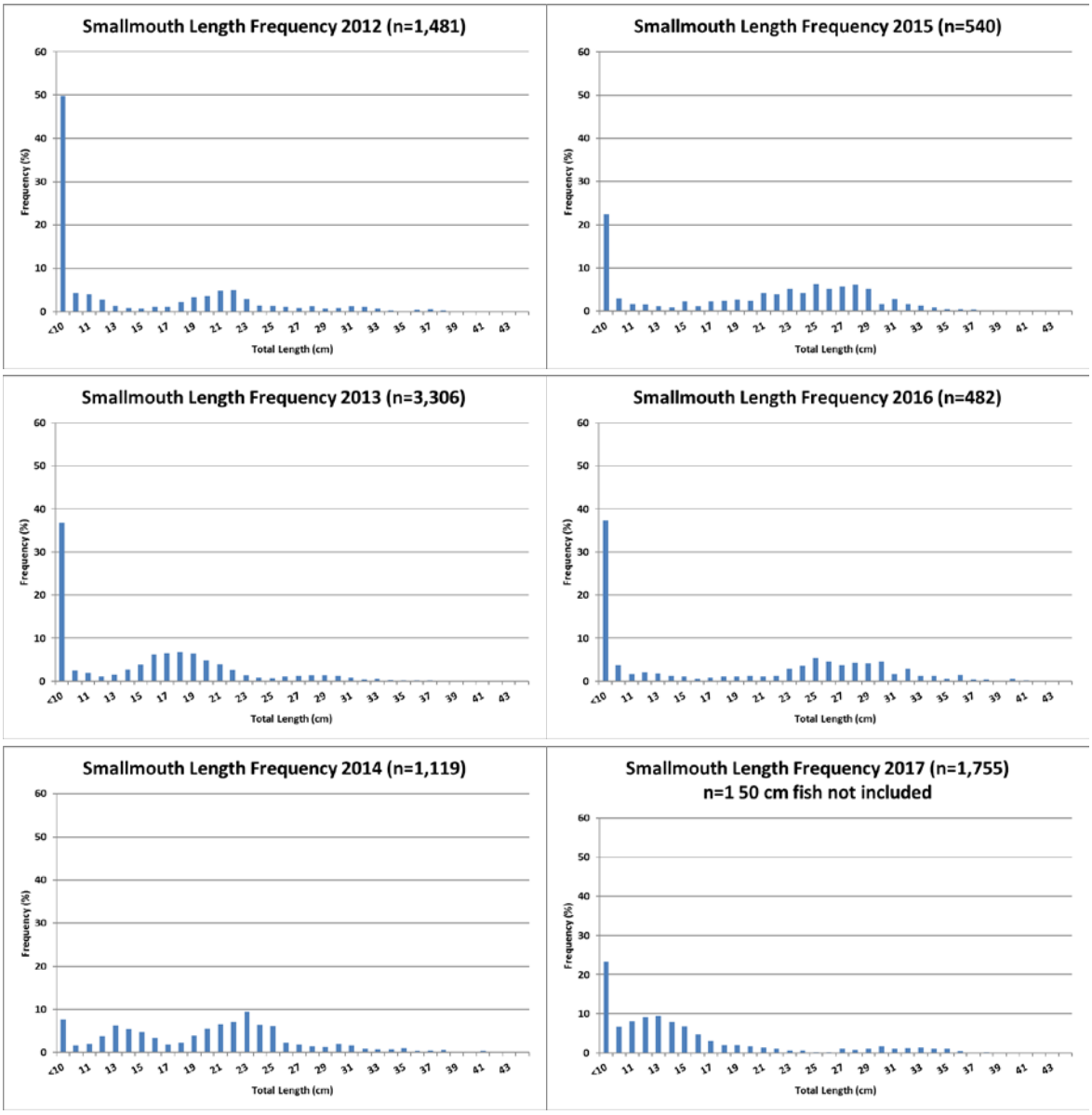
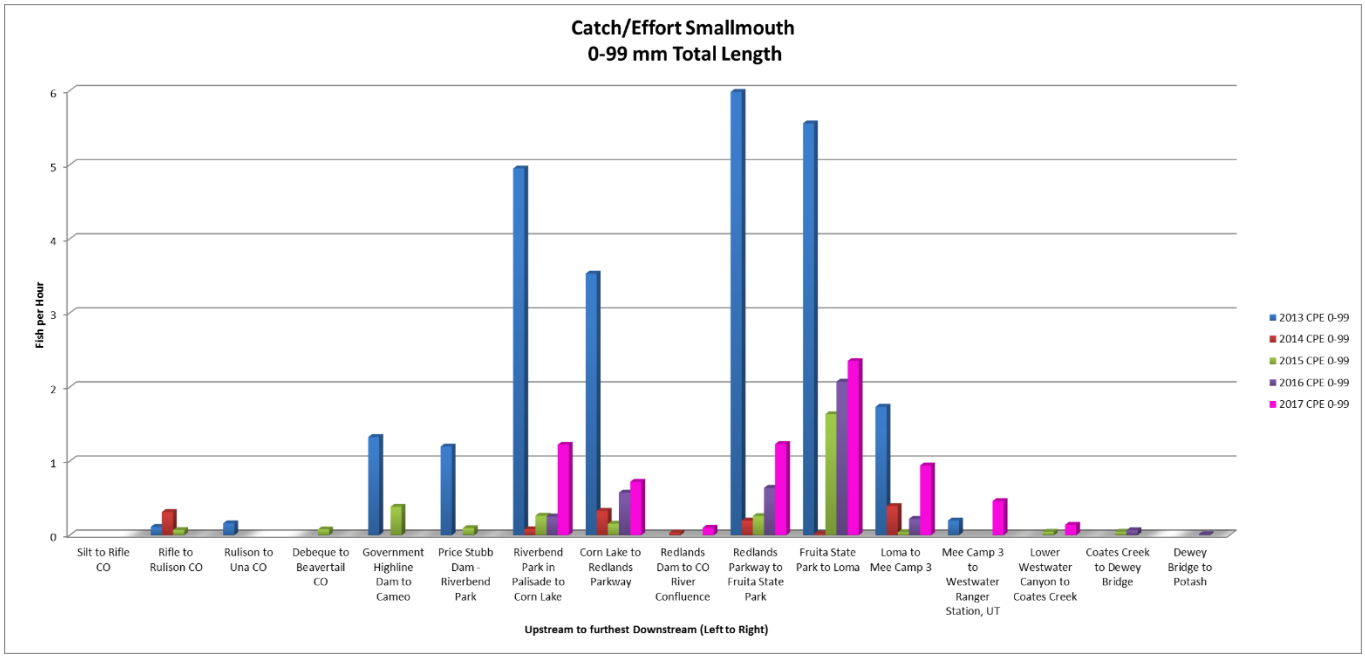
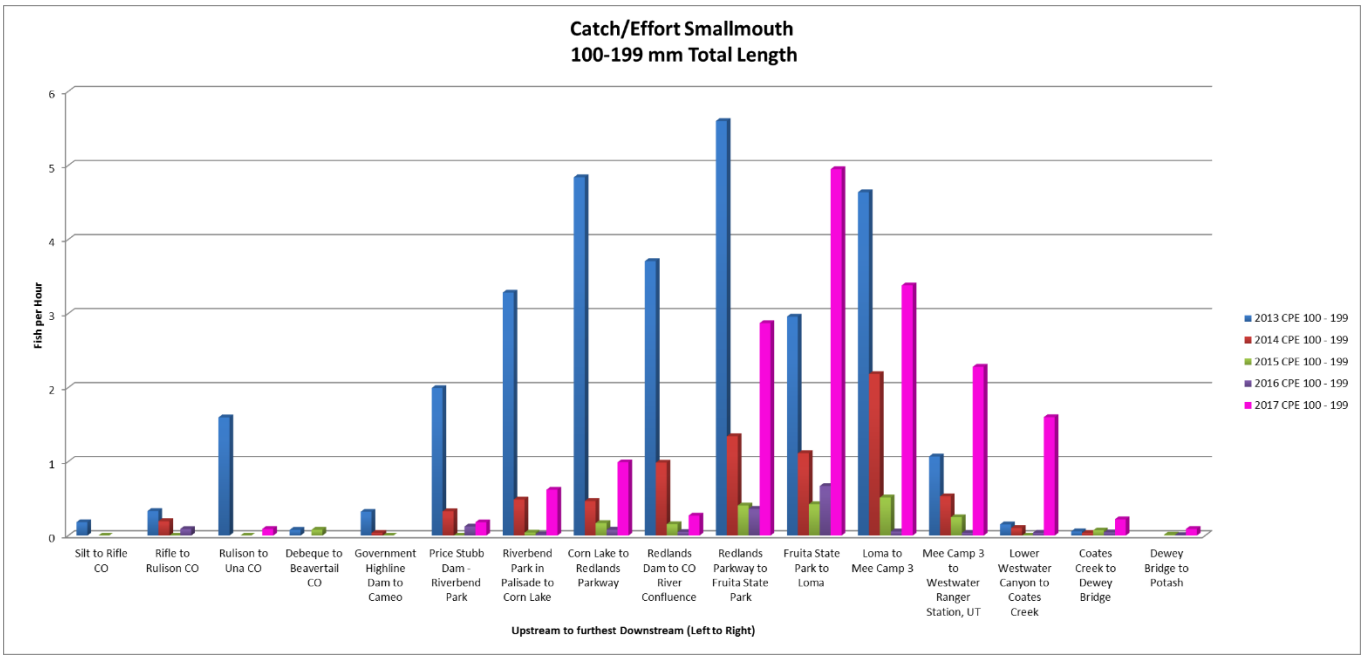


Figure 1. Length frequency histograms for smallmouth bass removed from the Colorado River from Silt, CO to the confluence of the Green River (RMI 0.0), UT from 2012 through 2017.


Catch/Effort Smallmouth
0-99 mm Total Length
Fish per Hour
0
1
2
3
4
5
6
Silt to Rifle CO
Rifle to Rulison CO
Rulison to Una CO
Debeque to Beavertail CO
Government Highline Dam to Cameo
Price Stubb Dam - Riverbend Park
Riverbend Park in Palisade to Corn Lake
Corn Lake to Redlands Parkway
Redlands Dam to CO River Confluence
Redlands Parkway to Fruita State Park
Fruita State Park to Loma
Loma to Mee Camp 3
Mee Camp 3 to Westwater Ranger Station, UT
Lower Westwater Canyon to Coates Creek
Coates Creek to Dewey Bridge
Dewey Bridge to Potash
Upstream to furthest Downstream (Left to Right)
2013 CPE 0-99
2014 CPE 0-99
2015 CPE 0-99
2016 CPE 0-99
2017 CPE 0-99


Catch/Effort Smallmouth
100-199 mm Total Length
Fish per Hour
0
1
2
3
4
5
6
Silt to Rifle CO
Rifle to Rulison CO
Rulison to Una CO
Debeque to Beavertail CO
Government Highline Dam to Cameo
Price Stubb Dam - Riverbend Park
Riverbend Park in Palisade to Corn Lake
Corn Lake to Redlands Parkway
Redlands Dam to CO River Confluence
Redlands Parkway to Fruita State Park
Fruita State Park to Loma
Loma to Mee Camp 3
Mee Camp 3 to Westwater Ranger Station, UT
Lower Westwater Canyon to Coates Creek
Coates Creek to Dewey Bridge
Dewey Bridge to Potash
Upstream to furthest Downstream (Left to Right)
2013 CPE 100 - 199
2014 CPE 100 - 199
2015 CPE 100 - 199
2016 CPE 100 - 199
2017 CPE 100 - 199

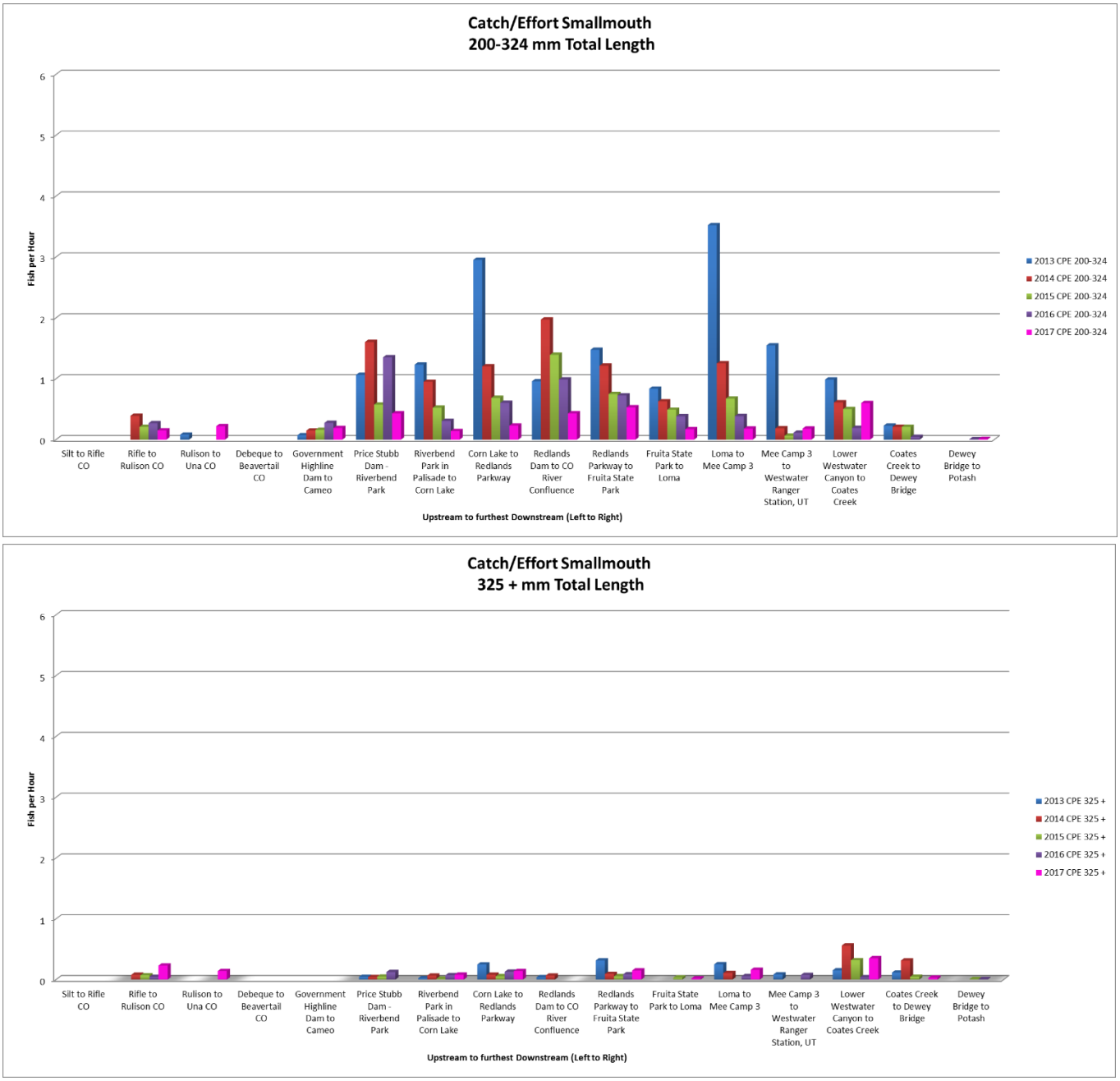


Figure 2. Catch/Effort (number of fish caught per hour electrofishing) by reach for smallmouth bass removed from the Colorado River from Silt, CO (RMI 248.0) to Potash, UT (RMI 47.2), UT during 2017. Smallmouth less than 100 mm are young-of-year, 100-199 mm are juvenile fish, > 200 mm are adults, and >325 mm are 'piscivorous'.

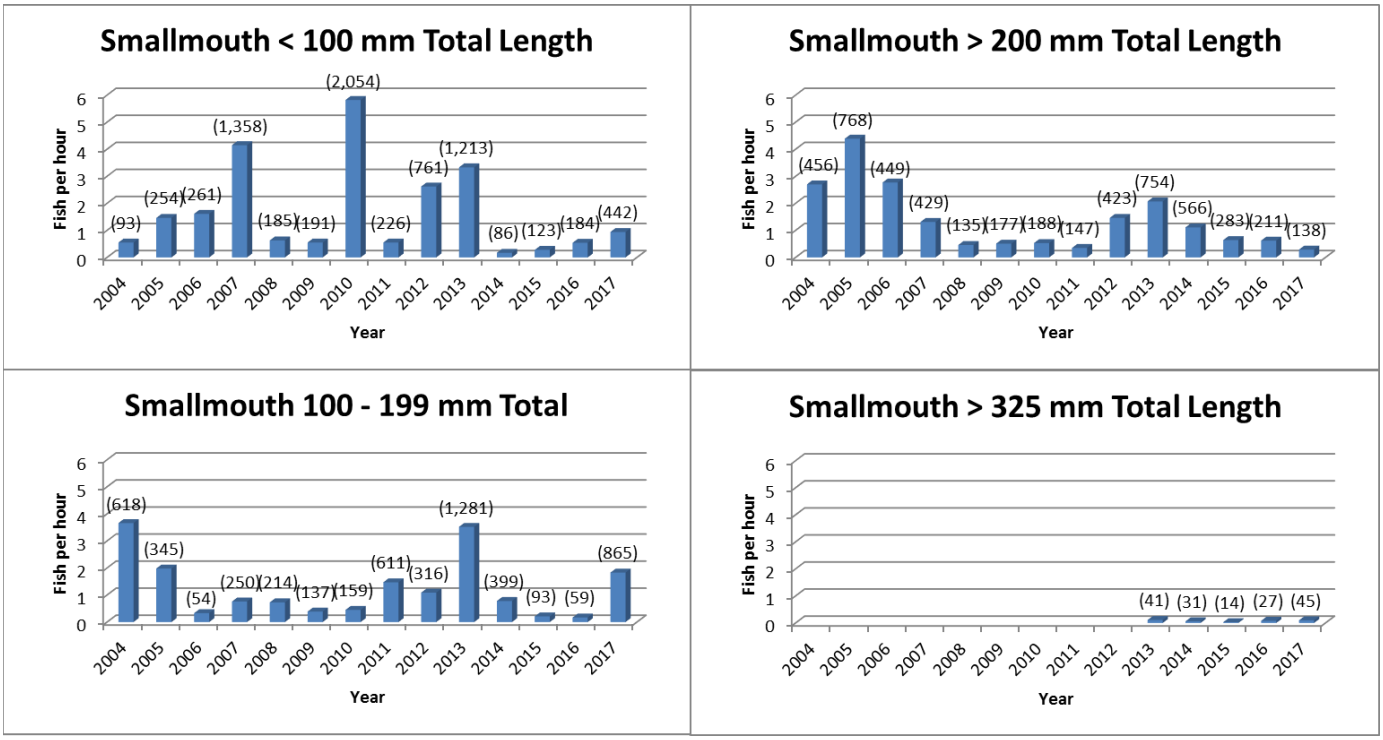


Figure 3. Catch/Effort (number of fish caught per hour electrofishing) by year for smallmouth bass removed from the Colorado River from Government Highline Dam, CO (RMI 193.7) to Loma, CO (RMI 152.6) and Lower Westwater Canyon (RMI 113.0) to Potash, UT (RMI 47.2) from 2004 to 2017. Smallmouth less than 100 mm are young-of-year, 100-199 mm are juvenile fish, > 200 mm are adults, and > 325 mm are 'piscivorous'. Ruby Horsethief Canyon data can be seen in Figure 6.

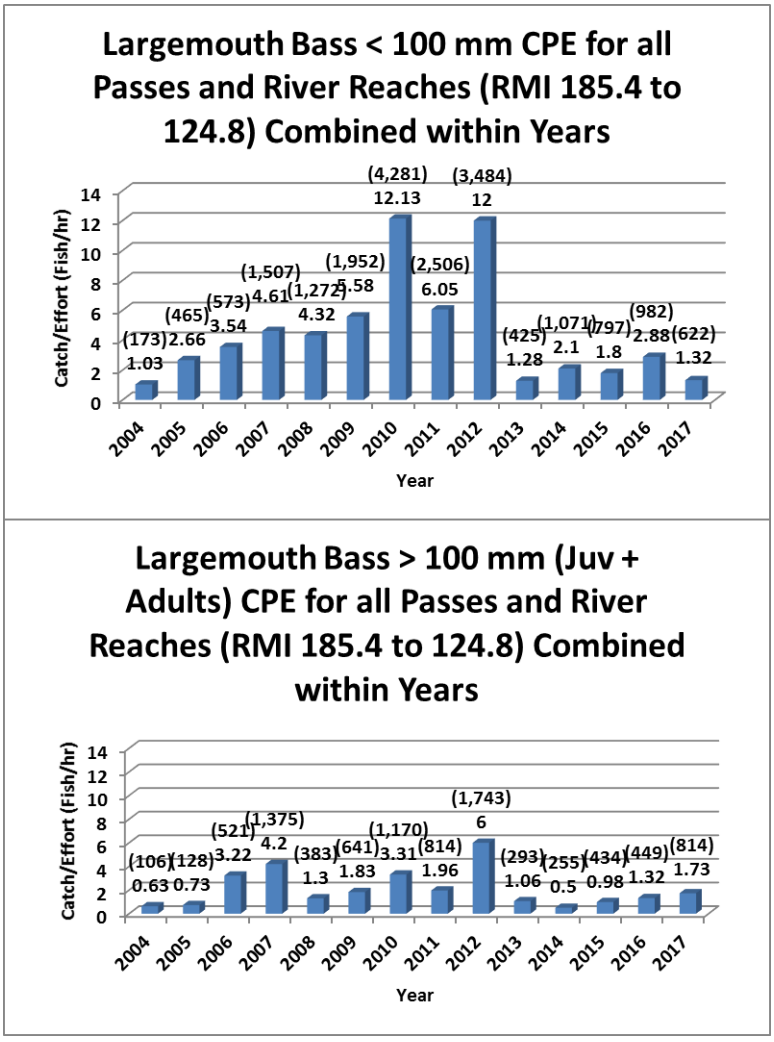


Figure 4. Fouteen year comparison of catch/effort (fish/hr) for largemouth bass (< 100 mm) (upper) and juvenile and adult largemouth bass (≥ 100 mm) (lower), 2004-2017, for the Colorado River (RMI 248 to 47.2). Note: numbers of largemouth bass collected in parentheses.

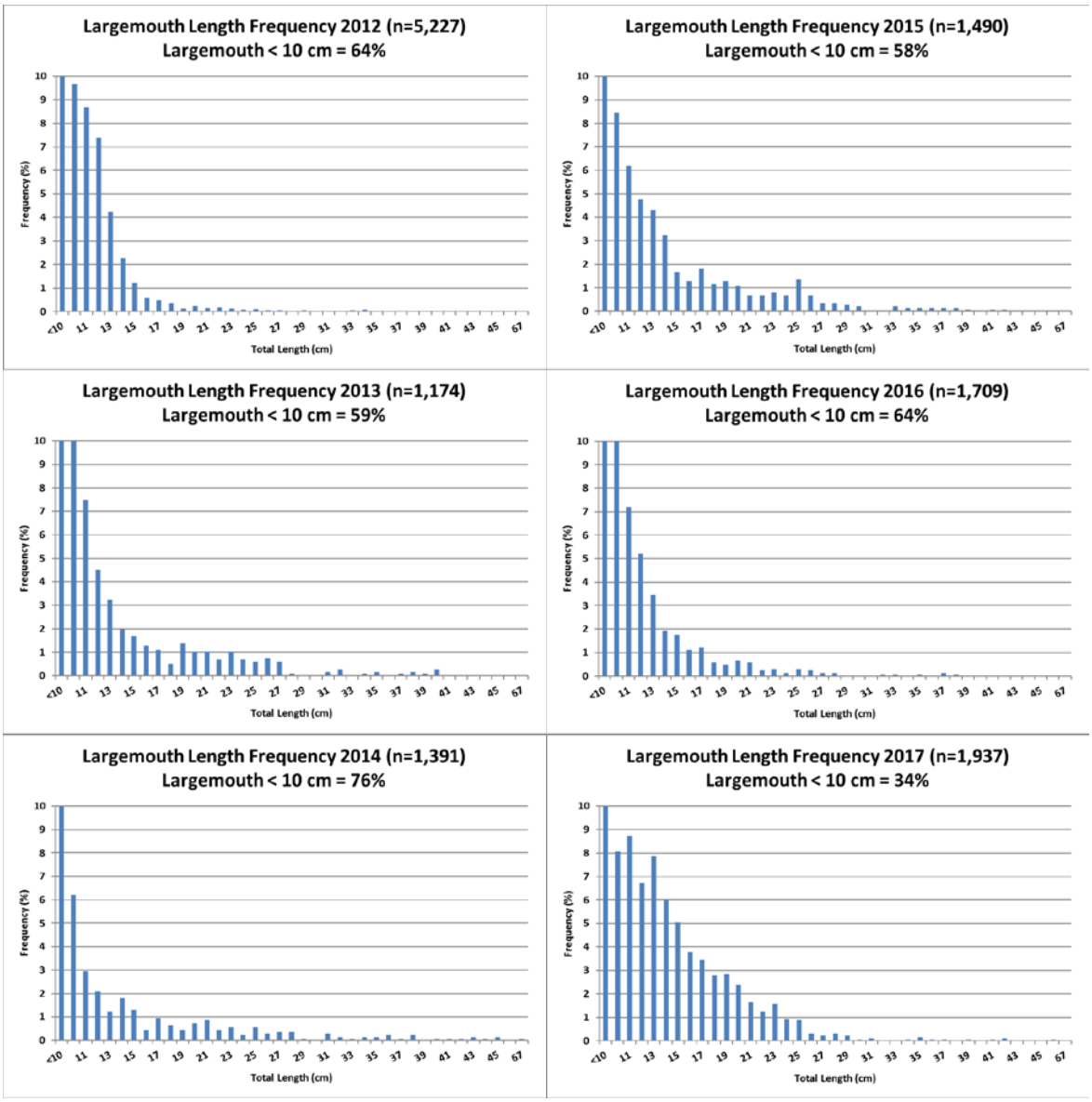


Figure 5. Length frequency histograms for largemouth bass removed from the Colorado River from Silt, CO to the confluence of the Green River (RMI 0.0), UT from 2012 through 2017.

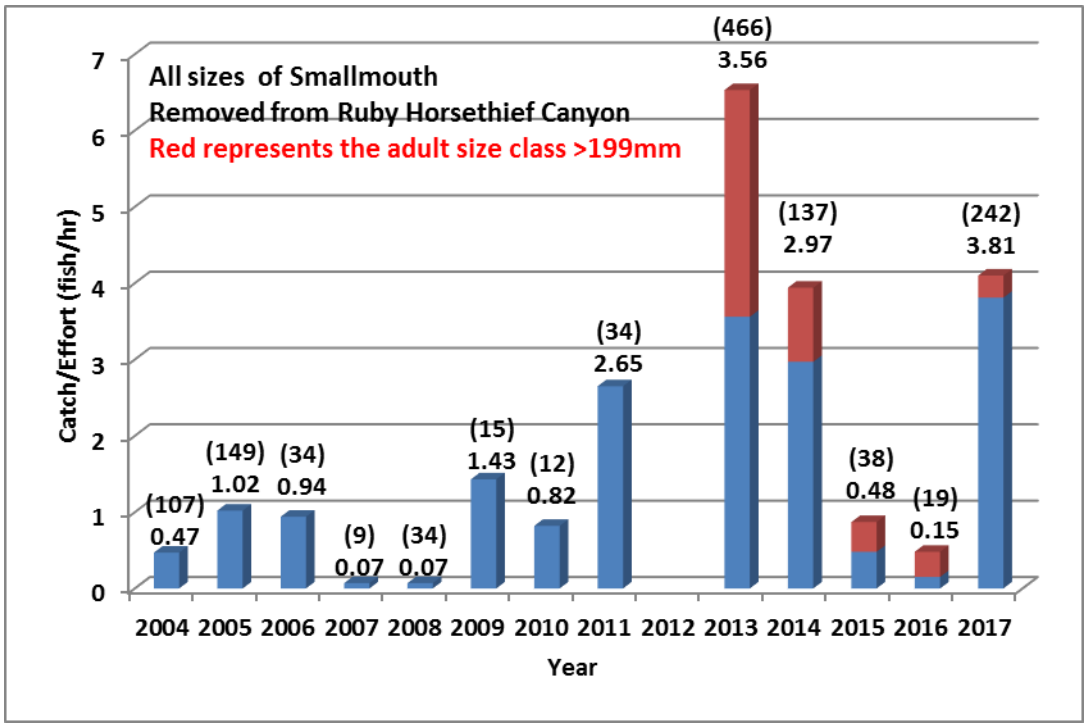


Figure 6. Thirteen year comparison of catch/effort (fish/hr) for young-of-year, juvenile and adult smallmouth bass, 2004-2017, for Ruby Horsethief Canyon of the Upper Colorado River. Note: numbers of smallmouth bass collected in parentheses.

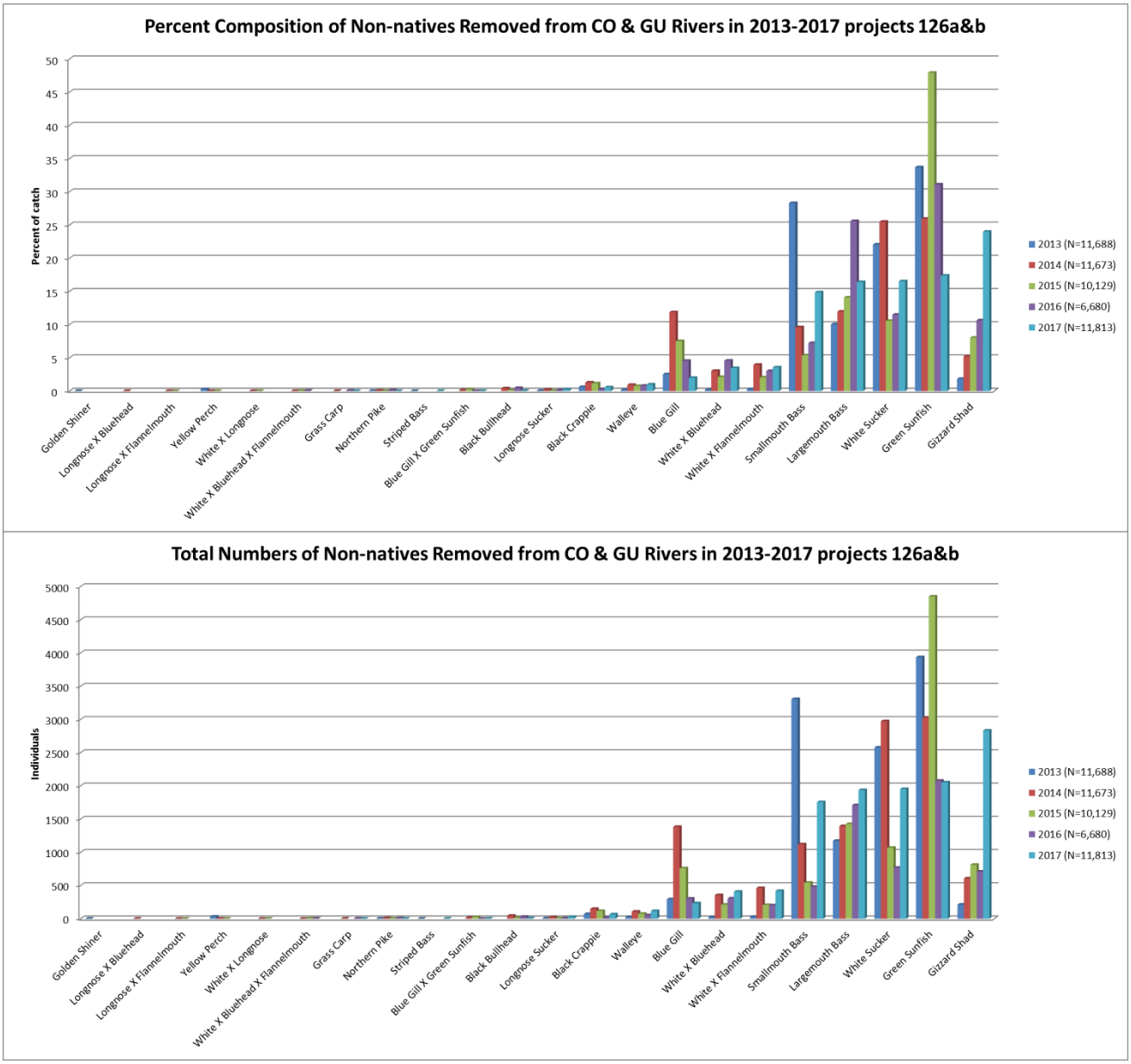


Figure 7. Percent composition and total numbers of nonnative fish removed from the Colorado (river mile 240.7 to 47.2) and Gunnison (river mile 3.0 to 0.0) rivers from 2013 through 2017.

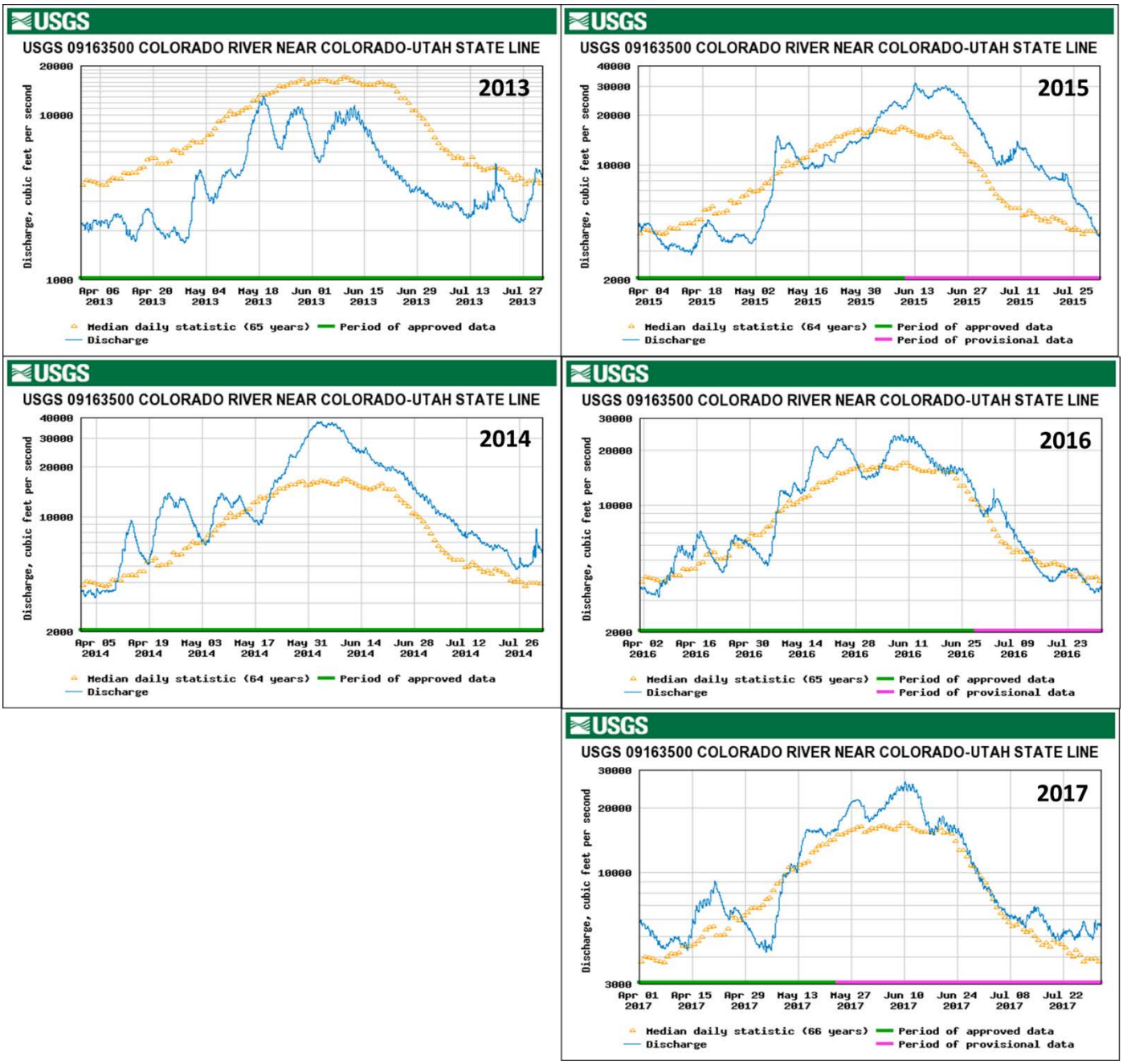


Figure 8. Spring Colorado River discharge as measured at the USGS gauge (09163500) near the CO/UT state-line; 2013-2017. Note: Notice the value change on the Y axis.

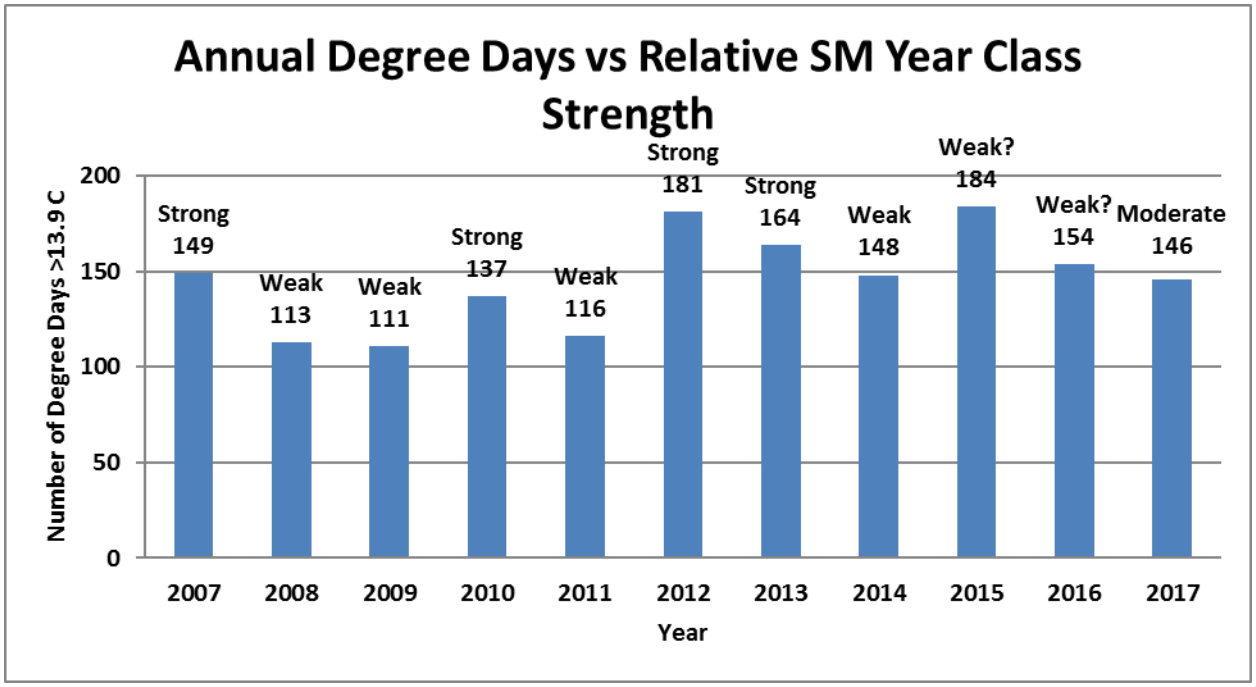


Figure 9. Annual degree days exceeding 13.9° (Celsius) as measured at the USGS 09163500 Colorado River near Colorado- Utah state line gauge.

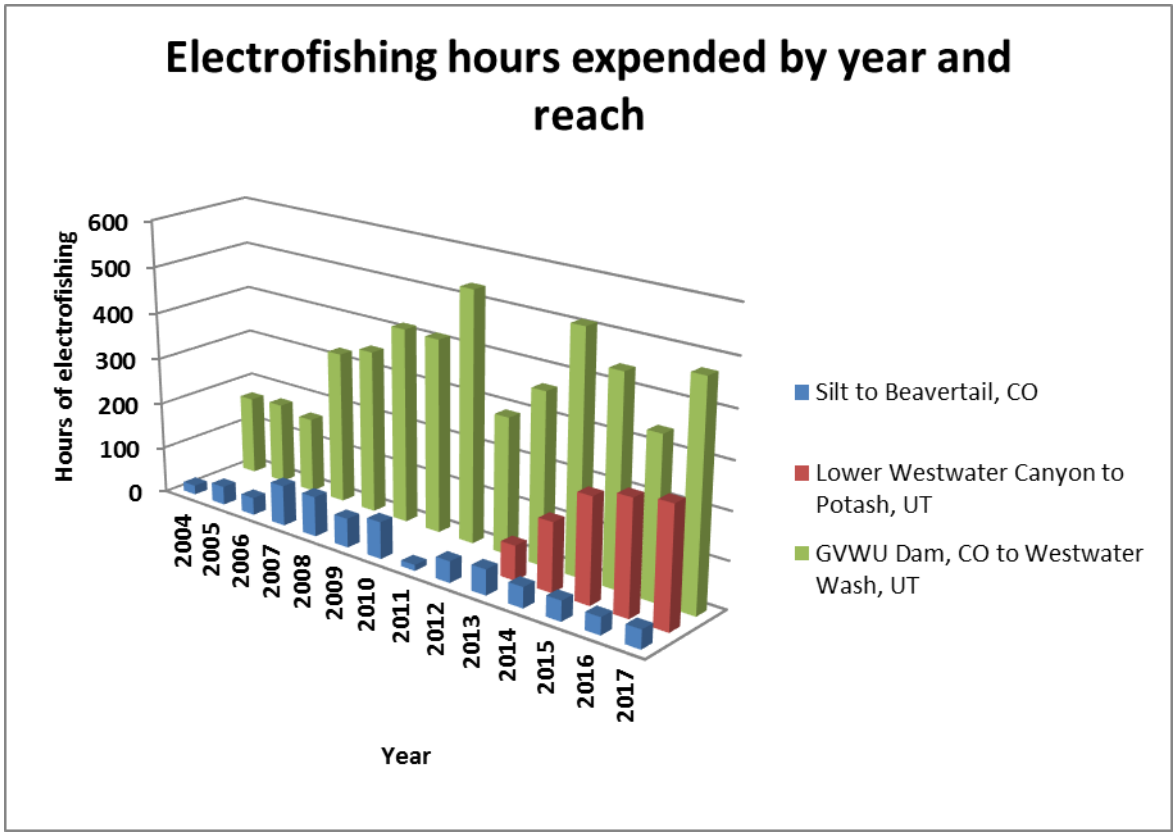


Figure 10. Electrofishing effort for 126a & 126b by year and reach.

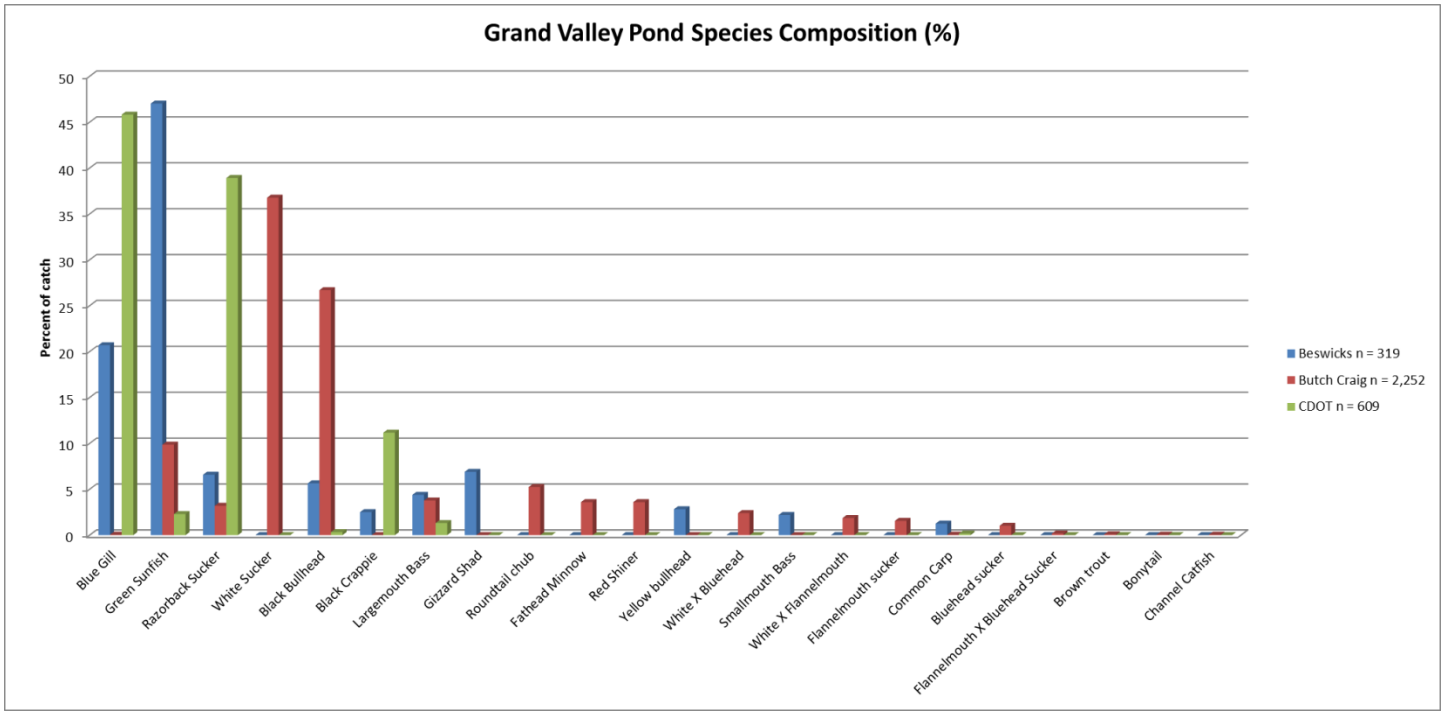


Figure 11. Species composition of fishes handled in Beswicks, Butch Craig and CDOT pond 2017.

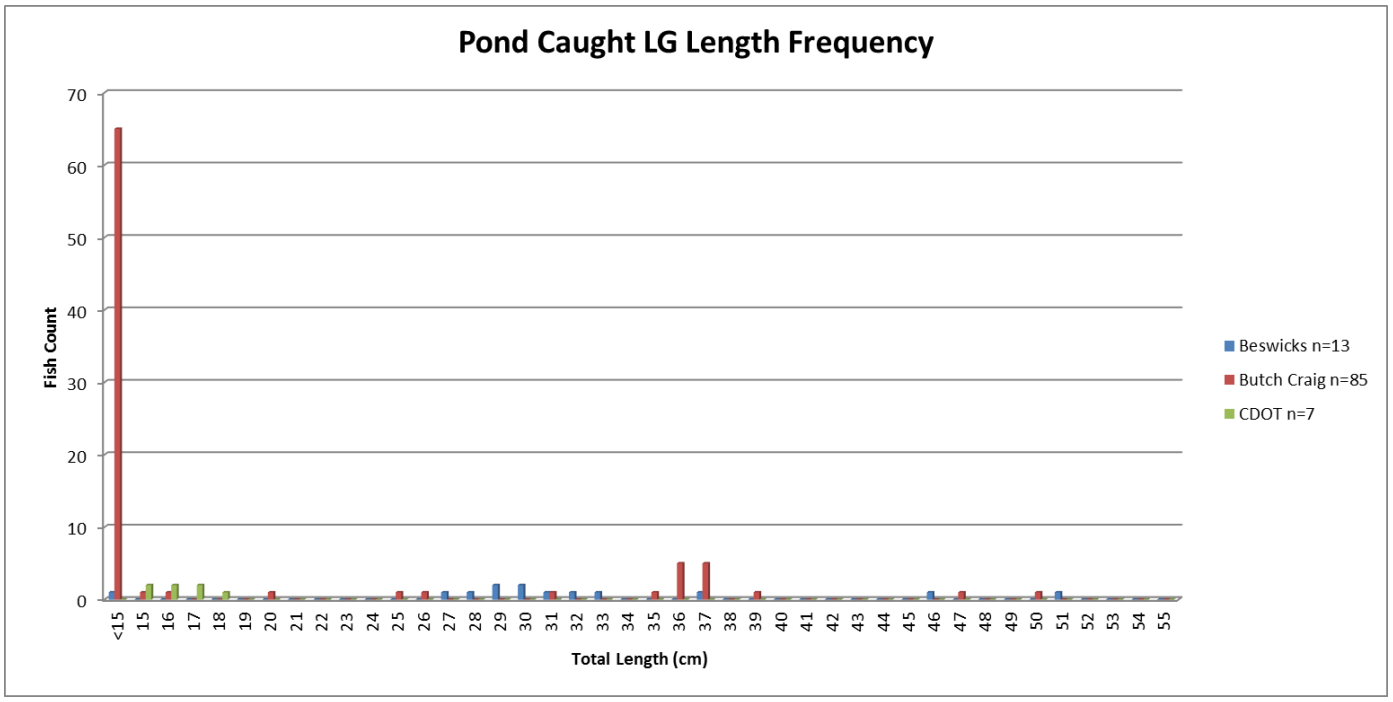


Figure 12. Beswicks, Butch Craig and CDOT ponds largemouth bass length frequency histogram 2017.

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**

Principal Investigator: Ben Felt, Aquatic Biologist

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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, 2017
Is this the final report? Yes _____ No __X__

Performance:

Summary of Colorado Park and Wildlife's Project 126b: Colorado River Non-Native Removal for 2017

- The Colorado River was sampled between Silt (RM 248.0) and the town of Debeque (RM 209.7) by CPW crews as part of Project 126b. Debeque (RM 209.7) to Beaver Tail (195.8) was omitted in 2017 in favor of sampling two reaches (Silt to Rifle and Parachute to Debeque) that had been omitted the previous year due to low flow conditions. 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 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 2017, non-native catostomids and hybrid catostomids were removed opportunistically. Otoliths will be extracted from the Northern Pike captured to assist in determination of fish origination.

- One electrofishing pass was completed from Silt (RM 248.0) to Debeque (RM 209.7), where the main channel and backwaters were electrofished. Additional efforts were expended in 4 backwaters downstream of Rifle utilizing block and shock tactics. A backwater at RM 236.6 has been identified as a concentration area and was electrofished on 3 occasions. Block nets were deployed during all 3 electrofishing events. All Northern Pike were captured within this single backwater for the 2nd year in a row. In general, Black Bullheads and most centrarchids were captured within backwater, slackwater, and eddy habitats.

- Slightly more total effort was expended in 2017 than 2016. Overall catch rates for centrarchids decreased in 2017 to 12.36 fish/hour from 18.24 fish/hour in 2016. The back water at RM 236.6 also experienced a decreased catch rate from 94.95 fish/hour in 2016 to 56.67 fish/hour in 2017. Total number of fish and catch rates decreased for Green Sunfish, Bluegill and Northern Pike. Smallmouth Bass catch rates were similar to 2016. However, Largemouth Bass catch rates and total numbers removed increased in 2017. 34% of the Largemouth Bass removed in 2017 came from the 2 reaches that had not been sampled in 2016. However, only 1 Smallmouth Bass was captured within these 2 reaches. The remaining 10 Smallmouth Bass were captured between Rifle and Parachute.

- We recommend expending similar effort in 2018 and continuing to use block and shock methods for backwaters and known concentration areas.

- 34 Razorback Suckers were captured, checked for pit tags, measured and released. Information will be submitted to the STreaMS database.

- Total Number of Fish Removed = 876 (386 of these fish were removed from a backwater at RM 236.6)
  Total Number of Black Bullhead = 4 (Total length ranged from 193 mm- 262 mm)
  Total Number of Bluegill= 3 (Total length ranged from 90 mm- 96 mm)
  Total Number of Green Sunfish = 318 (Total length ranged from 29 mm-170 mm);
  254 $\leq$ 100 mm; 59 fish > 100 mm and <150 mm; 5 fish $\geq$ = 150 mm
  Total Number of Largemouth Bass = 164 (Total length ranged from 42 mm- 421 mm);
  100 fish $\leq$ 100 mm; 42 fish > 100 mm and < 150mm; 22 fish $\geq$ 150 mm
  Total Number of Northern Pike = 2 (Total length = 758 mm & 950 mm)
  Total Number of Smallmouth Bass = 11 (Total length ranged from 120 mm-496 mm);
  0 fish $\leq$ 100 mm; 1 fish > 100 mm and <150 mm; 10 fish $\geq$ = 150 mm
  Total Number of Non-native sucker/hybrid sucker= 374 (Total Length ranged 68 mm- 495 mm)

- Total Electrofishing Effort Expended = 40.13 hours
  (5.17 hours expended in backwater at RM236.6)

- Centrarchid CPUE = 12.36 fish/hour (56.67 fish/hour within RM 236.6 backwater, n=293);
  -Green Sunfish = 7.92 fish/hour (41.20 fish/hour within RM 236.6 backwater, n=213)
  -Largemouth Bass = 4.09 fish/hour (14.13 fish/hour within RM 236.6 backwater, n=74)
  -Bluegill= 0.07 fish/hour (.39 fish/hour within RM 236.6 backwater, n=2)
  -Smallmouth Bass = 0.27 fish/hour (0.77 fish/hour within RM 236.6 backwater, n=4)

- Northern Pike CPUE = 0.05 fish/hour
  (Northern Pike CPUE= 0.39 fish/hour for RM 236.6 backwater, n=2)

Summary of CPW's Project 126b: 2017 Mamm Creek Pits Non-Native Removal

Mamm Creek Pit #1

- The 37 surface acre Mamm Creek Pit #1 was surveyed by CPW crews using both active (16' hard bottom jet boats equipped with ETS electrofishing gear) as well as passive (gill nets and Merwin trap) sampling gears. A combination of standard mesh (1.25"to 1.5" bar length) and experimental mesh gill nets were utilized throughout the project, typically for overnight sets. A Merwin trap (large trap typically used to collect kokanee salmon during the spawning season in Colorado) was deployed in the pond on March 22 in the spawning shallows in the eastern side of the pond. The trap was moved from the east end of the pond to the downstream breach (outlet) on May 15 to preclude non-native fishes from escaping the pond and entering the Colorado River during run-off. This trap passively caught fish until it was removed from the pond on June 26. CPW crews visited the pond on 22 occasions between March 13 and June 26. Fish captured were measured for length to the nearest millimeter and were weighed to the nearest gram. Non-native, non-salmonid fish captured were lethally removed.

- Peak flows in the Colorado River were fairly low in 2017; as a result, the Colorado River did not appear to breach the pond which resulted in little or no connection between the pond and the river through either the upstream or downstream breach. Despite this apparent lack of connectivity, the Merwin trap was deployed at the downstream breach during high flows to ensure the vast majority of fish were prevented from leaving the pond if a connection between the pond and river were to occur. In addition to blocking the outlet breach, the Merwin trap also served to passively remove non-native fish from the pond during the three months in which it was deployed. The Merwin trap was professionally repaired prior to deployment in 2017; these repairs held up well so the Merwin trap will not need professional repairs prior to deployment in 2018.

- CPW recommends that we continue the annual removal efforts on Mamm Creek Pit #1 using approximately the same methods and effort as in previous years. Gill net sets should continue to consist mostly of overnight sets when feasible as overnight sets early in the year were responsible for the majority of the removals in 2017.

- Total number of fish removed = 1,616 fish
  Total number of common carp = 1,040 (total length ranged from 30mm-753mm)
  Total number of green sunfish = 76 (total length ranged from 53mm-135mm)
  Total number of largemouth bass = 172 (total length ranged from 45mm-273mm):
  168 fish ≤ 100mm
  0 fish > 100mm and ≤ 200mm
  4 fish > 200mm and ≤ 300mm
  Total number of northern pike = 306 (total length ranged from 316mm-795mm):
  0 fish <200mm
  22 fish ≥ 200mm and < 400mm
  33 fish ≥ 400mm and < 500mm
  203 fish ≥ 500mm and < 600mm
  44 fish ≥ 600mm and < 700mm
  4 fish ≥ 700mm and < 800mm
  0 fish ≥ 800mm
  Total number of yellow perch = 20 (total length ranged from 54mm-281mm)
  Total number of white sucker = 1 (total length = 379mm)

- Total effort expended (electrofishing = 1.9 hours; gill net sets = 1820.1 hours; Merwin trap set = 2298.1 hours) = **4120.1 hours**

- Centrarchid (green sunfish and largemouth bass, combined) CPUE:
  All methods combined = 0.06 fish/hour
  Electrofishing = 9.56 fish/hour
  Gill nets = < 0.01 fish/hour
  Merwin trap = 0.10 fish/hour

  - Green sunfish CPUE:
    Electrofishing = 5.31 fish/hour
    Gill nets = < 0.01 fish/hour
    Merwin trap = 0.03 fish/hour

  - Largemouth bass CPUE:
    Electrofishing = 4.25 fish/hour
    Gill nets = < 0.01 fish/hour
    Merwin trap = 0.07 fish/hour

- Northern pike CPUE:
  All methods combined = 0.07 fish/hour
  Electrofishing = 2.12 fish/hour

Gill nets = 0.16 fish/hour
Merwin trap = < 0.01 fish/hour

- Common carp CPUE:
  Electrofishing = 0.53 fish/hour
  Gill nets = < 0.01 fish/hour
  Merwin trap = 0.45 fish/hour

- Yellow perch CPUE:
  Electrofishing = 0.53 fish/hour
  Gill nets = < 0.01 fish/hour
  Merwin trap = < 0.01 fish/hour

- White sucker CPUE:
  Electrofishing = 0 fish/hour
  Gill nets = 0 fish/hour
  Merwin trap = < 0.01 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. Northern pike were first found in Mamm Creek Pit #2 in 2016. Prior to the 2016 survey, northern pike were suspected to potentially be in Mamm Creek Pit #2 because of its connection with Mamm Creek Pit #1 during high flows in 2011. In 2017, Mamm Creek Pit #2 was surveyed five times using 3-4 overnight gill net sets between March 28 and May 31. The purpose of the increased effort in Mamm Creek Pit #2 relative to efforts in 2016 was to more fully understand the species composition within the pond and evaluate reproduction and recruitment of northern pike. Despite the increased effort in 2017, only one large (1000 mm) northern pike was surveyed which suggests northern pike have not successfully reproduced in the pond and that the small number of northern pike found in 2016 and 2017 are likely fish that moved into the pond from Mamm Creek Pit #1 during high flows in 2011.

- CPW recommends that we continue to monitor Mamm Creek Pit #2 in a reduced manner annually using an overnight set of 3-4 gill nets. This proposed reduction in effort moving forward is in response to the data gathered in 2017 which show a very low density of northern pike in the pond as well as the lack of successful reproduction and recruitment. Removal efforts will be increased if future data provide evidence for increases in northern pike densities or if juvenile northern pike are surveyed.

- Total number of fish removed = 167 fish
  Total number of black bullhead = 5 (total length ranged from 279mm - 328mm)
  Total number of common carp = 9 (total length ranged from 412mm – 699mm)
  Total number of largemouth bass = 21 (total length ranged from 280mm - 415mm)
    0 fish > 100mm and ≤ 200mm
    3 fish > 200mm and ≤ 300mm
    17 fish > 300mm and ≤ 400mm
    1 fish > 400mm and ≤ 500mm
    0 fish > 500mm
  Total number of northern pike = 1 (total length = 1000 mm)
  Total number of green sunfish = 8 (total length ranged from 77mm – 260mm)
  Total number of white sucker = 123 (total length ranged from 302mm – 397mm)

- Total effort expended (all gill netting): **495.35 hours**.

- Gill net CPUE:
  Black bullhead: 0.01 fish/hour
  Common carp: 0.02 fish/hour
  Largemouth bass: 0.04 fish/hour
  Northern pike: < 0.01 fish/hour
  White sucker: 0.25 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. Northern pike were first found in Mamm Creek Pit #3 in 2016. Prior to the 2016 survey, northern pike were suspected to potentially be in Mamm Creek Pit #3 because of its connection with Mamm Creek Pit #1 during high flows in 2011. In 2017, Mamm Creek Pit #3 was surveyed five times using 3-5 overnight gill net sets between April 4 and May 31. The purpose of the increased effort in Mamm Creek Pit #3 relative to efforts in 2016 was to more fully understand the species composition within the pond and evaluate reproduction and recruitment of northern pike. Despite the increased effort in 2017, only one large (980 mm) northern pike was surveyed which suggests northern pike have not successfully reproduced in the pit and that the small number of northern pike found in 2016 and 2017 are likely fish that moved into the pond from Mamm Creek Pit #1 during high flows in 2011.

- CPW recommends that we continue to monitor Mamm Creek Pit #3 in a reduced manner annually using an overnight set of 3-4 gill nets. This proposed reduction in effort moving forward is in response to the data gathered in 2017 which show a very low density of northern pike in the pond as well as the lack of successful reproduction and recruitment. Removal efforts will be increased if future data provide evidence for increases in northern pike densities or if juvenile northern pike are surveyed.

- Total number of fish removed = 105 fish
  Total number of common carp = 2 (total length ranged from 666mm - 767mm)
  Total number of largemouth bass = 44 (total length ranged from 232mm - 453mm)
    0 fish ≤ 200 mm
    3 fish > 200mm and ≤ 300mm
    37 fish > 300mm and ≤ 400mm
    4 fish > 400mm and ≤ 500mm
  Total number of northern pike = 1 (total Length = 980mm)
  Total number of green sunfish = 1 (total length = 252mm)
  Total number of white sucker = 49 (total length ranged from 340mm - 765mm)
  Total number of yellow perch = 7 (total length ranged from 97mm - 282mm)

- Total effort expended (all gill netting): **501.41 hours**.

- Gill net CPUE:
  Common carp: < 0.01 fish/hour
  Largemouth bass: 0.09 fish/hour
  Northern pike: < 0.01 fish/hour
  Green sunfish: < 0.01 fish/hour
  White sucker: 0.10 fish/hour
  Yellow perch: 0.01 fish/hour

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.**

Principal Investigator: Christopher Michaud, Fish Biologist
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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 Green River:
Twenty-five hours of electrofishing effort, targeting walleye on the lower Green River, was completed between 8 March and 13 October, 2017. All effort was focused on high value walleye habitat between Tusher diversion and Green River State Park (RM128-120). A total of 32 walleye were removed from the Green River (CPUE=1.28) in 2017.

Walleye removal on the Colorado River:
Utah Division of Wildlife Resources crews completed seven hours of targeted walleye sampling on the Colorado River between Big Hole and Cisco boat ramp (RM 115.8-110.5) in 2017. Targeted walleye removal began on 4 October and concluded on 12 October, 2017. Nineteen walleye were encountered over the sampling period (CPUE=2.7). Other notable encounters include 35 smallmouth bass (CPUE=4.96) and 37 gizzard shad (CPUE=5.25).

All 2017 work was completed under Tasks 4, 5 and 6 of the FY17 123a Scope of Work. Future work will be completed under the 123d Scope of Work.