COLORADO RIVER RECOVERY PROGRAM
FY 2013 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 126a & 126b

I. Project Title: **Removal of Smallmouth Bass in the Upper Colorado River between Price-Stubb Dam near Palisade, Colorado, and Westwater, Utah.**

II. Bureau of Reclamation Agreement Number(s): R11PG40024 and R13PG40018

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IV. Abstract: The purpose of this study is to remove as many non-native 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 tenth year of this study, which started in 2004.

During 2013, six removal passes were completed from the GVWU dam at river mile (RMI) 193.7 downstream to Loma launch (RMI 152.6); 3 removal passes were completed between Loma (RMI 152.6) and Westwater (RMI 127.6); Colorado Parks and Wildlife (CPW) performed 2 passes in the 45-mile reach between Rifle (RMI 240.7) and Beavertail Mountain (RMI 195.7).

Due to increased numbers of non-native piscivores collected during spring Colorado pikeminnow sampling, the decision was made to also do 2 removal passes from Cisco (RMI 111.0) downstream to Dewey Bridge (RMI 94.6) and 1 removal pass from Dewey Bridge (RMI 94.6) downstream to Potash (RMI 47.2), all in UT.

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 2013 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1. Remove all sizes of smallmouth bass, other centrarchids, and other non-native species as deemed appropriate and described in state (Colorado and Utah) collection permits.

Task completed. In 2013, the marking pass was eliminated; therefore, no abundance estimates will be calculated. The FY 2013 scope of work called for increasing the number of passes from 6 to 8 in the Grand Valley; however, large numbers (n=259) of walleye captured during our spring Colorado pikeminnow collections in lower reaches of the Colorado River (RMI 111.0 to 0.0) warranted additional investigation in these reaches during the summer and fall. To complete these trips in other areas of the river, we reduced the amount of removal passes in the Grand Valley to 6 complete passes.

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

Task completed. Preparation of the annual report also sufficed for the December 2013 nonnative fish workshop.

B. Findings (2013 Highlights)

General

Study Direction. From 2004 to 2011, the study area encompassed a 61-mile section of the Colorado River in western Colorado from the Price-Stubb Dam to the Westwater, UT BLM River Ranger Station, and a 2.3-mile section of the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence. For 2013, the study area was lengthened 69.2 miles including river segments from GVWU dam (RMI 193.7) to Price-Stubb Dam (RMI 188.3) and Cisco boat launch, UT (RMI 111.0) to Potash boat launch, UT (RMI 47.2).

In 2012 and 2013, study direction was further modified. Colorado Parks and Wildlife (CPW) personnel performed all of the work in the upstream portion of the river from Silt downstream to Beavertail Mountain Tunnel (52.3 miles), in CO.

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

Methodology

General

In 2013, six removal passes were made using raft-based electrofishing to collect non-native fishes in the Grand Valley from 9 July to 26 September. Three removal passes (8-9 August, 28-29 August, and 4-5 September) were completed between Loma, CO and Westwater Ranger Station, UT. Two removal passes (22-23 July and 9-10 October) were completed between Cisco, UT and Dewey Bridge, UT. One removal pass (15-19 July) was completed in the reach between Dewey Bridge, UT and Potash, UT. Two electrofishing craft were used in every river segment during the removal passes.

During 2004, 2005, and 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 this 45-mile reach was reduced from three to one. Moreover, 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 in 2013, CPW conducted all of the removal (2 electrofishing passes) from Silt to Beavertail Mountain. However, CPW crews were not able to sample the Colorado River from Parachute (RM 223.0) to Debeque (RM 209.7) due to access issues and a dangerous river diversion (Bluestone Ditch) upstream of Debeque. This work was completed sporadically from 8 April to 3 October.

Although smallmouth bass were the target fish for removal in this project, all other centrarchid fishes encountered were collected and removed. These fishes included largemouth bass, green sunfish, bluegill, and black crappie. All gizzard shad, walleye, perch, and northern pike encountered were also collected and removed. For the first time in 2013, the majority of white sucker and white sucker x native sucker hybrids encountered were also collected and removed. All fishes removed were frozen and then taken to the Mesa County landfill.

Total length and weight were recorded for each smallmouth bass, largemouth bass, walleye, gizzard shad, and walleye caught, and number of individuals collected was recorded for each species. Capture date and corresponding river mile for each centrarchid fish collected were recorded along with actual time electrofished (seconds; converted to hours fished).

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, catch/effort 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 Non-native Workshop that CPE will suffice as an index of population size during most years (starting in 2013), and that during an as yet to be determined interval (e.g. every third 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 and released and a population estimate was not possible. For those years' data, effort was recorded, catch/effort 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. Because population estimates for smallmouth bass were not available for 2004, 2005, and now 2013, effort was still recorded during 2006-2012 and catch/effort was computed for use as a trend to compare annual abundance of smallmouth bass and other centrarchids during 2004-2013. Where abundance estimates were not performed for a population statistic, catch/effort was a useful metric in comparing relative abundance and interpreting year class strengths among years, particularly for juvenile smallmouth and largemouth bass (< 100 mm).

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 2013. Removal passes performed by the CPW in the Upper Colorado River between Silt and Beavertail Mountain are also reported here. Data are presented for main channel habitats only. This includes backwaters that are hydrologically connected to the mainstem river. Integration and comparison of results from earlier years (2004-2012) of this study are provided where appropriate.

Size Distribution–Length Frequency.

Smallmouth Bass

Length frequency distribution of all sizes of smallmouth bass collected with electrofishing during 2013 between Rifle, CO and Potash, UT were plotted (Figure 1). All age groups of smallmouth bass (age-0, juveniles, and adults) were present in the 2013 summer collections (Figure 1). These ranged from age-0 (40 mm) to adult (432 mm) fish with a mean of 179 mm. A total of 3,306 smallmouth bass were removed, including 57 considered 'piscivores[1]' (≥325mm). A strong year class of smallmouth bass (< 100 mm) was produced in 2013 in the Grand Valley reaches of the Upper Colorado, similar to the 2010 year class (Figure 3). However, an early spawn must have occurred because these fish were being collected as early as 15 July 2013.

In 2009, age-0 smallmouth bass were first detected in the Grand Valley reaches starting in mid-August (39 mm total length). Length frequency comparison between 2008 (see 2008 annual report no. 126(a)) and 2009 suggest that the 2009 year class may be stronger than 2008. However, overall catch rates for juvenile smallmouth bass (< 100 mm) in the Grand Valley sections of the Upper Colorado and Lower Gunnison rivers are almost identical during these two years (Figure 4).

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=5.82 fish/hr, n=2,054) exceeded catches during the 2007 removal passes (C/E=4.15 fish/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. During the 2010 marking pass in the Grand Valley reaches, age-0 smallmouth bass were first detected during the last week of July (31mm) (Figure 2).

In 2011, the catch rate for juvenile size fish < 100 mm declined precipitously (91%) from 2010 from 5.82 fish/hr to 0.55 fish/hr, similar to catch rates during 2004 and 2009 (Figure 3). The hypothesized reason for this decline was the prolonged large (magnitude) discharge from the 2011 spring runoff. Elevated discharge extended into July, which delayed the warming of river waters. Decreased and prolonged cooler river temperature may have resulted in smallmouth bass delaying spawning, larvae hatching later, 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 lead to a shorter growing season and a weak year class of smallmouth bass in 2011.

[1] fish representing a competitive threat to adult Colorado pikeminnow based on bioenergetics

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 aided in 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 some river segments (15-mile reach [GVIC Diversion Dam to the Colorado/Gunnison River confluence], 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 cannot be proven if 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 (<50mm or <100mm) 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 4). Except for the 2007 and 2010 year classes, young smallmouth bass (<100mm) have proven to be highly susceptible to low survival to age-1. The strong 2012 year class (age-0) coupled with the strong 2013 year class (age-0) may have produced enough individuals to provide concern as to how many may survive to age-1 and age-2.

Largemouth Bass

A total of 1,174 largemouth bass were removed from all reaches, in 2013, a substantial decrease from 2012's catch (n = 5,227, Table 2). Our catch ranged from age-0 fish (20 mm) to adult fish (400 mm) with a mean of 111 mm (Figure 2). Less than 1% of our catch (n=10) were of a size > 325 mm. However, our catch was proportionate in size classes to our 2012 catch: 88% (n=1,024) were less than 150 mm, 63% (n=700) were less than 100 mm and only 3% (n=35) were adults greater than 250 mm.

In 2012, a total of 5,299 largemouth bass were collected during the six removal passes. Ninety seven percent (n=5,080) of these fish were less than 150 mm; and 67% (n=3,484) were less than 100 mm. Only 0.07% (n=32) of the total number of largemouth bass were greater than 250 mm. This suggests that survival of juvenile largemouth bass to adults in the river to sizes as large as 325 mm TL is relatively low due to the very low, based on the number of adult fish (i.e., >250 mm) in electrofishing collections vs. the high number of juvenile size fish. This would suggest that largemouth bass > 325 mm TL, at their current probable abundance are less likely a competitive threat to Colorado pikeminnow than are other large-bodied nonnative predators within these reaches.

Actual Numbers.

During 2004, 2005, and 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. Therefore, comparing actual numbers of fish removed per pass or by combining passes and river reaches with the earlier sampling years is not warranted. Actual numbers of smallmouth bass removed are provided among the various figures and tables by major river section and year in the attached appendices.

There is one location that could be consistently used to compare total number of fish captured to establish annual trends. This is the fish trap at the Redlands Diversion Dam fish passageway on the Lower Gunnison River. The number of smallmouth bass collected in the fish trap of the Redlands Diversion Dam passageway has been recorded for 18 years. From 1996–2001, only one smallmouth bass was captured. However, 13 were collected in 2002, 6 in 2003, 9 in 2004, and 21 in 2005. Keeping with the pattern of lower smallmouth bass catches in main channel habitats, no smallmouth bass were found in the Redlands fish trap during 2006 or 2007. In 2008, four smallmouth bass were collected in the Redlands fish trap, none in 2009, and three 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 this past year, 2013 (n=22).

Catch/Effort.

General

Mean catch/effort (fish/hr) was computed separately for smallmouth bass and largemouth bass for each of the ten sampling years, 2004-2013 (Tables 1 & 2; Figures 3, 4, 5, and 6). To view the "big picture", for some analyses, river reaches and removal passes were consolidated. Catch rates were computed separately from the Rifle to Beavertail Mountain reaches, the Grand Valley River reaches (Government Highline Dam to Westwater, UT, plus the Lower Gunnison River), and the Cisco to Potash, UT reaches.

Effort Fished

Electrofishing effort in 2004 (168.665 hours) was similar to 2005 (174.560 hours) between Price Stubb Dam and the Westwater, UT, ranger station and the Lower Gunnison River. In 2006, electrofishing effort in these reaches was 161.906 hours. The electrofishing effort increased to 327.101 hours in 2007 because of the addition of four removal passes. The total effort (1 marking and 8 removal passes) during 2008 was 349.889 hours. In 2009, the total effort (1 marking and 8 removal passes) was 416.851 hours. A 3.9-mile reach between Government Highline Dam (GVWU) and the Cameo

XCEL Bridge was added in 2009 which accounts for some of the increased effort in 2009 over earlier years. In 2010, the total effort was (1 marking and 8 removal passes) was 413.555 hours. In 2011, the total effort was (1 marking and 10 removal passes) was 449.934 hours. Effort was decreased in 2012 because low water levels in certain reaches (2.3-mile section of the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence, the additional reach between the Government Highline Dam and the Cameo Bridge, and from Cameo Bridge to GVIC) made them impassible by electrofishing craft. In addition, no passes were conducted from Loma boat landing to Westwater Ranger Station. Three pre-marking passes, one marking pass, and six post-marking passes expended 290.326 hours of electrofishing effort. In 2013, six removal passes between GVWU dam and Loma boat launch and three removal passes from Loma to Westwater Ranger Station expended 364.39 hours of electrofishing effort.

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 and 54.58 hours in 2013, and 10.8 gill net hours in 2012 and 5.2 hours in 2013. The increased effort was in response to the increase in northern pike catch in this reach in 2011.

In response to an elevated catch of walleye (n = 259) by our crews during our spring 2013 Colorado Pikeminnow abundance collections from Cisco, Utah to the confluence of the Green River (see appended summary), 73.6 hours of electrofishing effort was expended experimentally during this project from Cisco to Potash, Utah.

Smallmouth Bass

For the Grand Valley river reaches, the trend for smallmouth bass relative abundance from 2006-2009 was downward. Overall mean catch rate was highest for smallmouth bass juveniles (100-199 mm) and adults (≥ 200 mm) during 2004 (6.37 fish/hr) and 2005 (6.36 fish/hr). However, a 51% decline in catch rate was detected from 2005 to 2006. In 2007, the catch rate dropped even lower to a 4-year low (2.27 fish/hr; 27 % decline from 2006, Figure 3). And again in 2008 and 2009, the overall catch rate continued to decline to 1.19 and 0.9 fish/hr, respectively. This catch effort decline is consistent with the decline observed with the population estimate between 2006 and 2007, and between 2007

and 2008 (Table 3). During 2010, the catch rate for smallmouth bass > 99 mm (0.98 fish/hr) increased slightly from 2009. During 2011 and 2012, another increase in catch per effort occurred from the juvenile and adult size classes to 1.83 and 2.55 fish per hour, respectively. A large recruiting class of smallmouth < 100 mm collected in 2012 represented the third highest catch rate of juvenile and adults, in 2013 (5.57 fish/hr).

During the summer of 2010, for the Grand Valley river reaches, overall mean catch rate for smallmouth bass < 100 mm total length was the highest in this eight-year removal study (5.82 fish/hr). Formerly, 2007 had the highest catch rate (4.15 fish/hr) and the lowest was during 2004 (0.55 fish /hr) (Table 1; Figure 4). 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. Now that the 2012 sampling is complete, from the abundance estimate for juvenile smallmouth bass (100-199 mm), the 2011 cohort apparently survived overwinter. Catch rates for this 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 – 3.52 fish/hr, 2004 3.66 fish/hr; Table 1). The strong year classes produced in 2007, 2010, 2012 and now 2013 may continue to recruit 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 a weak year class was produced in 2008 (0.63 fish/hr) (Table 1; Figure 3) since this study commenced in 2004. The high spring flows during the 2008 runoff 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. From catch/effort comparisons, the 2009 year class (0.55 fish/hr) also appeared similar to 2008.

The hydrologic conditions of 2008, 2009, and 2011 in the Upper Colorado River were similar, 2011 being the most dramatic because of the prolonged high discharge extending into July. These three years have been characterized as average or moderately wet with sustained runoff compared to former years (2003-2007, 2010, and 2012) and 2013 that were dryer with shorter runoff magnitude and duration. The three 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, 2012's catch of juvenile (100-199 mm) smallmouth bass (1.09 fish/hr) suggests 2011's recruitment may have been negatively impacted but a mild winter may have allowed for better survival of the few that were still alive after the high run-off.

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 the 9 July.

Catch rate for all length sizes of smallmouth bass, in the reaches between Rifle and Silt, increased to 0.62 in 2013. This increase follows a drop in mean catch per effort in 2012 (0.09 fish/hr), the lowest value was achieved during 2009 (0.24 fish/hr) compared to 2011 (0.49 fish/hr), 2010 (0.92 fish/hr), 2008 (0.95 fish/hr), 1.04 fish/hr (2007), 2.11 fish/hr (2006), and highest during 2005 (5.75 fish/hr; Table 1). Spawning success in these reaches appears not to be as successful as that 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 or 2011. One age-0 smallmouth bass was collected in 2012 and four were collected in 2013. Only one smallmouth bass (237 mm) was collected between Rifle and Silt at RM 241.2 during 2007 and 2012; none were collected during 2008. Mean catch rates for smallmouth bass < 100 mm was the lowest in 2004 (0.15 fish/hr); the highest was during 2005 (1.46 fish/hr; Table 1). During 2013, the catch rate for smallmouth bass < 100 mm was 0.07 fish/hr.

Catch rates for all length sizes 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 .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 in Ruby Horsethief Canyon at 6.53 fish/hr (Figure 4). Late summer and fall rain events may have washed a portion of this population downstream, or this population may be expanding. In either case, continued effort is necessary in this reach in 2014.

New effort was expended experimentally, in 2013, from Cisco to Potash, Utah. While the primary species being targeted was walleye, juvenile and adult smallmouths were removed from these reaches at a rate of 0.33 fish/hr (Table 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; figure 5). 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. Catch rate increased to 3.31 fish/hr in 2010. Catch rate, however, 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 (in 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 (1.0 fish/hr, n=293; Figure 5).

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 – that a large reduction in production occurred in 2013 largemouth bass < 100 mm (1.45 fish/hr, n= 425; Figure 5). This reduction follows the 2012 (12 fish/hr) year class which has been the second strongest in this ten-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 2011 (Table 2; Figure 5). 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 of 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 migrated 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

(6.9 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 2010 (0.86 fish/hr). In 2007 the catch rate declined to 3.30 fish/hr (Table 2). In 2005, catch effort (0.93 fish/hr) was the second lowest in this eight-year study. 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 (5.4 fish/hr)(Table 2). In 2010, catch rate (0.3 fish/hr) was the second lowest in this eight-year study. In 2011, overall catch rate (all length sizes) was 2.14 fish/hr and 2012 brought a reduction in the catch to 1.27 fish/hr.

New effort was expended experimentally, in 2013, from Cisco to Potash, Utah. While the primary species being targeted was walleye, juvenile and adult largemouths were removed from these reaches at a rate of 0.29 fish/hr (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. During the 2012 non-native 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 non-natives being collected and returned to the river with a mark and to increase removal effort. Therefore, 2013 was a removal year and no abundance estimates were calculated. However, for reference, abundance estimate text and results were included in this report from past years (Table 3).

Smallmouth Bass

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 3). 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 4) 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 5) 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 5) 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 5) 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 4). 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

2012 was the first year attempting at a mark-recapture population estimate for largemouth bass. 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 6).

CPW began, in coordination with the private land owner, an effort to remove non-native fishes from a gravel pit pond between Rifle and Silt, Colorado now referenced as Snyder Pond. While these fish do have opportunities to escape into the river during certain peak flows, they are isolated from the river during lower water years. Therefore, these efforts and results are included in the PPR section at the end of this report. It is possible that the elevated peak flows experienced in 2011, which did connect Snyder Pond with the river, contributed to the increase in catch of northern pike experienced in the main stem in both 2011 and 2012. CPW has had great success, in terms of CPE, removing largemouth bass, northern pike, green sunfish, and yellow perch.

Three adult northern pike were removed by CPW and USFWS crews during these projects in 2013 (Figure 6). Two (TL: 702 mm, 840 mm) were collected in the Grand Valley, and one was collected near Rifle (TL: 744 mm). In addition, six northern pike were removed from the Grand Valley reaches during the spring Colorado pikeminnow

project (n = 5) and from the fish trap at the Grand Valley Water User's Fish Ladder (n = 1). All otoliths have been preserved from these fish for future aging and natal origin microchemistry research. Sixteen adult northern pike were collected by CPW near Rifle (RM 238 – 241.8) in 2012. These fish ranged in total length from 434 mm to 825 mm with a mean total length of 712 mm. Ten adult northern pike were captured in the 2011 centrarchid removal efforts by FWS and CPW. Nine of these fish were collected from the Rifle Bridge to Cottonwood Park boat landing near Parachute in mid-October. Three northern pike were captured immediately underneath the I-70 bridge at RM 238.2; seven northern pike were captured between RM 238.2 and the Rifle Bridge. For reference point, Rifle Creek empties into the Colorado River at RM 239.8. One other northern pike was collected in September between Price-Stubb fishway and GVIC Diversion Dam at Palisade (RMs 187.7-184.9). One other northern pike (680 mm) was captured in the fish trap of the Redlands fishway on the Lower Gunnison River in 2011. All 11 of these fish have been preserved (frozen) for future otolith microchemisty analyses. Such analyses can help in determining their possible origin, i.e., had this fish escaped from off-channel riverine habitats such as isolated gravel pits breached by the 2011 high spring flows and now connected to the mainstem river, escaped from nearby reservoirs, or possibly illicitly translocated.

In response to an elevated catch of walleye (n = 259; Appended summary and photo) by our crews during spring 2013 Colorado Pikeminnow abundance collections from Cisco, Utah to the confluence of the Green River (see appended summary), 73.6 hours of electrofishing effort was expended experimentally during this project from Cisco to Potash, Utah. Our first opportunity to work in this reach occurred during the middle of July 2013. Walleye during this time of year were not as available to our gear as they were in the spring. They were most likely holding up in deep water holes in the middle of the river. During this pass, ten walleye were removed. We were unable to return until the middle of October and we were only able to cover 16.4 (Cisco to Dewey Bridge, UT) of the 63.8 river miles covered in July. During this trip we removed thirteen walleye and observed many more. The total lengths for all twenty three walleye removed in 2013 (Figure 6) ranged from 391 mm to 605 mm with a mean total length of 482 mm. Four adult walleye were removed from the Grand Valley reaches between RM 158.7 and 183.6 in 2012. Their total lengths ranged from 417 to 459 mm. All of these fish have been preserved (frozen) for future otolith microchemisty analyses.

Two adult striped bass (TL: 457, 562) were collected just downstream of Kane Springs near Moab, Utah in 2013. In 2012, one adult striped bass collected just upstream of the town of Fruita at RM 161.3. The fish's total length was 572 mm.

Captures of adult gizzard shad in the Upper Colorado and Lower Gunnison rivers exploded during 2007 (total=179). One hundred thirty-nine adult gizzard shad were collected during the 2007 smallmouth bass removal project. An additional 43 were collected in the fish trap of the Redlands Dam fish passageway. This compares to 12 captured during the smallmouth bass removal study in 2006 and only 3 in the Redlands

fish passageway fish trap. One age-0 or age-1 gizzard shad (66 mm) was collected in the Upper Colorado River during 2009.

However, in 2008 the number of gizzard shad collected declined markedly from 2007, almost one magnitude less. Eighteen gizzard shad were collected during 2008, all from Grand Valley reaches of the Upper Colorado and Lower Gunnison rivers. No gizzard shad were found in the fish trap at the Redlands fish passageway in 2008. During the 2009 centrarchid removal, 36 gizzard shad (three juvenile and 33 adult) were collected in the Grand Valley reaches. Three adult gizzard shad were also collected in the fish trap of the Redlands fish passageway during 2009.

In 2010, 40 adult gizzard shad were captured during the centrarchid removal study and five adults were collected in the fish trap at the Redlands fishway. In 2011, no gizzard shad were observed or collected from the centrarchid removal study or Redlands fish trap. No gizzard shad were collected in the Government Highline fish passageway between 2006 and 2011.

In 2012, 72 gizzard shad were collected during centrarchid removal in the Grand Valley reaches. This marks the first year that both juvenile and adult shad were found in our catch with total lengths ranging from 53 to 485 mm and a mean total length of 413 mm. In 2012, 22 adult gizzard shad were collected Redlands fish trap.

Both juvenile and adult gizzard shad were collected in all reaches sampled in 2012 from the Grand Valley (n = 97; TL range 54 – 468 mm) to Ruby Horsethief (n = 1; TL 167 – 467 mm) and Cisco to Potash (n = 11; 78 – 580 mm). In 2013, 10 adult gizzard shad were collected Redlands fish trap and one adult gizzard shad was collected and GVWUs fish trap. It appears that drought years allow for the upstream expansion of gizzard shad's range in the Colorado and Gunnison Rivers.

In 2012, 614 white sucker and white sucker hybrids were removed from the Grand Valley reaches. Their total length ranged from 53 to 519 mm with a mean total length of 255 mm. Our effort in 2013 removed 2,627 white sucker and white sucker hybrids from all sampled reaches, these fish ranged in total length from 80 to 510 mm. These fish were removed opportunistically when white sucker catch wouldn't overwhelm the crew's primary focus on centrarchid removal.

VIII. Additional noteworthy observations:

During most years, we don't collect and handle Colorado pikeminnow during the centrarchid removal project. However, in an effort to increase the number of Colorado pikeminnow captured in the final pass for spring 2013's population estimate project, 33 additional fish were captured during the beginning of the centrarchid removal project. After one complete non-native removal pass, we discontinued handling Colorado pikeminnow.

During 2013, 160 individual razorback sucker, 13 humpback chub, and 3 bonytail were collected by CPW and USFWS crews while working on projects 126a and 126b.

During our July 2013 Cisco to Potash, UT pass a fish kill was observed (18 July), mostly likely the result of a flash flood in Onion Creek markedly increasing the sediment load in the river downstream of the Onion Creek confluence (river mile 85.5). No native fishes were observed in the kill which was dominated by channel catfish and walleye.

IX. Recommendations:

1. Continue to collect and lethally remove all centrarchids from the Colorado and Gunnison rivers during all station sampling efforts, which includes sampling on the Colorado and Gunnison rivers.

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

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. Sampling these features with electrofishing may increase catches of centrarchid fishes.

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

6. Continue with three nonnative fish removal passes in river reach between the Loma Boat Landing and Westwater Ranger Station, Utah, to determine if 2013's extremely high catch rate of smallmouth bass was an anomaly or if the population is expanding

7. Evaluate the feasibility of sampling floodplain ponds in addition to Snyder's (specifically those tied to gravel pit operations and others that have hydrologic connections directly to the Colorado River) in the Silt and Rifle areas to determine fish species presence and abundance/density.

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.

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. Considering a large recruitment year (1150 Smallmouth bass < 100 mm TL) in 2013, increase the number of passes back up to eight to eradicate potential future spawners in the Upper Colorado River.

12. Little to no large bodied fishing effort has been expended in the Colorado River below the Colorado/Utah state line to the confluence of the Green River in years when the Colorado pikeminnow estimate work is on its two year rest cycle. In 2010, during Colorado pikeminnow estimate work, walleye captures were equal to pikeminnow captures, in these reaches, at 46. The two year cycle of no work in these reaches passed (2011 &2012) and then in 2013, walleye captures during the Colorado pikeminnow estimate work skyrocketed to 259. Additional work in the summer and fall 2013 produced another 23 walleye. In addition, for the first time in 9 years of centrarchid removal work, 2012 produced 4 walleye in the Grand Valley reaches. Another experimental pass should be conducted in 2014 from Cisco to Potash, UT in the fall when water temperatures allow for walleye to occupy shoreline habitats making them available to our gear. In addition, during the years that Colorado pikeminnow estimate field work is not occurring – increased effort (at least three passes) needs to occur in these reaches in the spring and/or fall to manage these predators that are sitting on top of important nursery areas for age-0 to age-3 Colorado pikeminnow and razorback sucker.

X. Project Status: On track and ongoing

XI. FY 2013 Budget Status

A. Funds Provided: 165,231
B. Funds Expended: 165,231
C. Difference: -0-
D. Percent of the FY 2013 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 2013.

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XIII. Signed: Travis Francis 11/22/2013
Principal Investigator Date

APPENDIX:

A. More comprehensive/final project reports. If distributed previously, simply reference the document or report.

Burdick, B. D. 2008. Removal of smallmouth bass and four other centrarchid fishes from the Upper Colorado and Lower Gunnison Rivers: 2004–2006. FINAL REPORT prepared for the Upper Colorado River Endangered Fish Recovery Program. Recovery Program Project Number 126. U. S. Fish and Wildlife Service, Colorado River Fishery Project, Grand Junction, Colorado. 61 pp + appendices.

B. Appendix A: 3 tables attached
6 figures attached

C. References

Burdick, B. D. 2008. Removal of smallmouth bass and four other centrarchid fishes from the Upper Colorado and Lower Gunnison Rivers: 2004–2006. Final Report prepared for the Upper Colorado River Endangered Fish Recovery Program. Recovery Program Project Number 126. U. S. Fish and Wildlife Service, Colorado River Fishery Project, Grand Junction, Colorado. 61 pp + appendices.

Chapman, A. D. 1951. Some properties of the hypergeometric distribution with applications to zoological sample censuses, University of California Publ. Stat. 1(7):131–160.

Hangsleben, M. A., M. S. Allen, and D. C. Gwinn. 2013. Evaluation of Electrofishing Catch per Unit Effort for Indexing Fish Abundance in Florida Lakes. Transactions of the American Fisheries Society 142:247–256.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Dept. of Environment, Fisheries and Marine Service, Ottawa, Canada, 382 pp.

Pollock, K. H., J. D. Nichols, C. Brownie, and J. E. Hines. 1990. Statistical inference for capture-recapture experiments. Wildlife Monographs 107.

Table 1. Catch/effort (CPE, fish/hr) comparison by year for three different length classes (total length) of smallmouth bass (< 100mm = age-0; 100–199 mm = juveniles; ≥200 mm = adults) for the Upper Colorado River Rifle to Beavertail Mountain reaches (river miles 240.4 – 195.7), the Upper Colorado River from Government Highline Dam to the Westwater BLM ranger station, Utah (river miles 193.7.7 – 136.0) 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 – 2013. Note: a) all removal passes and all reaches were combined within years for the Rifle 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, and c) Government Highline to Cameo XCEL Bridge reach added in 2009, d) in 2011, some reaches were not sampled which included Black Rocks to Westwater Ranger Station, Government Highline to Cameo, and Cottonwood Park boat landing to Beavertail Mountain, e) some reaches not sampled in 2012 include the 2.3- mile section of the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence, the additional reach between the Government Highline Dam and the Cameo Bridge, from Cameo Bridge to GVIC, and Parachute to Debeque , f) Cisco to Potash, Utah reaches were added in 2013.

Table 1.

			Smallmouth Bass									
River Section	Length Class (mm)		Year									
			2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
Rifle 🖫 Beavertail Mountain	< 100	No. of fish	4	1	0	57	0	21	17	36	58	3
		C/E	0.07	0.02	0	0.72	0	0.25	0.2	0.96	1.46	0.15
	100-199	No. of fish	29	1	6	0	3	29	28	2	54	4
		C/E	0.53	0.02	0.48	0	0.05	0.34	0.32	0.05	1.36	0.2
	> 200	No. of fish	1	3	5	39	12	32	45	41	118	14
		C/E	0.02	0.05	0.01	0.49	0.19	0.37	0.52	1.09	2.96	0.71
Government Highline Dam 🖫 Westwater, Utah + Lower Gunnison River	< 100	No. of fish	1,213	761	226	2,054	191	185	1,358	261	254	93
		C/E	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	1281	316	611	159	137	214	250	54	345	618
		C/E	3.52	1.09	1.47	0.45	0.39	0.73	0.76	0.33	1.98	3.66
	> 200	No. of fish	754	423	147	188	177	135	429	449	768	456
		C/E	2.07	1.46	0.35	0.53	0.51	0.46	1.31	2.77	4.39	2.7
Cisco 🖫 Potash Utah	< 100	No. of fish	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0									
	100-199	No. of fish	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.04									
	> 200	No. of fish	21	NA	NA	NA	NA	NA	NA	NA	NA	NA
		C/E	0.29									

Table 2. Catch/effort (CPE, fish/hr) comparison by year for three different length classes (total length) of largemouth bass (< 100mm = age-0; 100–199 mm = juveniles; ε 200 mm = adults) for the Upper Colorado River Rifle to Beavertail Mountain reaches (river miles 240.4 – 195.7), the Upper Colorado River from Government Highline Dam to the Westwater BLM ranger station, Utah (river miles 193.7.7 – 136.0) 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 – 2013. Note: a) all removal passes and all reaches were combined within years for the Rifle 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, and c) Government Highline to Cameo XCEL Bridge reach added in 2009, d) in 2011, some reaches were not sampled which included Black Rocks to Westwater Ranger Station, Government Highline to Cameo, and Cottonwood Park boat landing to Beavertail Mountain, e) some reaches not sampled in 2012 include the 2.3- mile section of the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence, the additional reach between the Government Highline Dam and the Cameo Bridge, from Cameo Bridge to GVIC, and Parachute to Debeque , f) Cisco to Potash, Utah reaches were added in 2013.

Table 2.

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

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 - 2012. 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	65.0	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	0.060
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	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	0.037
2013	NO POPULATION ESTIMATE PERFORMED											

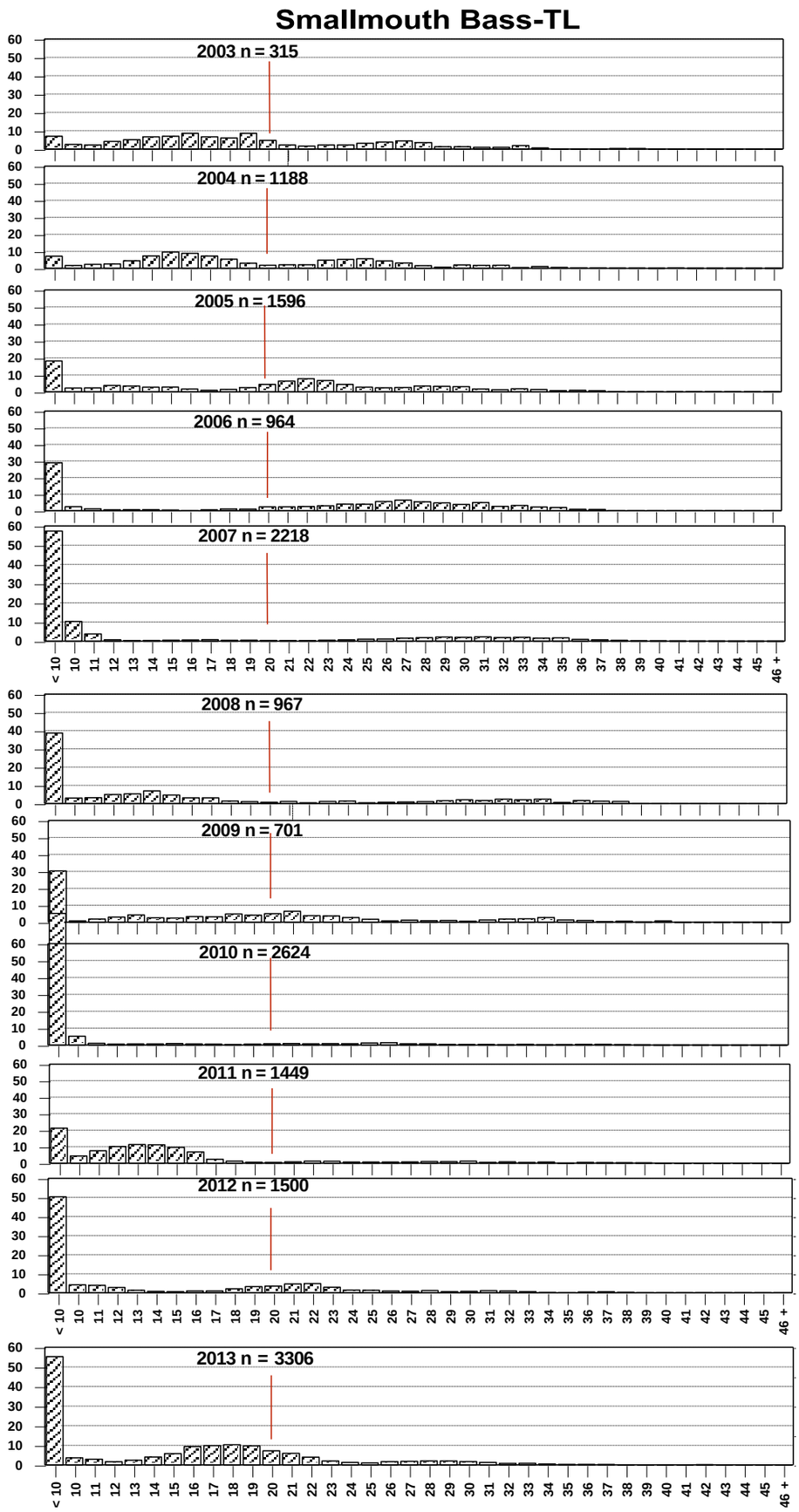

Figure 1. Length (cm) frequency histogram for all smallmouth bass captured in all reaches from 2003 to 2013. The red line represents 200 mm.

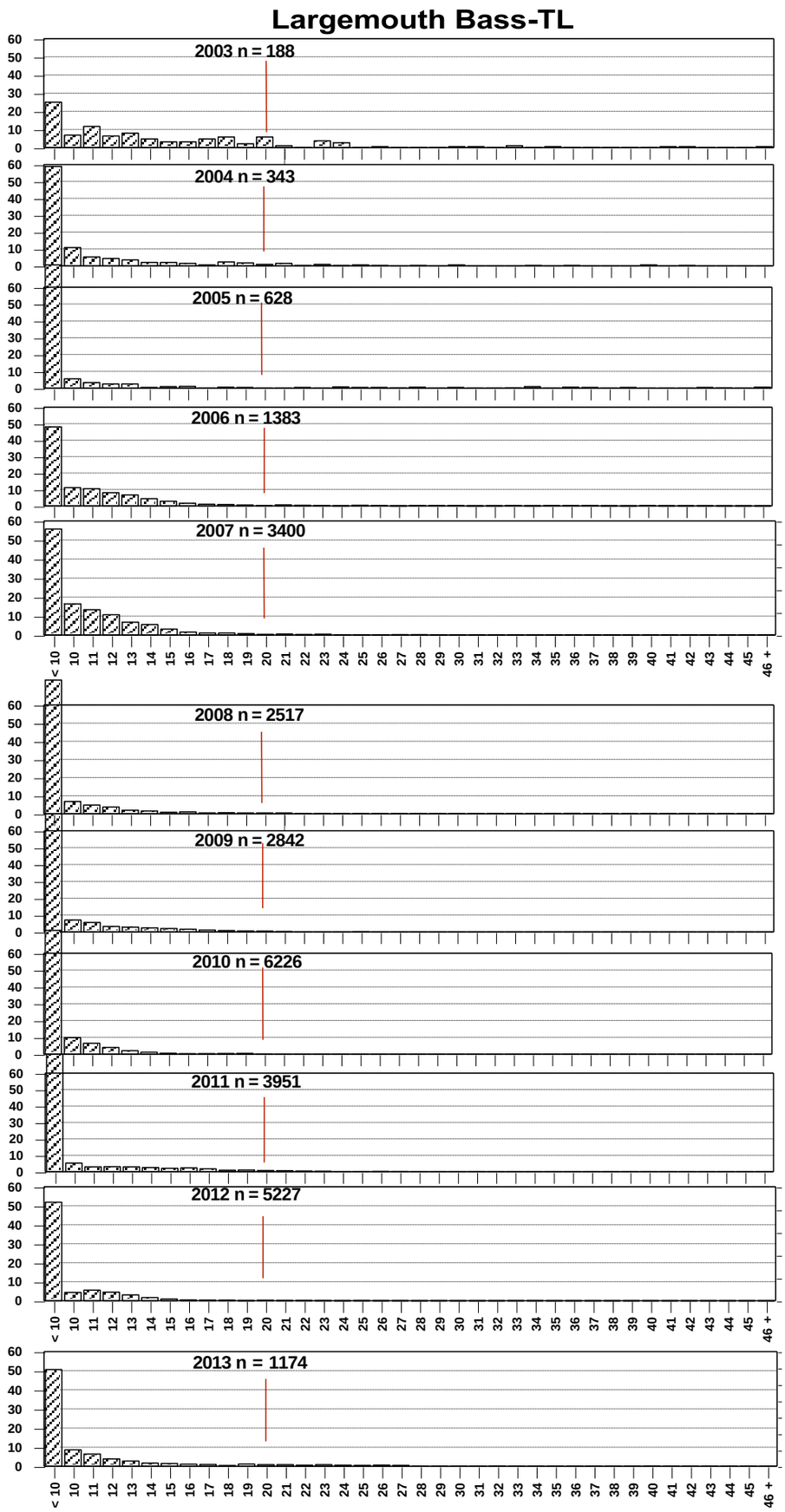

Figure 2. Length (cm) frequency histogram for all largemouth bass captured in all reaches from 2003 to 2013. The red line represents 200 mm.

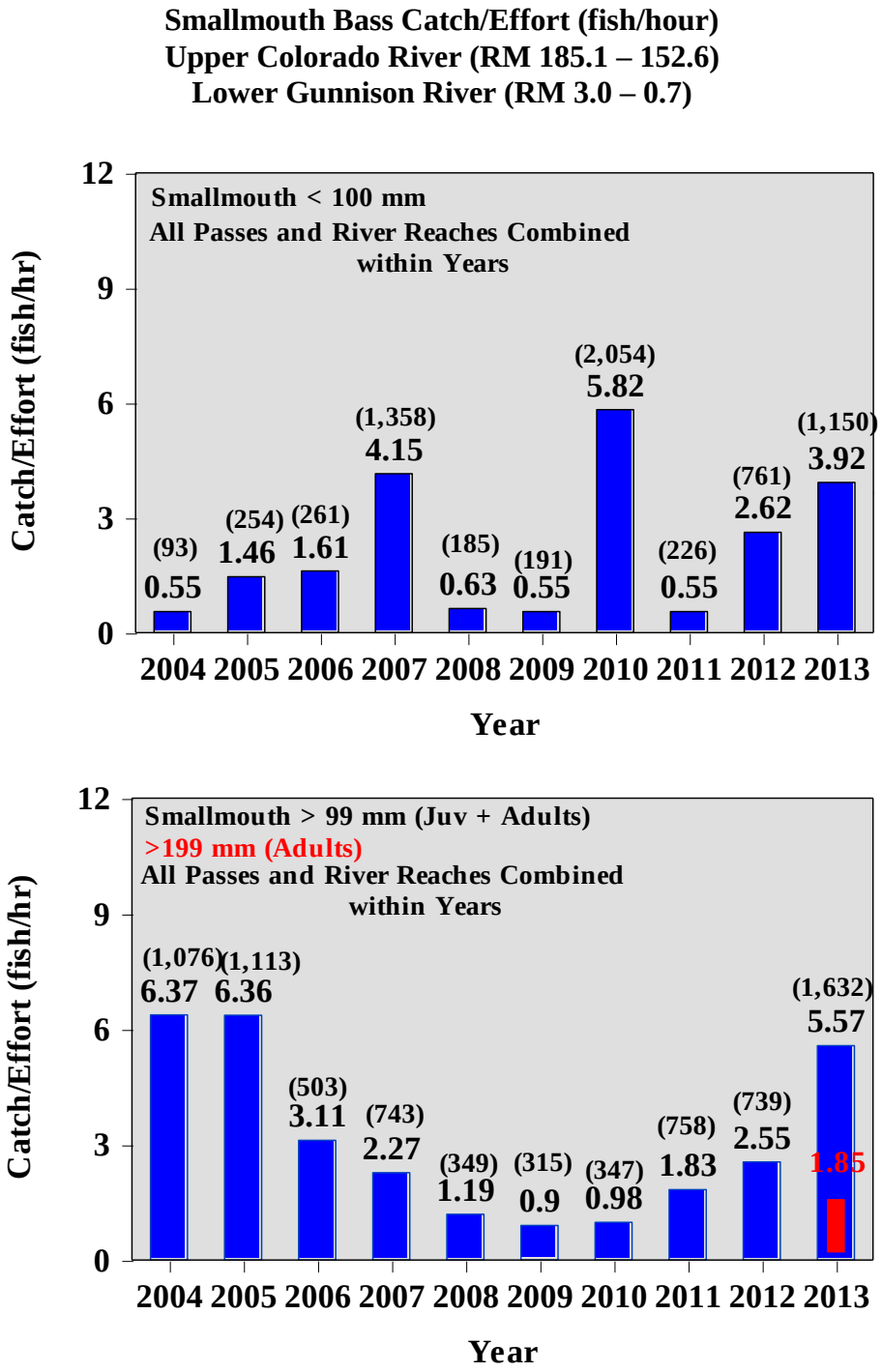

Figure 3. Ten year comparison of catch/effort (fish/hr) for smallmouth bass less than 100mm (upper), and juvenile & adult smallmouth bass (≥ 100 mm) (lower), 2004-2013, for the Grand Valley reaches of the Upper Colorado and Lower Gunnison rivers. Note: numbers of smallmouth bass collected in parentheses.

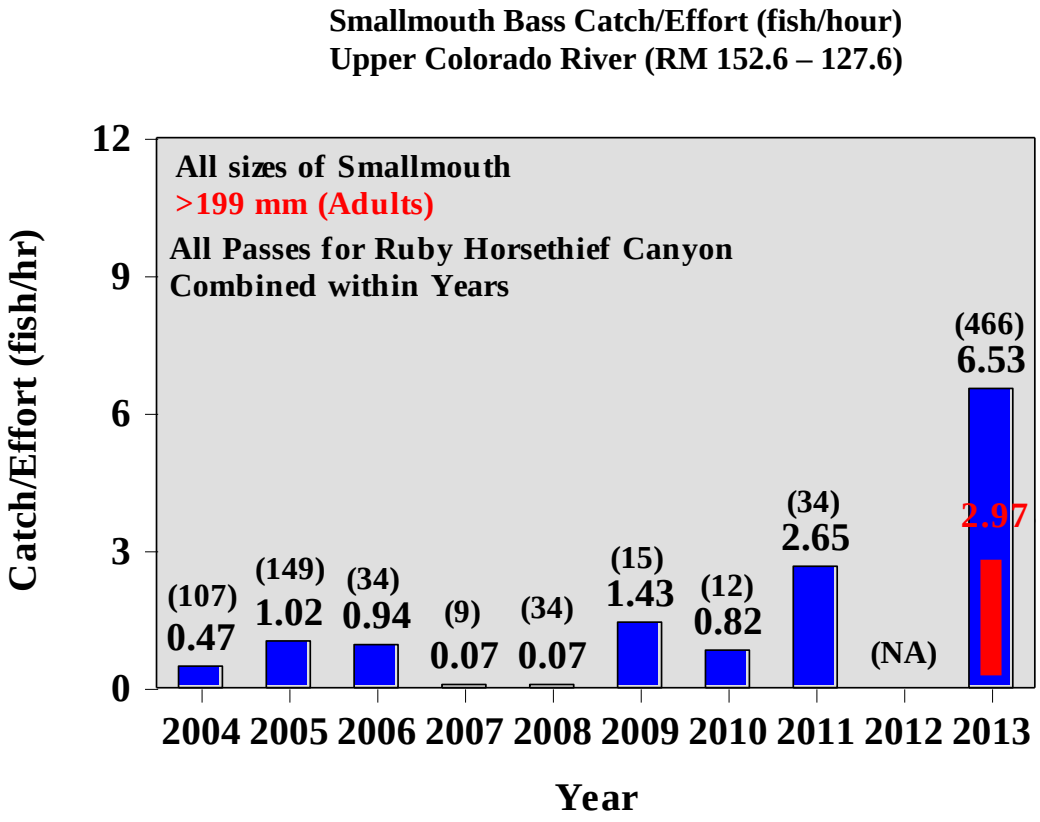

Figure 4. Ten year comparison of catch/effort (fish/hr) for young-of-year, juvenile and adult smallmouth bass, 2004-2013, for Ruby Horsethief Canyon of the Upper Colorado River. Note: numbers of smallmouth bass collected in parentheses.

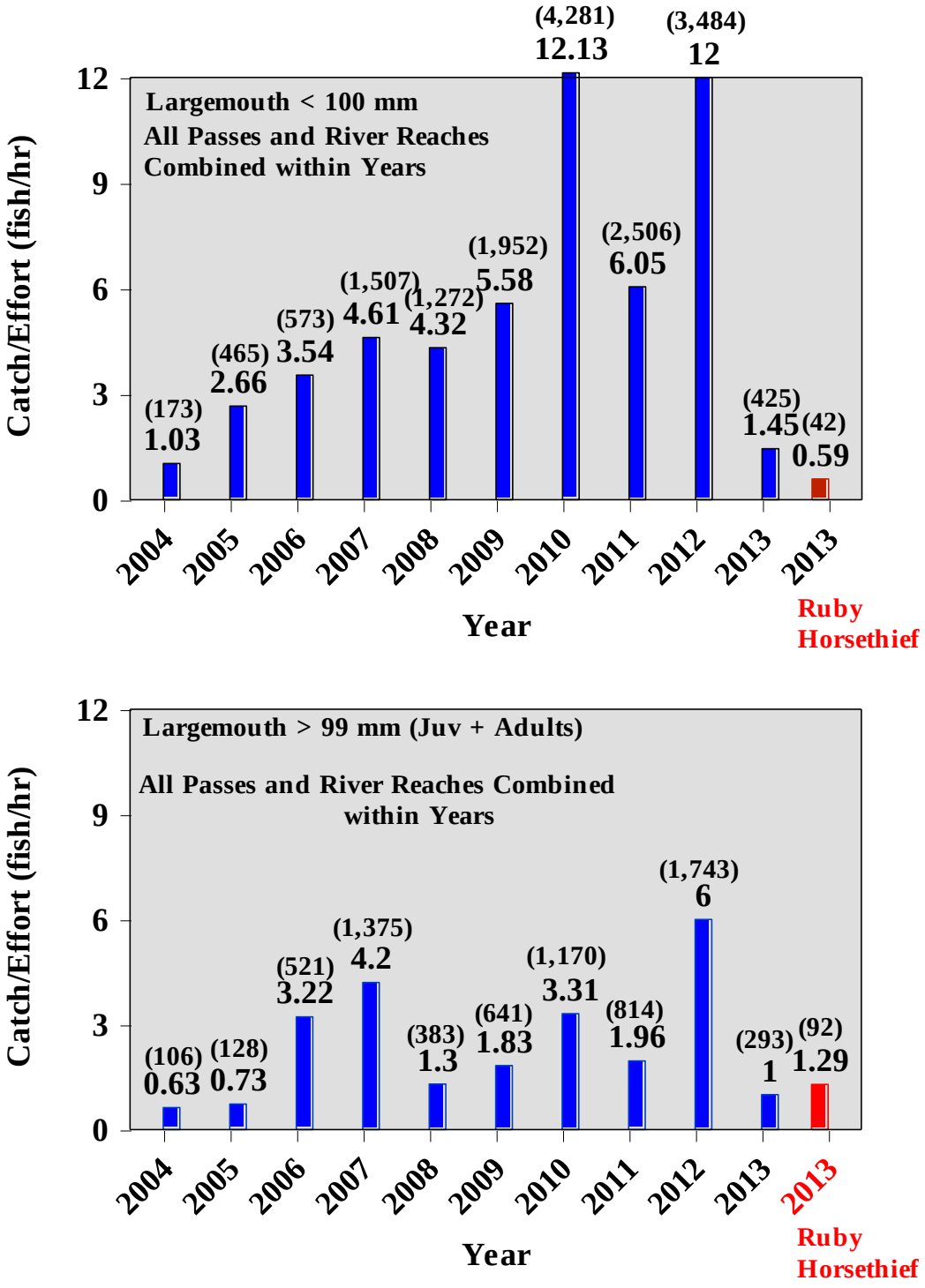

Figure 5. Ten year comparison of catch/effort (fish/hr) for largemouth bass less 100 mm (upper), and juvenile & adult smallmouth bass (≥ 100 mm) (lower), 2004-2013, for the Grand Valley reaches of the Upper Colorado and Lower Gunnison rivers. Note: numbers of largemouth bass collected in parentheses.

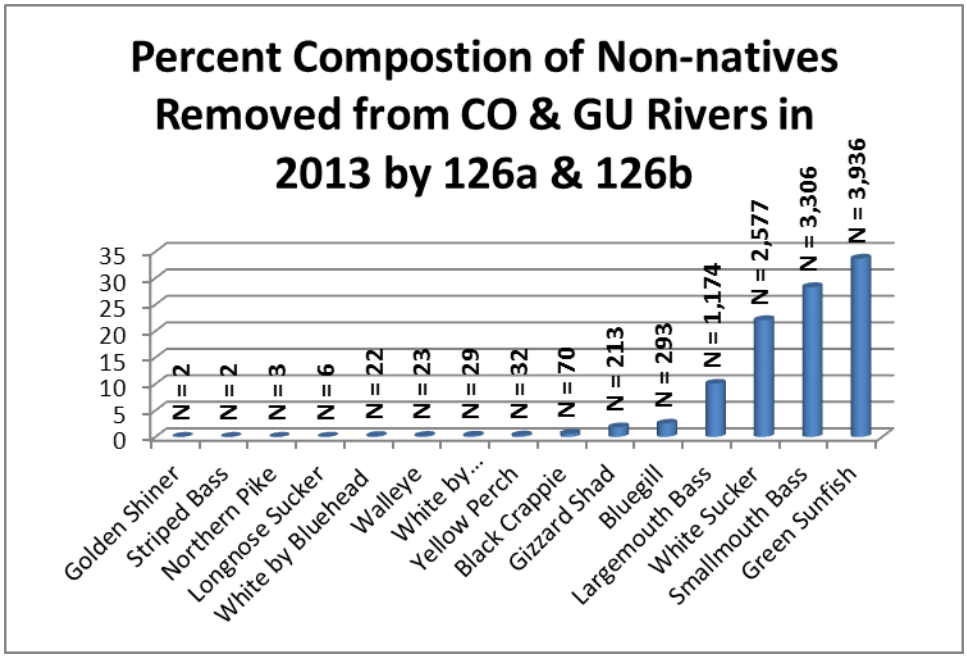

Figure 6. Percent composition of non-native fish removed from the Colorado (river mile 240.7 to 47.2) and Gunnison (river mile 3.0 to 0.0) rivers in 2013. Note: numbers of fish collected above bars.

Appended summary:
Walleye captures during Colorado pikeminnow sampling in the Colorado River

Caption – One day's catch of walleye just upstream of Moab, UT during the spring 2013.
Credit – Britney McKelvey, USFWS

Until this year, funded projects dedicated to non-native fish removal in the Colorado River have been confined to the 'upper reach' (Palisade to Westwater) and reaches further upstream (Rifle to DeBeque Canyon). For reaches occupied by the endangered fish, the only river-wide index to non-native fish relative abundance is the catch rate derived during the Colorado pikeminnow monitoring effort that runs from April through June. This spring monitoring effort includes electrofishing shorelines and trammel-netting backwaters. Three to five passes are made through occupied habitat per year. In addition to the aforementioned upper reach, surveys include the lower reach, which extends from the base of Westwater Canyon (Cottonwood Wash) to the confluence with the Green River. These surveys typically occur for three years in a row followed by a two-year non-sampling period. Since 2000, there have been two complete 3-year efforts (2003-2005 and 2008-2010) with 2013 being the first year of the next 3-year effort.

Three non-native species have significantly increased in the Colorado River since 2000: smallmouth bass, gizzard shad, and walleye. Another species of concern is northern pike, because significant numbers were detected near Rifle, Colorado in recent years. There is an annual centrarchid removal project conducted during July-October in the upper reach. Results of that project are reported at workshops and in annual and final reports. Captures of invasive species during the spring pikeminnow project are not routinely reported but are instructive in that they provide a river-wide perspective on distributional trends.

Gizzard shad first showed up in the study area in 2009. Northern pike and walleye have been captured rarely since at least 1980 (Valdez et al. 1982). Smallmouth bass were first detected in the Grand Valley in 1999 (Osmundson 2003). Annual catch-per-effort has not yet been calculated for these species, but total numbers captured during April-June provide a rough index from which we can draw some interim conclusions regarding distribution and trends in abundance (see Fig. 1).

Walleye captures in the Colorado River went from being 'rare' during 2003-2009 to 'common' in 2010, and then increased dramatically by 2013. Through 2009, total annual captures in the lower reach ranged from two to six. In 2010, there were 46 captures. Captures of unique Colorado pikeminnow in 2010 in the lower reach totaled 92. Walleye captures were therefore about half those of pikeminnow. In 2013, total walleye captures soared to 259, or about three times that of pikeminnow captures (n = 80). Although a few walleye were captured in the upper reach during the 2012, summer, non-native removal project, none have been captured in the upper reach during spring pikeminnow sampling. To date, this sudden invasion of walleye into Colorado pikeminnow habitat appears to be largely restricted to the lower reach.

Length frequency of captured walleye was fairly similar between 2010 and 2013 with most individuals between 400 and 550 mm TL (Fig. 2). The most abundant 50-mm length group did, however, increase from 400-449 mm to 450-499 mm and 99% of our catch (n=256) was > 375 mm.

Distribution within the lower reach in 2010 appeared to be restricted to the lowest 80 miles of the study area (ending at the Green River confluence); however, by 2013, captures extended upstream to RM 112 at the top of the lower reach, indicating an upstream range expansion (Fig. 3). In both years, the area with the greatest number of captures was between RM 60 and 80, the reach between Moab and Onion Creek (Professor Valley). This 20-mile segment made up 18% of the lower reach yet yielded 46% (2010) and 38% (2013) of the captures, suggesting there may be a preference for this area. However, there were also a considerable number of captures in the primary nursery area of Colorado pikeminnow (downstream of Moab): 54% of captures in 2010 and 43%

in 2013. Walleye distribution also overlapped that of young, naturally-produced razorback sucker captured in 2013 (Fig. 3).

Unlike smallmouth and largemouth bass, whose primary distribution is in the upper reach, walleye directly overlap with small size classes of both Colorado pikeminnow and razorback sucker. If probability of capture of walleye is similar to that of pikeminnow, our removal of 259 in 2013 may have only represented 10-20% of what was there. This invasion by a large-bodied piscivore constitutes a new and very significant threat to recruitment of both endangered species.

Other non-native fish observations include: 1) gizzard shad were most abundant in the lower reach; 2) northern pike remain relatively uncommon in both the lower and upper reaches with 0-5 captures per year; 3) the annual number of smallmouth bass captured in the lower reach has remained relatively low; 4) high numbers of smallmouth bass were captured in the upper reach in both 2004 (prior to removal efforts) and in 2013 (Fig. 1).

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Dale Ryden

Colorado River Fishery Project, USFWS
Grand Junction, Colorado

November 7, 2013

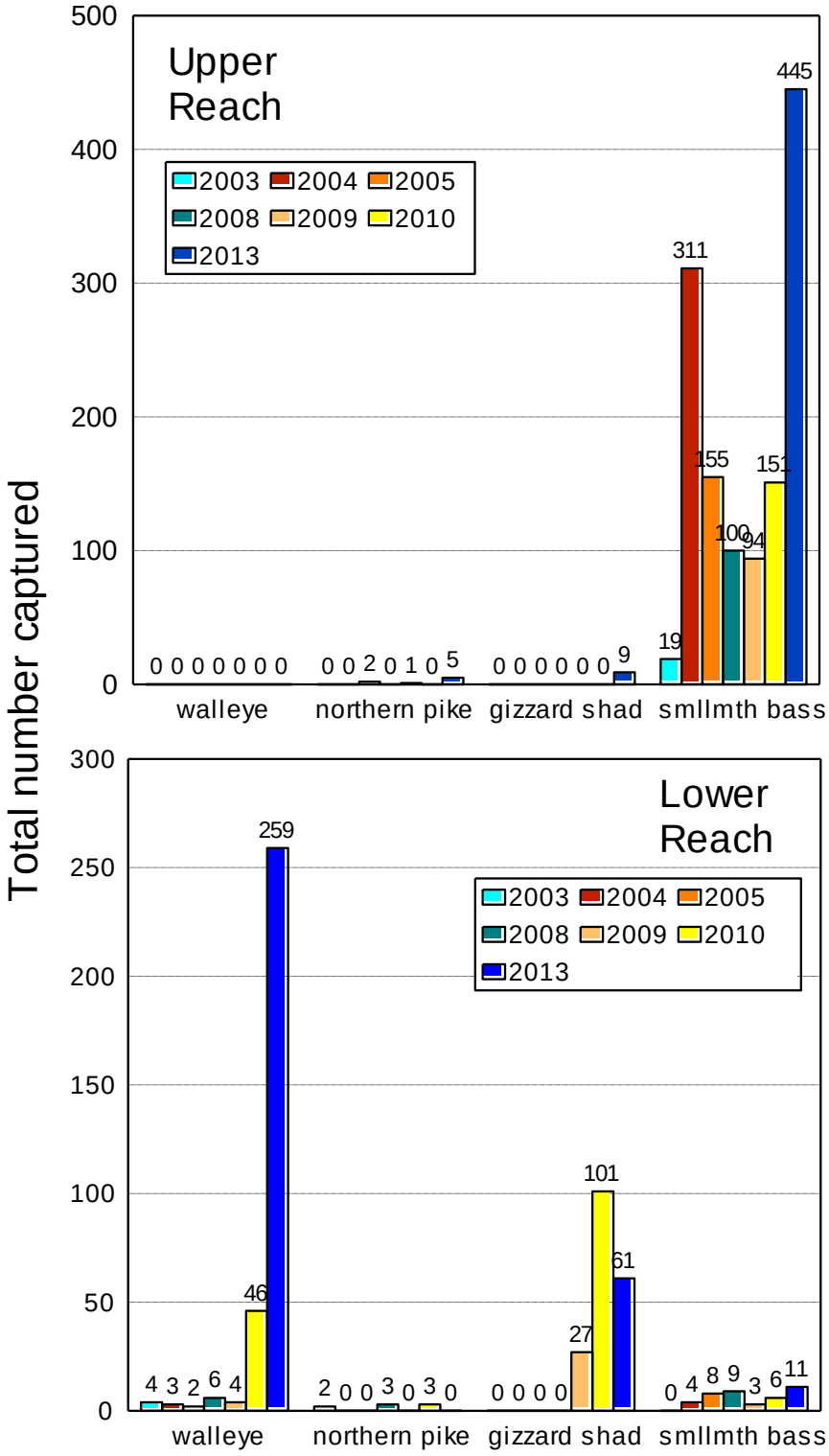

Table 1. Four species of non-native fish captured during April-June, river-wide sampling for endangered fish in the Colorado River using electrofishing and trammel netting, 2003-2013.

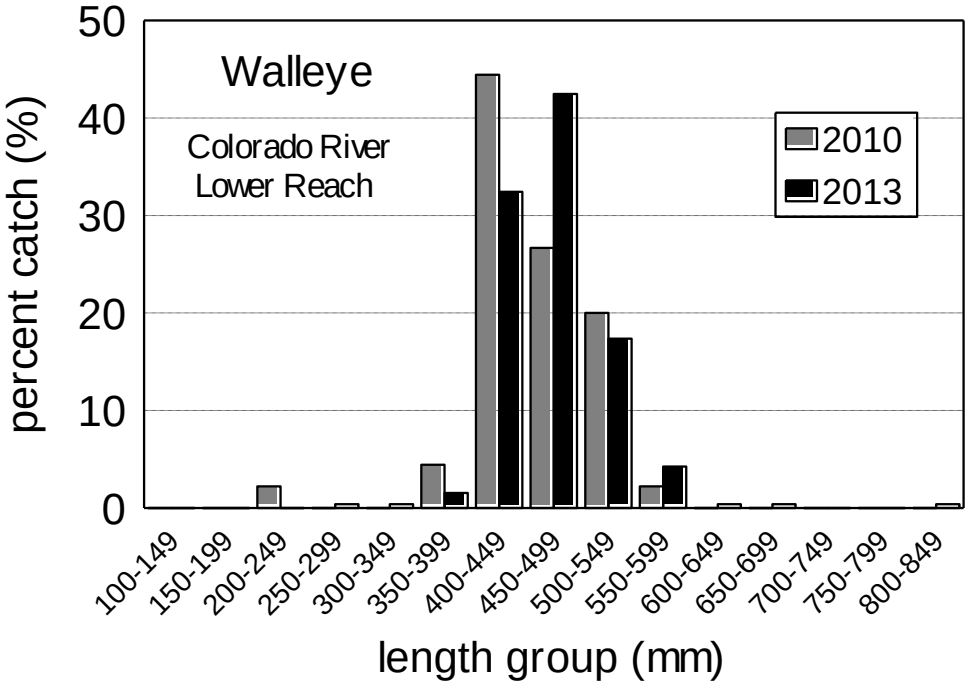

Figure 2. Length frequency of walleye captured from the lower colorado River reach, 2010 and 2013

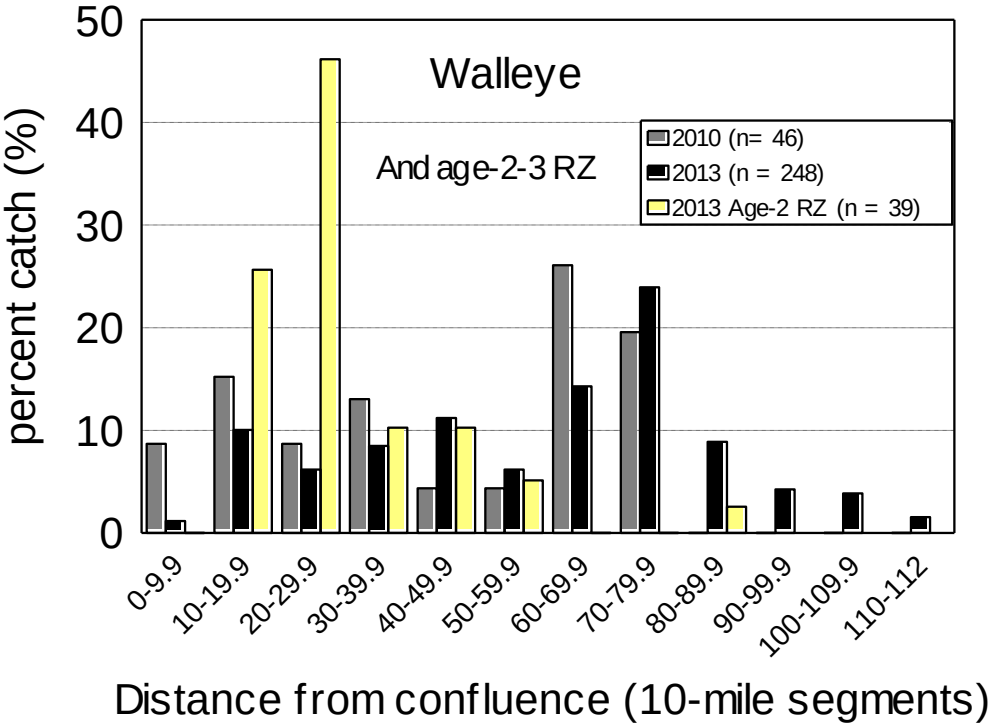

Figure 3. Distribution of walley captures in the lower Colorado River reach, 2010 and 2013. Also shown is the distribution of age-2-3 naturally-produced razorback sucker captured in 2013.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: _____
UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 126b

Project Title: Colorado River Centrarchid, Etc. Removal for 2013

Principal Investigator:

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Project/Grant Period: Start date (Mo/Day/Yr):
End date: (Mo/Day/Yr):
Reporting period end date (Mo/Day/Yr):
Is this the final report? Yes _____ No _X__

Performance:

- The Colorado River was sampled by CPW crews via two, 16' rafts equipped with ETS mounted electrofishing gear. Rafts electrofished downstream along both shorelines, and utilized experimental gill nets at the mouths of and within backwaters to complete "block and shock" sampling on several occasions. Fish captured were measured in length to the nearest millimeter and weighed to the nearest gram. All non-native, non-salmonid fish captured were lethally removed. Otoliths and cleithra will be extracted from the northern pike collected to assist in determination of fish origination.

- One electrofishing pass was completed from Silt (RM 248.0) to Parachute (RM 222.2) and from Debeque (RM 209.7) to Beavertail Tunnel (RM 195.7). This pass included sampling the main channel and backwaters via electrofishing. Northern pike, black bullheads, yellow perch, and most centrarchids were all captured within backwater/slackwater/eddy habitats.

- A second electrofishing pass was completed from Rifle to Parachute, where only backwater/slackwater/eddy habitats were targeted utilizing the "block and shock" technique.

- One backwater upstream of Rifle (RM 241.8) and two backwaters downstream of Rifle (RM 240.4 and RM 238.0) where northern pike were concentrated in 2012 sampling efforts were also sampled on multiple occasions (one sample event for RM 241.8 and two sample events each for RM 240.4 and RM 238.0). These backwaters were accessible by shore once river discharge declined and conditions became too dangerous for rafts to access the sites. Multiple, experimental gill nets were set at the mouths of and within these backwaters while backpack electrofishers were utilized to complete "block and shock" sampling.

- CPW crews were not able to sample the Colorado River from Parachute (RM 222.2) to Debeque (RM 209.7) due to access issues and a dangerous river diversion (Bluestone Ditch) upstream of Debeque. CPW learned that an energy company is working with Garfield County to construct a new (public) boat ramp at the Una Bridge crossing. Construction should be complete by the 2014 field season.

- Total Number of Fish Captured = 1,223
  Total Number of Black Bullhead = 6 (Total length ranged from 96mm-219mm)
  Total Number of Black Crappie = 50 (Total length ranged from 56mm-90mm)
  Total Number of Bluegill = 4 (Total length ranged from 71mm-135mm)
  Total Number of Green Sunfish = 807 (Total length ranged from 43mm-185mm)
  Total Number of Largemouth Bass = 300 (Total length ranged from 21mm-400mm);
  234 fish $\leq$ 100mm; 39 fish > 100mm and <150mm; 27 fish $\geq$ = 150mm
  Total Number of Northern Pike = 1 (Total length was 744mm)
  Total Number of Yellow Perch = 21 (Total length ranged from 67mm-181mm)
  Total Number of Smallmouth Bass = 34 (Total length ranged from 50mm-264mm);
  4 fish $\leq$ 100mm; 6 fish > 100mm and <150mm; 24 fish $\geq$ = 150mm

- Total Effort Expended (Electrofishing Hours = 54.58 hours) and (Gill Net Hours = 5.20 hours) = 59.78 hours overall

- Centrarchid CPUE = 19.99 fish/hour;
  -Green Sunfish = 13.50 fish/hour
  -Largemouth Bass = 5.02 fish/hour
  -Black Crappie = 0.84 fish/hour
  -Smallmouth Bass = 0.57 fish/hour
  -Bluegill = 0.067 fish/hour

- Northern Pike CPUE = 0.017 fish/hour

Summary of CPW's Project 126b: Snyder Pond Centrarchid, Etc. Removal for 2013

- Snyder Pond (approximately 37 surface acres) was sampled by CPW crews using both active (a 16' hard bottom jet boat equipped with Smith Root mounted electrofishing gear) as well as passive (fyke nets) sampling gears. Electrofishing was completed during the day and evening in the spring and fall of 2013. Concurrently, six fyke nets were strategically placed along the shorelines, and used to capture fish throughout the day and night hours. Both methodologies were used across seven days in April (8th, 10th-12th, and 15th-18th), and across three days in October (28th-30th). Fish captured were measured in length to the nearest millimeter and weighed to the nearest gram. All non-native, non-salmonid fish captured were lethally removed. Otoliths and cleithra will be extracted from the northern pike collected to assist in determination of fish origination.

- Total Number of Non-Native Fish Captured = 401

  Total Number of Common Carp = 1 (Total length was 557mm)
  Total Number of Green Sunfish = 124 (Total length ranged from 36mm-128mm)
  Total Number of Largemouth Bass = 119 (Total length ranged from 73mm-499mm);
  46 fish $\leq$ 100mm; 45 fish > 100mm and < 150mm; 28 fish $\geq$ = 150mm
  Total Number of Northern Pike = 131 (Total length ranged from 162mm-928mm);
  15 fish <200mm;
  8 fish $\geq$ 200mm and < 400mm;
  4 fish $\geq$ 400mm and < 500mm;
  37 fish $\geq$ 500mm and < 600mm;
  61 fish $\geq$ 600mm and < 700mm;
  3 fish $\geq$ 700mm and < 800mm;
  3 fish $\geq$ 800mm
  Total Number of Yellow Perch = 26 (Total length ranged from 99mm-145mm)

- Total Effort Expended (Electrofishing Hours = 7.98 hours) and (Fyke Net Hours = 951 hours) = 958.98 hours overall

- Centrarchid Electrofishing CPUE = 28.7 fish/hour;

  -Green Sunfish = 15.2 fish/hour
  -Largemouth Bass = 13.5 fish/hour

- Northern Pike CPUE

  -Electrofishing CPUE = 9.8 fish/hour
  -Fyke Netting CPUE = 0.06 fish/hour