I. Project Title: **Smallmouth bass control in the White River**

II. Bureau of Reclamation Agreement Number(s): R14AP00007 (UDWR)
R15PG00083 (USFWS)

III. Principal Investigator(s):

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IV. Abstract:

U.S. Fish and Wildlife Service, Utah Division of Wildlife Resources, and Colorado Parks and Wildlife worked collaboratively to remove an emerging population of smallmouth bass from the White River. Smallmouth bass have been present in the White River for some time, but an expanding population was first detected in 2011, and mechanical removal began in 2012. In 2016, a total of 2,264 smallmouth bass were removed between Taylor Draw Dam and the Green River confluence (river mile [RM] 104.3-0.0). Catch rates in Colorado were higher in 2016 than the previous two years, where the highest densities of adults and spawning occur, but lower than the first two years of this project (2012 and 2013). Catch rates in Utah, where the smallmouth bass population is apparently still expanding and establishing, were higher this year than the previous three years. However, catch rates are impacted by across year flow variability and changing removal strategies (especially in Utah). Three size classes were caught, demonstrating that successful reproduction and survival have occurred in this system for the past three years. Adult smallmouth bass catch rates decreased below Douglas Creek (RM 97.1) and catch rates for all size classes decreased significantly below Evacuation Creek (RM 61.5), likely due to habitat changes from sediment inputs at both locations.

V. Study Schedule: 2012 – ongoing

VI. Relationship to RIPRAP:

GENERAL RECOVERY PROGRAM SUPPORT ACTION PLAN
III. Reduce negative impacts of nonnative fishes and sportfish management activities.
III.A. Reduce negative interactions between nonnative and endangered fishes.
III.A.2. Identify and implement viable active control measures.

GREEN RIVER ACTION PLAN: WHITE RIVER
III. Reduce negative impacts of nonnative fishes and sportfish management activities.
III.A. Reduce negative interactions between nonnative and endangered fishes.
III.B.2. Preclude new nonnative species introductions, translocations or invasions to preserve native species dominance within critical habitat.

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

Task 1: Smallmouth bass removal from Taylor Draw Dam to the Colorado/Utah border

U.S. Fish and Wildlife Service (Green River Basin FWCO) and Colorado Parks and Wildlife removed smallmouth bass from this reach between 19 April and 7 July 2016 (Table 1). The majority of effort occurred in the 11 miles immediately below Taylor Draw Dam, as previous data suggested this was the area of highest bass densities and spawning adult bass (Breen et al. 2012; Webber et al. 2013, Webber et al 2014, Smith et al 2015). Moderately high and sustained spring flows caused low clearance at the Highway 64 bridge, restricting early June raft electrofishing capabilities to the upper 9.2 miles. Conversely, low flows and wind restricted the final pass in the upstream reach to the upper 7.2 miles. This resulted in three sampling passes between river miles (RM) 104.3-95.1, five passes from RM 104.3-93.4, one pass from RM 104.3-97.1, one pass from RM 95.1-93.4, and ten passes from RM 93.4-87.5 (Table 1). Additional bass removal was conducted as part of Project 128 (Colorado Pikeminnow Population Estimate). This was done prior to the start of this project and consisted of three electrofishing passes from the Taylor Draw Dam to the White-Green River confluence (RM 104.3-0.0). Data from Project 128 (Table 1) would otherwise not be reported, and is not factored into the catch rates presented in this report. In total, 1,807 smallmouth bass were removed, consisting of 671 adults (≥ 200 mm TL), 839 sub-adults (100-199 mm TL), and 297 fish < 100 mm TL (likely age-1). Of the 671 adults captured, 23 were large enough to be considered piscivores (≥ 325 mm TL) posing a competitive threat to Colorado pikeminnow and a predatory threat to smaller native fishes.

The catch rate for smallmouth bass from Taylor Draw Dam to the BLM boat ramp (RM 104.3-87.5) in 2016 was 13.4 fish/hour. We compared the 2016 catch rate to catch rates from 2012 through 2015 (Figure 1). The combined catch rate for smallmouth bass in 2016 was higher than the previous two years, as was the overall number of bass captured, but lower than the first two years of this study (2012 and 2013). Except for adult catch rates from Douglas Creek to the Chevron boat ramp (RM 97.1-93.4), catch rates for all

sizes classes of bass increased throughout the study reach from 2015. Similar to 2015, catch rates for all smallmouth bass size classes were more consistent throughout the Colorado portion of this project in 2016 than during the first three years of this project, when catch rates decreased rapidly downstream of RM 102.6 (Webber et al. 2013; Webber et al. 2014, Smith et al. 2015, Figures 2 and 4). In contrast to the proportionally high adult bass catch rates observed in 2015, sub-adult catch rates drove the consistency in catch rates from RM104.3-93.4 in 2016. The size structure of bass caught in 2016 revealed three size classes that correspond to fish spawned in 2013, 2014, and 2015 (Webber et al. 2013; Webber et al. 2014, Smith et al. 2015, Figures 2 and 4). The strong 2012 cohort that dominated our samples from 2013-2015 appears to have diminished this year, however the size classes present suggest that, at some level, smallmouth bass spawned in the past three years have become established in the White River given the relatively strong representation of each size class. Catch rates by pass were variable, and reflected the fact that passes were conducted over different reaches of river and at different flows.

Task 2: Three smallmouth bass removal passes from the Colorado/Utah border to Enron boat launch

Eleven days of electrofishing removal (RM 71.6-24.0; 101.8 hours of total effort) were completed from 7-27 June 2016 (Table 1). We selected this time frame to maximize the removal of spawning adult smallmouth bass based on preferred temperatures and real-time upstream field observations relayed by FWS and CPW crews. We focused our efforts on a nest disturbance strategy, "Operation Bass Eradication", in upstream areas that have consistently proven to hold higher densities of smallmouth bass during past removal efforts (Smith et al. 2015). More specifically, we conducted two cycles of electrofishing every other day in the same area (RM 71.6-59.0; stopping at RM 61.5 on one occasion), three to four times per cycle (Table 1). In order to verify that we were not missing any emerging threats in downstream areas and to maintain a record of population expansion/suppression through time, we conducted one complete pass of our study reach (RM 71.6-24.0) from 15-18 June 2016. This complete pass verified that we were focusing our removal efforts in the most appropriate locations.

During this effort, 449 smallmouth bass were removed (mean ± SE = 158.9 ± 2.0 mm TL; range = 72-358 mm TL; Figure 5). Catch consisted of 384 sub-adults (≤ 199 mm TL), 62 adults (200–324 mm TL), and three bass in the piscivore size class (≥ 325 mm TL; Figures 4 and 5). Overall catch-per-unit-effort (CPUE) was 4.41 fish/hour, nearly twice the 2015 catch rate (Smith et al. 2015) and similar to 2014 levels which followed successful cohorts produced in 2012 and 2013 (Webber et al. 2014). Adult bass were dissected for sex determination and gamete expression. Fifty-seven of the 65 bass in the adult category (range = 200–358 mm TL) were reproductively mature (34 females, 23 males); 20.6% of adult female bass and 39.1% of adult males were ripe at the time of collection. . During 2014 sampling efforts, only one ripe bass was collected (Webber et al. 2014) and percentages of ripe females and males removed in 2016 in this reach exceeded 2015 results (Smith et al. 2015), thus demonstrating the effectiveness of Operation Bass Eradication to target spawning bass when most appropriate to achieve our

main goal. Combining all removal efforts, 4.7 bass/mile were removed on average, representing more than a two-fold increase over 2014 (Smith et al. 2015; Figure 6), also demonstrating effectiveness of targeting specific locations with high densities of bass. Separating our data by pass demonstrates that depletion was not observed, likely an artifact of decreasing flow volume and associated increased sampling efficiency near the end of our efforts (Table 1). Our total catch consisted of 14.5% adults, which represents a decrease following an increasing trend observed in 2014 (19.1%; Webber et al. 2014) and 2015 (27.5%; Smith et al. 2015). With the exception of bass < 75 mm TL (i.e., limited recruitment in 2014; Webber et al. 2014), population structure is well represented by all size classes (Figure 5).

Catch-per-unit-effort of smallmouth bass in this sampling reach has varied considerably during the first five years of this project, a result of flow variability and changing removal strategies. More importantly, dramatic changes in bass distribution along an upstream to downstream gradient are evident. More specifically, 2012 represents CPUE influenced by distance to an upstream source population (Breen et al. 2012; Figure 6a), 2013 CPUE reflects population expansion from excellent recruitment in 2012 (Webber et al. 2013; Figure 6b), and the 2014 CPUE gradient is most likely influenced by environmental factors (Webber et al. 2014; Figure 6c). River mile 61.5 is the end of a 5-mile sample reach as well as the location of the Evacuation Creek confluence. The Evacuation Creek watershed was devastated by the 20,000 acre Wolfden wildfire in July of 2012, leaving a barren landscape that has since been subject to increased erosion and high sediment loads during severe rainstorms. For example, young-of-year surveys revealed significant changes in marginal, low-velocity habitats that were nearly or completely filled in with sediment, ash, and debris (Fiorelli and Breen 2014). Given a clear break in CPUE at RM 61.5 (Figure 6c), we suspect that 2013 sub-adult bass downstream of Evacuation Creek experienced poor survival rates or moved out of the reach to seek more suitable habitat and have not recolonized the area. Furthermore, Fiorelli and Breen (2015) describe a positive relationship between downstream distance from Evacuation Creek and water depth (i.e., sediment depth in low-velocity habitats). Our 2015 and 2016 results clearly demonstrate that this has had a profound effect on bass distribution in the lower White River. Comparing average CPUE above and below Evacuation Creek (Figure 6c), there was more than a four-fold difference in catch rates in 2015 (4.80 fish/hour vs. 1.05 fish/hour) and more than a three-fold difference in 2016 (5.88 fish/hour vs. 1.80 fish/hour); this result may or may not be associated with the Wolfden fire at this point, but regardless, there is a stark difference upstream and downstream of a known sediment contributor.

Overall observations of smallmouth bass on the White River from Taylor Draw Dam to the Enron Boat Ramp:

In summary, more smallmouth bass were captured in 2016 than in 2015, with higher catch rates. The majority of bass (n=1,553) were sub-adults (mean ± SE = 149.2 ± 0.7 mm TL) that were likely spawned in 2014. Adult catch rates were highest near Taylor Draw Dam and decreased moving downstream (Figures 4 and 6c). Adult smallmouth bass catch rates were similar in the Utah portion of the White River (0.65 adults/hour in

2015 vs. 0.64 adults/hour in 2016). In Colorado, catch rates for all smallmouth bass were higher in 2016 than in 2015 except for adult bass from Douglas Creek to the BLM takeout (RM 97.1-93.4). Overall, the highest bass catch rates and densities observed in the White River in 2016 occurred in the most upstream reach (RM 104.3-102.6). This year's results remain consistent with previous observations suggesting that a large population of adults near Rangely, Colorado successfully spawned, and young fish dispersed downstream. Reduced bass densities downstream of Evacuation Creek in Utah further suggest that turbidity and/or sediment deposition from flash flood events resulting from the Wolfden fire may have helped suppress bass numbers. Although catch rates were up in 2016, they have generally declined since 2013.

Task 3: Data entry, analysis, and reporting

Recovery Program annual progress report submitted November 2015.

VIII. Additional noteworthy observations:

In addition to Tasks 1 and 2, Cameron Walford and crewmembers from the Colorado State University Larval Fish Lab removed nonnative fish from the White River immediately below the Taylor Draw Dam with an electric seine for the third year on 16-August and 4 October 2016. During these two days they removed 927 smallmouth bass, of which 890 were classified as juveniles (< 100 mm TL). Smallmouth bass catch rates were noticeably lower in 2016 (215 fish/hour) than in 2015 (381 fish/hour) and 2014 (354 fish/hour), which was likely due to substantial changes in flow and depth in the channels below the dam where observed bass densities were the highest in the previous two years. The 45-day flow alteration was the result of maintenance to the dam's power generation system, which caused discharge to go over the dam, rather than through the hydropower facility. Electric seining allows smallmouth bass removal efforts to continue when flows are too low for electrofishing rafts and is arguably better suited to removing smaller bass in shoreline habitat where rafts cannot hold position. Additionally, the high electric seine catch rates observed in 2014 and 2015 verified successful bass spawning in the White River prior to the detection of what appeared to be relatively strong year-classes in 2016.

A significant increase in the number of white sucker x native sucker hybrid captures was observed, especially in the Utah portion of the White River in 2015 (Smith et al. 2015) followed by a smaller increase again in 2016 (Table 2), while white sucker abundance increased to a lesser extent (nine more fish in 2016 than in 2015). Moreover, size distribution of both flannelmouth x white sucker and bluehead x white sucker hybrids has increased, suggesting more stable populations through time. This raises concern that the level of white sucker hybridization in the White River is increasing, thus presenting a direct threat to the genetic integrity of this robust native catostomid community (e.g., Fiorelli and Breen 2014, 2015). Additionally, competition, predation, or a combination of both may be a driving factor for decreased abundance of native fishes collected during this project, including Colorado pikeminnow, razorback sucker, and especially roundtail chub (Table 2).

In addition to bass removal, UDWR deployed two submersible PIT antennas in the White River. An experimental process in 2016 to prepare for future purchase of submersible antennas by Recovery Program partners designated for use in conjunction with this project, these two antennas were deployed at a location where the river split into three channels (RM 68.0) and operated for a total of 31 days from 6 July 2016 to 25 August 2016. During this time, a total of 22 individual fish were detected, including nine roundtail chub, eight flannelmouth suckers, two bluehead suckers, two Colorado pikeminnow, and one fish that is yet to be determined. Interestingly, nine roundtail chub were detected with this technique in a single location, whereas 36 individuals were captured in the Utah portion (Table 2) during more than 100 hours of electrofishing effort. Further discussion of capture histories of these individuals will be included in the 2016 Utah Statewide Three Species Monitoring Summary (Fiorelli and Breen, In Prep).

IX. Recommendations:

- We recommend maintaining current levels of smallmouth bass removal effort in both the Colorado and Utah portions of this study. Crews will continue to coordinate and adjust removal strategies to maximize effectiveness and efficiency. Since 2013, a general decrease in catch rates has been observed in the White River, but increased numbers in 2016 warrants continued pressure on this population.

- Despite relatively low white sucker densities, a significant increase in white sucker hybrid captures occurred from 2014 to 2015 and again from 2015 to 2016. This warrants an increased focus toward white sucker and white sucker hybrid removal in the White River in the future.

- Given the observed decline in roundtail chub, with more of a decline expected in the near future (Budy et al. 2016), all crews working on the White River should capture and PIT tag these fish; the White River is one of few stronghold populations remaining throughout their range that we can learn from.

X. Project Status: On track and ongoing

XI. FY 2016 Budget Status
- A. Funds Provided: $59,999
- B. Funds Expended: $59,999
- C. Difference: $0
- D. Percent of the FY 2016 work completed: 100%
- E. Recovery Program funds spent for publication charges: $0

XII. Status of Data Submission:

We will submit all data to the database manager by December 2015.

XIII. Signed: *Chris Smith & Matthew J. Breen* November 14, 2016
Principal Investigators Date

References:

Breen, M.J., J.A. Skorupski Jr., A. Webber, and T. Jones. 2012. Smallmouth bass control in the White River. Annual Report to the Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Budy, P., M.M. Conner, N.L. Salant, and W.W. Macfarlane. 2015. An occupancy-based quantification of the highly imperiled status of desert fishes of the southwestern United States. Conservation Biology 29 (4):1142–1152.

Fiorelli, M.D. and M.J. Breen. 2015. Conservation activities for three species in northeastern Utah, 2014. 2014 Statewide Three Species Monitoring Summary, Publication No. 15-27. Utah Division of Wildlife Resources, Salt Lake City, Utah

Fiorelli, M.D. and M.J. Breen. 2014. Conservation activities for three species in northeastern Utah, 2013. 2013 Statewide Three Species Monitoring Summary, Publication No. 14-19. Utah Division of Wildlife Resources, Salt Lake City, Utah.

Smith, C., T. Jones, M.J. Breen, R.C. Schelly, and J. Logan. 2015. Smallmouth bass control in the White River. Annual Report to the Upper Colorado River Endangered Fish Recovery Program. Denver, CO

Webber, A., M.J. Breen, and J.A. Skorupski Jr. 2013. Smallmouth bass control in the White River. Annual Report to the Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Webber, A., M.T. Jones, M.J. Breen, and R.C. Schelly. 2014. Smallmouth bass control in the White River. Annual Report to the Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Table 1. Sub-adult (includes all bass < 200 mm) and adult smallmouth bass removed from the White River for each pass in 2016. River miles (RM) and dates sampled are also indicated for each pass.

Pass/Date	RM	Sub-adults	Adults	Total
1 - CPW, 11 May	93.4 - 88.4	4	6	10
2 - CPW, 12 May	93.4 - 88.4	11	15	26
3 - CPW, 13 May	93.4 - 88.4	3	15	18
4 - CPW, 1 June	104.3 - 95.1	26	87	113
5 - CPW, 1 June	93.4 - 87.5	28	21	49
6 - CPW, 2 June	104.3 - 95.1	35	73	108
7 - CPW, 2 June	93.4 - 87.5	15	20	35
8 - CPW, 7 June	104.3 - 95.1	13	29	42
9 - CPW, 8 June	93.4 - 87.5	11	11	22
10 - FWS, 14 June	104.3 - 93.4	40	11	51
11 - FWS, 20 June	104.3 - 93.4	27	16	43
12 - FWS, 24 June	93.4 - 87.5	23	30	53
13 - FWS, 27 June	104.3 - 93.4	64	22	86
14 - FWS, 28 June	93.4 - 87.5	288	76	364
15 - FWS, 29-30 June	104.3 - 93.4	230	52	282
16 - CPW, 6 July	104.3 - 97.1	154	45	199
17 - CPW, 7 July	95.1 - 93.4	40	6	46
18 - CPW, 7 July	93.4 - 87.5	125	20	145
1 - UDWR, 6 June	71.6 - 59.0	8	10	18
2 - UDWR, 9 June	71.6 - 59.0	24	7	31
3 - UDWR, 11 June	71.6 - 59.0	28	10	38
4 - UDWR, 15-18 June	71.6 - 24.0	58	11	69
5 - UDWR, 21 June	71.6 - 59.0	35	3	38
6 - UDWR, 23 June	71.6 - 59.0	56	9	65
7 - UDWR, 25 June	71.6 - 59.0	126	14	140
7 - UDWR, 27 June	71.6 - 61.5	49	1	50
Project 128 1 - FWS, 19 April-5 May	104.3 - 0.0	10	38	48
Project 128 2 - FWS, 3 May-20 May	104.3 - 0.0	0	11	11
Project 128 3 - FWS, 23 May-6 June	104.3 - 0.0	22	42	64
Totals		1553	711	2264

Table 2. Ancillary captures from the White River, 2016.

Species	Total Captured	Length Range (mm)
Black bullhead	3	225 - 240
Black crappie	64	81 - 236
Bluehead x WS hybrid	28	116 - 420
Brown trout	1	297
Colorado pikeminnow	6	495 - 685
Flannelmouth x BH hybrid	1	336
Flannelmouth x WS hybrid	141	142 - 452
Green sunfish	126	56 - 169
Northern pike	2	545 - 662
Rainbow trout	1	291
*Roundtail chub	36	138 - 372
Razorback sucker	1	496
White sucker	49	77 - 485
Yellow perch	2	147 - 166

*** Roundtail chub were not collected in the Colorado portion of this project**

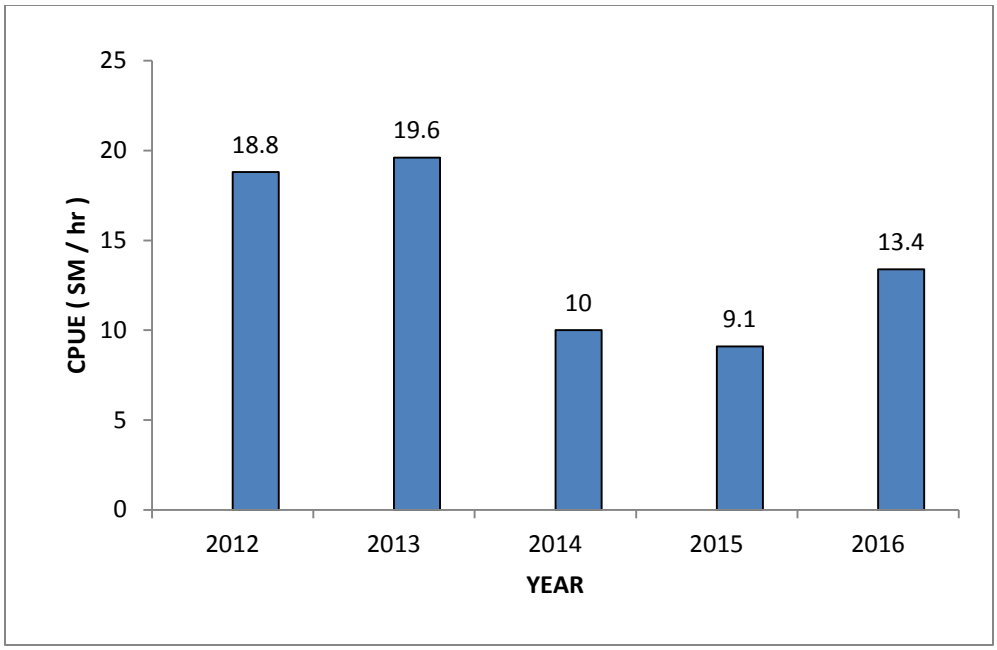

Figure 1. Catch rate for all smallmouth bass captured during nonnative fish passes in the White-River in Colorado (RMI 104.3-87.5), 2012-2016.

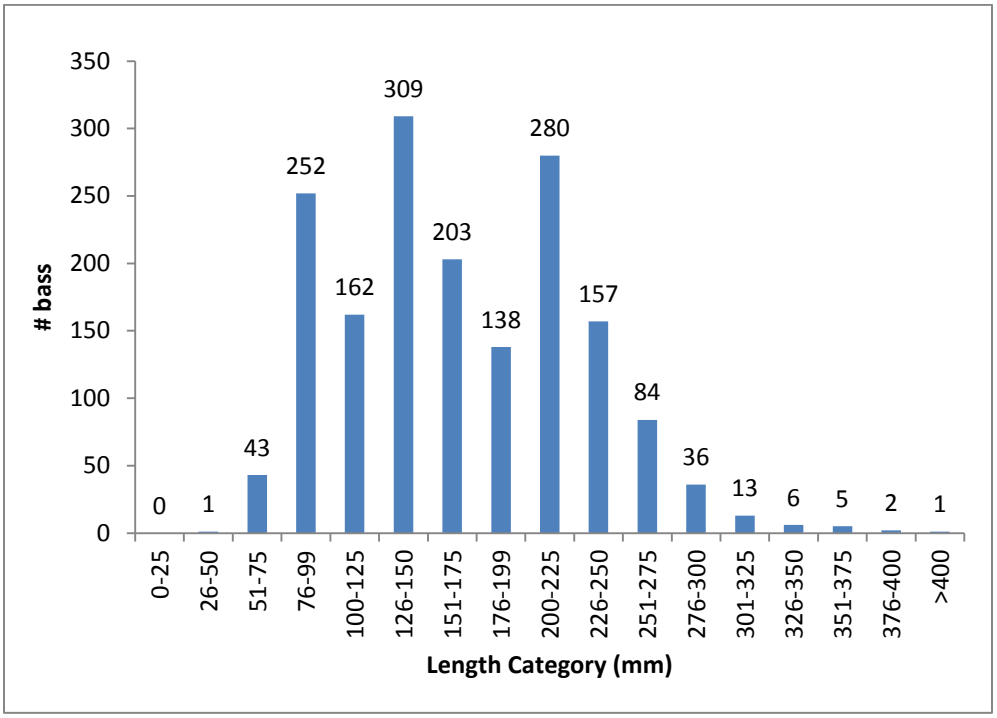

Figure 2. Length frequency of smallmouth bass removed from the White River in Colorado, 2016.

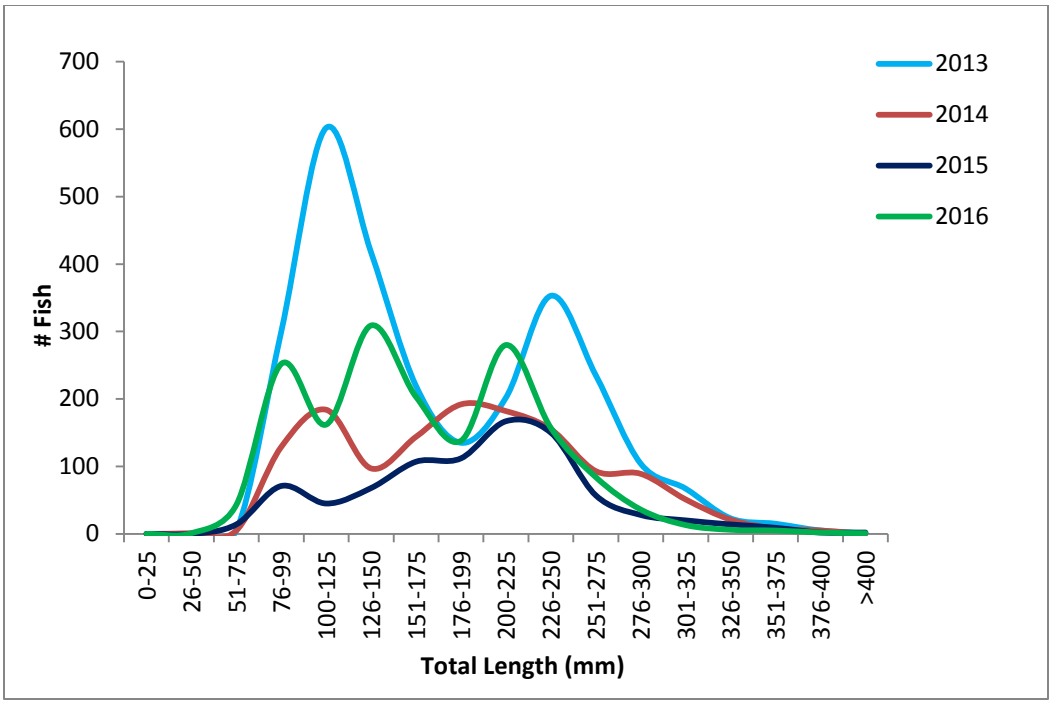

Figure 3. Length frequency of smallmouth bass removed from the White River in Colorado, 2012-2016.

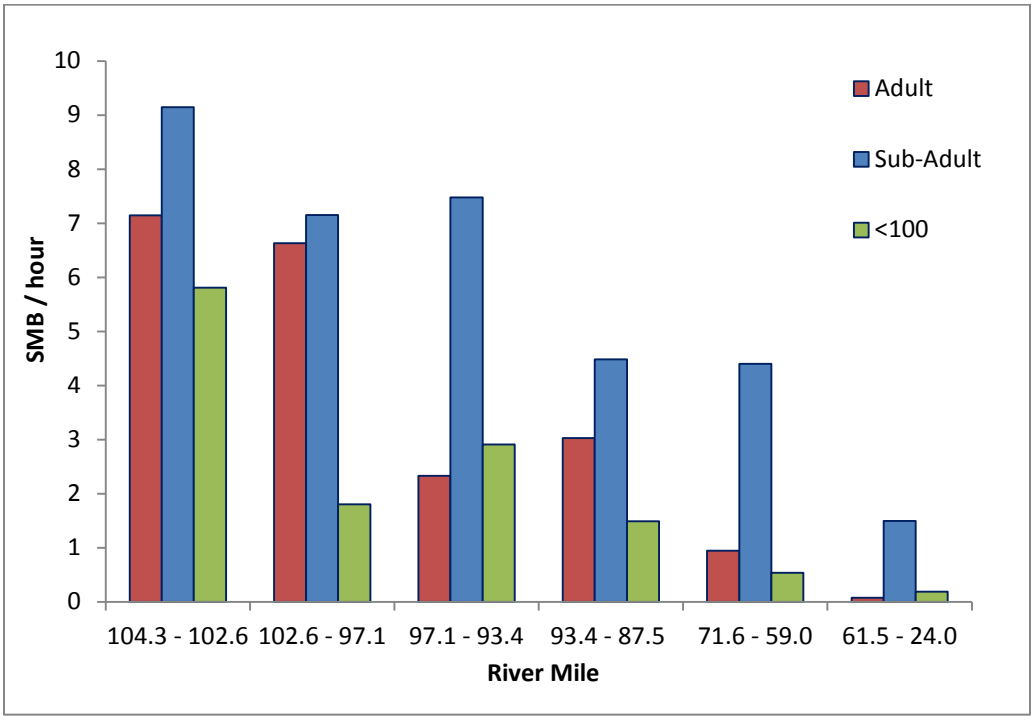

Figure 4. Catch rates for different size classes of smallmouth bass in the White River, CO and UT by river reach, 2016. The Evacuation Creek confluence is located at river mile 61.5.

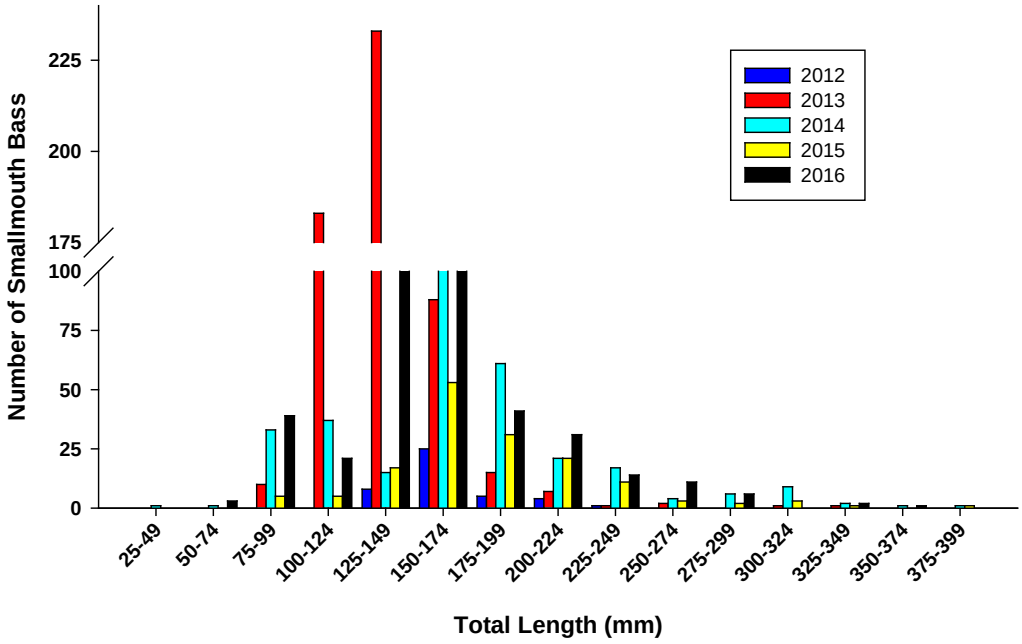

Figure 5. Length-frequency distribution of smallmouth bass collected in the Utah portion of the White River. Three passes of cataraft electrofishing were conducted from RM 66.5–24 in 2012, one pass was conducted from RM 75.8–24.0 in 2013, two passes were conducted from RM 71.6-24.0 in 2014, four passes (two full passes broken up) were conducted from RM 71.6-24.0 in 2015, and eight passes (three full passes broken up) were conducted from RM 71.6-24.0 in 2015.

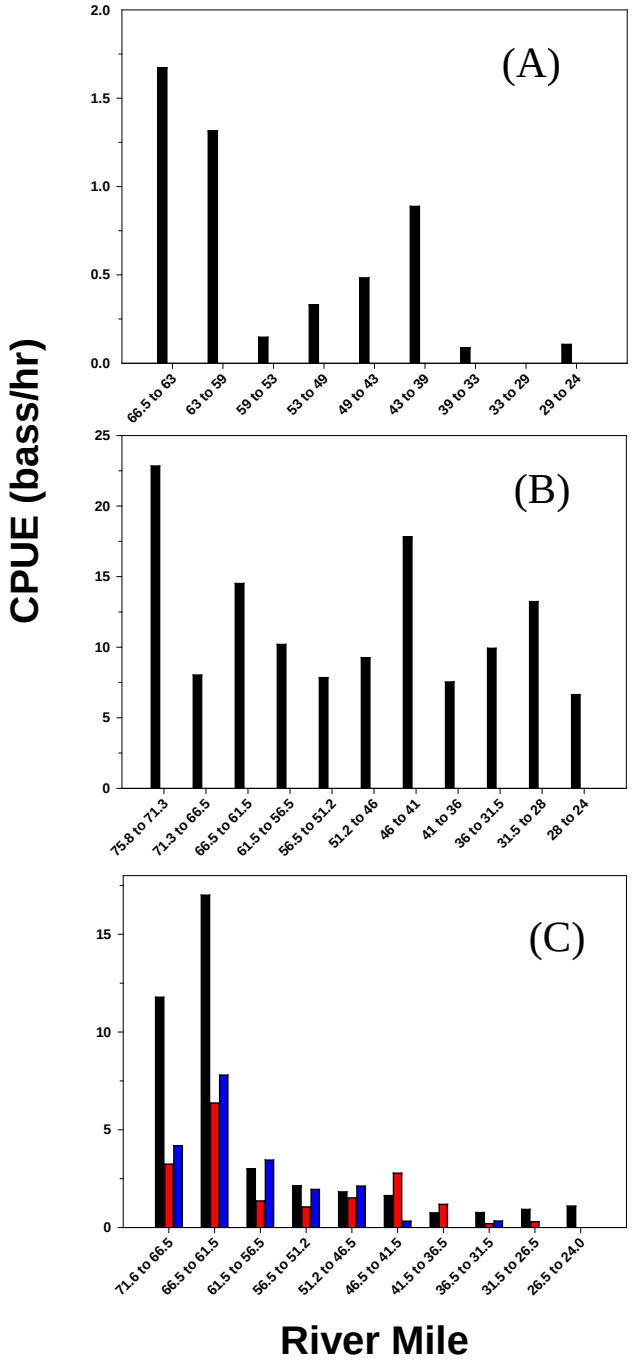

Figure 6. Catch-per-unit-effort (CPUE) of smallmouth bass collected during cataraft electrofishing in the White River from (A) three passes conducted in 2012 from RM 66.5–24, (B) one pass conducted in 2013 from RM 75.8–24, and (C) two passes conducted in 2014 from RM 71.6–24 (black bars), four passes (two passes broken up) conducted in 2015 from RM 71.6–24 (red bars), and eight passes (three passes broken up) conducted in 2016 from RM 71.6–24 (blue bars). Note the difference in the Y-axis scale when comparing panels.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: #R14AP00007

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 167

Project Title: Smallmouth bass control in the White River

Principal Investigator:

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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): 9/30/2016
Is this the final report? Yes _____ No __X___

Performance:

Tasks 2–3 were accomplished as outlined in the scope of work for this project. We completed two passes of cataraft electrofishing from RM 71.6–24.0 and determined that bass densities in the lower White River have decreased from initial range expansion of the strong 2012 cohort. However, a greater abundance of adult bass will continue to pose a challenge. We removed a total of 153 smallmouth bass, 27% of which were adults. Annual reporting is complete under task 3 and nonnative data will be submitted to Recovery Program personnel by January 2017.
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ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: # R15PG00083

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 167

Project Title: Smallmouth bass control in the White River

Principal Investigator:

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Project/Grant Period: Start date: 10/01/2014
End date: 09/30/2019
Reporting period end date (Mo/Day/Yr): 9/30/2016
Is this the final report? Yes ____ No __X___

Performance: USFWS completed tasks 1 and 3 under this scope of work. We conducted seven days of electrofishing in order to remove smallmouth bass from the White River downstream of Taylor Draw Dam (task 1). This report fulfills task 3, data analysis and reporting.