COLORADO RIVER RECOVERY PROGRAM
FY 2017 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 167

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 & Wildlife worked collaboratively to control an established and expanding population of smallmouth bass in the White River. In 2017, a total of 3,109 smallmouth bass were removed between Taylor Draw Dam and the Green River confluence (river mile 104.3-0.0). In Colorado catch rates were higher in 2017 than the previous three years; in Utah catch rates were the highest to date due to a dramatic increase in sub-adults. Juvenile (< 100 mm TL), sub-adult (100-199 mm TL), and adult (> 200 mm TL) smallmouth bass were caught in 2017, demonstrating that successful reproduction and survival have occurred in this system for at least the past three years.

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 2017 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 (CPW) removed smallmouth bass from the Taylor Draw Dam to the Colorado/Utah border between 3 May and 24 June 2017 (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 the most spawning adult bass (Breen et al. 2012; Webber et al. 2013, 2014; Smith et al. 2015, 2016). Additionally, one day of removal was conducted from the BLM Big Trujillo boat launch to the Utah border (RM 87.5-71.6) because early season effort in this reach indicated higher bass densities than previous years.

During eleven days of electrofishing 1,215 smallmouth bass were removed, consisting of 435 adults (≥ 200 mm TL), 558 sub-adults (100-199 mm TL), and 222 fish < 100 mm TL (likely age-1). Of the 435 adults caught, 15 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 size structure of bass caught in 2017 revealed three size classes that correspond to fish spawned in 2014, 2015, and 2016 (Figures 2-3; Webber et al. 2014, Smith et al. 2015, 2016). Although the magnitude of bass captured varies by year, age-1 fish comprise a noticeable proportion of each year's sample, indicating consistent reproduction and juvenile survival in the White River since 2012 (Figure 3).

The catch rate for smallmouth bass from Taylor Draw Dam to the Bureau of Land Management (BLM) Big Trujillo boat launch (RM 104.3-87.5) in 2017 was 14.7 fish/hr; catch rates below the Big Trujillo boat launch were similar (Effort = 13.3 hrs, catch-per-unit effort [CPUE] = 13.3 bass/hr). Although the catch rate for smallmouth bass in 2017 was higher than the previous three years (Figure 1), fewer smallmouth bass were caught

than in 2016. Higher catch rates in 2017 could reflect increased abundance of smallmouth bass in the Colorado portion of the White River, but at least partially result from decreased effort in 2017 compared to 2016 (84.1 hrs vs. 126.4 hrs, respectively) caused by logistical constraints (Federal hiring freeze, injuries). Targeted removal also occurred only during the descending limb of the hydrograph in 2017, when smallmouth bass catch rates tend to peak, potentially positively biasing catch rates.

Adult catch rates were markedly higher in 2017 than 2016 in the reach immediately below the Taylor Draw Dam (RM 104.3-102.6) and, similar to years past, declined abruptly downstream of Douglas Creek (RM 97.1; Figure 6; Webber et al. 2013, 2014). Sub-adult catch rates in Colorado also dropped moving downstream, akin to the declining catch rate gradient reported from 2012 to 2014, but unlike 2015 and 2016 where sub-adult catch rates between reaches were more consistent (Figure 6; Webber et al. 2013, 2014; Smith et al. 2015, 2016). This consistency in sub-adult catch rates observed in 2014 and 2015 hinted at the establishment of smallmouth bass throughout at least the Colorado portion of this study. While the absence of this pattern in 2017 counters this hypothesis, increased bass densities were noticed in reaches downstream of the upper 17 miles of this study reach during Project 128 passes in May, 2017.

Smallmouth bass removal from the Big Trujillo boat launch (RM 87.5) to the Utah state line (RM 71.6) had not been conducted as part of Project 167 since 2012 due to lower bass densities compared to reaches upstream observed during Project 128 passes and logistical issues resulting from limited access (private property) that would require a multi-day field trip and/or vehicle shuttle. The previously mentioned increase in bass captures in this reach in May prompted communication with the Program Director's Office, UDWR Vernal, and a cooperative landowner that allowed the addition of one day of electrofishing in this reach. During this single day of electrofishing, 177 smallmouth bass were caught, including 29 individuals in the adult size class, and the daily catch rate was 13.3 bass/hr. Given this relatively high catch rate, the number of bass caught in this reach when combined with Project 128 totals (n = 318), and the noticeable increase in Utah catch rates on the White River in 2017 (see below), targeted smallmouth bass removal should be continued in this "orphaned" reach in the future.

U.S. Fish and Wildlife Service (FWS) conducted additional bass removal on the White River as part of Project 128 (Colorado pikeminnow population estimate) as did CPW during annual Fish Community Surveys (FCS; Table 1). Project 128 consisted of three electrofishing passes from the Taylor Draw Dam to the Green River confluence (river mile [RM] 104.3-0.0) that were completed before Project 167 began. Colorado Parks and Wildlife's FCS also occurred prior to Project 167 fieldwork and consisted of three passes from RM 93.5-88.4. Combined, an additional 221 adult, 140 sub-adult, and 23 smallmouth bass < 100 mm were removed during these monitoring projects. Data from these projects (Table 1) are described here because it would otherwise not be reported within the Recovery Program, but is not factored into catch rates or length frequencies presented in this report to ensure comparability to previous efforts.

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

Twelve days of cataraft electrofishing removal (RM 71.6-24.0; 108.3 hrs of total effort) were completed from 2-24 June 2017 (Table 1). We selected this period 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 in upstream areas that have consistently proven to hold higher densities of smallmouth bass during past removal efforts (Breen et al. 2012; Webber et al. 2013, 2014; Smith et al. 2015, 2016). More specifically, we conducted three cycles of electrofishing (passes made every other day) in the same general area (RM 71.6 to 61.5 or 59.0), two to four days per cycle (Table 1). In order to monitor bass abundance in the lower White River, we conducted one pass from RM 59.0-24.0 from 14-16 June 2017. Although densities increased in this reach from 2016 (Smith et al. 2016), we verified that we were focusing the majority of our removal efforts in the most appropriate locations with even higher densities.

During this effort, 1,510 smallmouth bass were removed (mean ± SE = 112.4 ± 1.0 mm TL; range = 60-338 mm TL; Figure 4), representing more than a threefold increase over 2016, with a substantial shift to much smaller sizes on average size (46.5 mm drop in mean TL; Smith et al. 2016). Catch consisted of 1,461 sub-adults (≤ 199 mm TL) and 49 adults (> 200 mm TL), six of which were in the piscivore size class (≥ 325 mm TL; Figures 4 and 5). Overall CPUE was 13.94 fish/hr, more than three times the 2016 catch rate (Smith et al. 2016) and nearly five times the 2015 catch rate (Smith et al. 2015). Increased total catch and catch rates were driven largely by what appears to be a single year class of fish likely produced in 2016.

Combining all removal efforts, 15.9 bass/mile were removed on average, representing more than a threefold increase over 2016 (Smith et al. 2016; Figure 6). 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 3.3% adults, representing a substantial decrease over 2016 (14.5%; Smith et al. 2016), which followed an increasing trend observed in 2014 (19.1%; Webber et al. 2014) and 2015 (27.5%; Smith et al. 2015). However, this percentage is misleading with the drastic increase observed for sub-adults, specifically bass ranging in size from 75-124 mm TL (Figure 4), suggesting extremely successful recruitment of the 2016 cohort. With the exception of bass < 50 mm TL (i.e., 2017 cohort not yet susceptible to collection gear) and > 350 mm TL, population structure is represented by all size classes (Figure 4).

Adult bass were dissected for sex determination and gamete expression. Excluding one fish because sex was not recorded, 45 of 48 adult bass were reproductively mature (28 females, 17 males); 38.3% of adult female bass and 17.6% 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

our strategy to target spawning bass when most appropriate to achieve our main goal. Percentages of ripe bass removed in 2017 was similar to 2016 (Smith et al. 2016), but much higher for females, thus even more effective efforts essentially.

Catch-per-unit-effort of smallmouth bass in this sampling reach has varied considerably during the first six years of this project, a result of flow variability, fluctuating spawning success, and changing removal strategies. More importantly, dramatic changes in bass distribution along an upstream to downstream gradient are evident. 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).

To explain, RM 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 (YOY) 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 5c), 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 demonstrated that sediment deposition has had a profound effect on bass distribution in the lower White River. Moreover, comparing average CPUE above and below Evacuation Creek (Figure 5c), there was more than a four-fold difference in catch rates in 2015 (4.80 fish/hr vs. 1.05 fish/hr) and more than a three-fold difference in 2016 (5.88 fish/hr vs. 1.80 fish/hr); this result may or may not be associated with the Wolfden fire after several years of sediment sluicing, but regardless, there was a marked difference upstream and downstream of a known sediment contributor in both years.

We see similar results with 2017 catch rates, with the exception that CPUE was highest (26.8 fish/hr) in the 5-mile reach below Evacuation Creek (Figure 5c). This result possibly suggests that the successful 2016 cohort has made a density-based shift downstream (i.e., abundance of adults upstream; Figure 5) and/or spring runoff flushed smaller individuals well downstream of their origin. Regardless of the mechanism, substantially higher catch rates compared to previous years were observed as far downstream as RM 26.5 (Figure 5c). Given the drastic increase in sub-adults in the Utah portion of this study, the majority of which likely derive from 2015 and 2016 cohorts, we suspect that prolonged high spring discharge in previous years, especially 2014–2016, flushed smaller individuals downstream into the Utah reaches. Alternatively, bass may be reaching a critical mass in the White River, which may lead to permanent range expansion covering a greater percentage of the river.

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 the White River in 2017 than in 2016, with higher catch rates. The majority of bass (n=2,407) were sub-adults less than 200 mm TL (mean ± SE = 147.4 ± 1.3 mm TL) that were likely spawned in 2015 and 2016. In stark contrast to previous years, the majority of bass captures during Project 167 passes occurred in Utah in 2017, which is likely attributable to continuing range expansion and an improved removal strategy by crews in Utah. Adult catch rates were highest near Taylor Draw Dam and decreased moving downstream (Figures 4 and 5c). Adult smallmouth bass catch rates decreased in the Utah portion of the White River (0.64 adults/hr in 2016 vs. 0.45 adults/hr in 2017), however sub-adult catch rates and captures increased dramatically. In Colorado, catch rates for all smallmouth bass were higher in 2017 than in 2016 in the reach immediately downstream of Taylor Draw Dam, but were similar in other reaches. 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.

Task 3: Data entry, analysis, and reporting

Recovery Program annual progress report submitted November 2017.

VIII. Additional noteworthy observations:

Noting that white sucker x native sucker hybrids have been removed opportunistically in the Colorado portion of this study, substantial increases in the number of white sucker hybrid captures occurred, particularly in the Utah portion of the White River in 2015 followed by a smaller increase again in 2016 (Smith et al. 2015, 2016). Moreover, size distribution of both flannelmouth x white sucker and bluehead x white sucker hybrids has increased in the White River, suggesting more stable populations through time (Fiorelli and Breen 2016). White sucker hybridization in the White River presents a direct threat to the genetic integrity of this robust native catostomid community (e.g., Fiorelli and Breen 2014, 2015).

Continued concerns exist with the potentially negative impacts that electrofishing has on native fishes in the White River given the amount of effort exerted since the project began in 2012, especially in upper reaches. In comparison to other rivers where smallmouth bass control occurs in this region, the White River is generally narrower and electrofishing fields from two rafts could extend through the entire river. Native species, such as bluehead sucker and roundtail chub, are actively spawning while we are removing smallmouth bass, with higher concentrations of spawning aggregations corresponding with reaches containing the highest smallmouth bass abundance. Furthermore, fall YOY native fish surveys have shown a continued decline in recruitment since 2012 (Fiorelli and Breen, In Prep). Although this decline could be partially explained by sedimentation in rearing habitats derived from Evacuation Creek and/or the strong smallmouth bass cohorts from 2015 and 2016 mentioned above, negative impacts

from electrofishing should not be discounted. Past research has shown that electrofishing fields can disrupt reproduction and/or affect survival of species of concern (Muth and Ruppert 1996; Snyder 2003). More specifically, electrofishing over active spawning grounds can damage gametes in reproducing adults, cause premature expulsion of gametes, reduce viability of fertilized eggs, detrimentally affect survival of embryos on or in the substrate, and exposure of recently hatched larvae to electrical fields can reduce growth rates for up to several weeks (Snyder 2003). Shifting at least a portion of smallmouth bass removal effort to later in the year in Utah would limit overlap with spawning native fishes and increase catch rates as we are typically more effective in slower flows with better water clarity as peak discharge further recedes (Table 2). However, flow and access constraints would likely prevent extending smallmouth bass removal below discharges less than 450 cubic feet per second in Colorado. Nonetheless, we will continue to attempt to reduce electrofishing impacts on native fish by limiting the frequency of removal passes to at most every other day in a given reach and avoiding native fish whenever possible during spawning periods throughout the White River.

The onset of the smallmouth bass spawning period in the nearby Yampa and Green Rivers occurs at or near 16ºC (Bestgen and Hill 2016). In the White River, real time stream temperature data is recorded at the Bonanza Bridge PIT tag antenna (RM 59.0). This temperature logger is located up to 45.3 river miles downstream from reaches where the highest spawning adult densities have been observed in this system. Crews currently record water temperature while conducting removal in these reaches, but the data is only available for days when fieldwork is occurring. Comprehensive temperature data recorded by low cost temperature loggers would allow further understanding of the timing and duration of the smallmouth bass spawning period in the White River.

IX. Recommendations:

- We recommend maintaining current levels of smallmouth bass removal effort in both the Colorado and Utah portions of this study, but adjusting the spatial and temporal efforts to maximize coverage and efficiency (see further recommendations). Since 2013, a general decrease in catch rates has been observed in the White River, but increased numbers in 2016, and substantial increases in 2017 warrant continued pressure on this population.

- The future allocation of removal effort should include one or more passes in lower reaches in Colorado (RM 87.5-71.6) per year to monitor this previously unsampled reach.

- Removal passes in the upper 11 miles of the White River below Taylor Draw Dam should continue to target adult smallmouth bass before and during the spawn period since spawning adults make up a larger proportion of the total catch in Colorado.

- Given that subadults comprise a considerably larger portion of the catch than spawning adults in Utah, we propose to maximize the number of fish removed by

electrofishing after the spawning period since catch rates often increase as flows in the White River recede. Specifically, we will focus on water clarity and not necessarily water temperature to optimize the number of fish removed.

- Despite relatively low white sucker densities, a substantial increase in white sucker hybrid captures has occurred since 2014, warranting continued focus toward nonnative catostomid removal in the White River in the future.

- Annual thermographs from multiple locations down a longitudinal gradient would provide valuable information that could be used to better understand spawn timing and allow further refinement of removal strategies. Therefore, we recommend deploying low-cost temperature loggers throughout the White River below Taylor Draw Dam to collect this data.

X. Project Status: On track and ongoing

XI. FY 2017 Budget Status
- A. Funds Provided: $72,641
- B. Funds Expended: $72.641
- C. Difference: $0
- D. Percent of the FY 2017 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 2017.

XIII. Signed: *Chris Smith, Matthew J. Breen, & Jenn Logan* November 16, 2017

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.

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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 2017. River miles (RM) and dates sampled are also indicated for each pass.

Agency/Date	RM	Sub-adults	Adults	Total
FWS 128, 3 May-6 June*	104.3 - 0.0	126	173	299
CPW FCS, 9-11 May*	93.4 - 88.4	37	48	85
CPW, 30 May	93.4 - 87.5	45	30	75
CPW, 31 May	104.3 - 95.1	88	117	205
CPW, 1 June	104.3 - 95.1	118	83	201
CPW, 2 June	93.4 - 87.5	20	14	34
FWS, 8 June	104.3 - 93.5	75	66	141
FWS, 15 June	87.5 - 72.0	148	29	177
FWS, 16 June	93.4 - 87.5	33	18	51
FWS, 19-20 June	104.3 - 93.5	82	22	104
CPW, 22 June	104.3 - 95.1	116	44	160
CPW, 23 June	95.1 - 87.5	55	12	67
UDWR, 2 June	71.6 - 61.5	55	7	62
UDWR, 4 June	71.6 - 61.5	58	3	61
UDWR, 6 June	71.6 - 61.5	137	4	141
UDWR, 9 June	71.6 - 59.0	127	6	133
UDWR, 11 June	71.6 - 61.5	65	6	71
UDWR, 14-16 June	59.0 - 24.0	128	4	132
UDWR, 18 June	71.6 - 61.5	267	4	271
UDWR, 20 June	71.6 - 61.5	169	5	174
UDWR, 22 June	71.6 - 61.5	177	5	182
UDWR, 24 June	71.6 - 59.0	278	5	283
Totals		2404	705	3109

*** Ancillary captures from native and endangered fish monitoring projects**

Table 2. Ancillary captures from the White River, 2017.

Species	Total Captured	Length Range (mm)
Black bullhead	9	139 - 227
Black crappie	25	65 - 258
Bluehead x WS hybrid	15	168 - 418
Brown trout	2	180 - 211
*Colorado pikeminnow	11	199 - 816
Flannelmouth x WS hybrid	89	109 - 549
Green sunfish	73	36 - 192
Northern pike	1	595
Rainbow trout	2	339 - 380
**Roundtail chub	156	120 - 437
*Razorback sucker	1	454
White sucker	74	112 - 476
Yellow perch	1	171

*** Colorado pikeminnow and razorback sucker captured during Project 128 passes are not reported here.**
**** Roundtail chub captures in CO (n = 98) occurred during Project 128 passes only.**

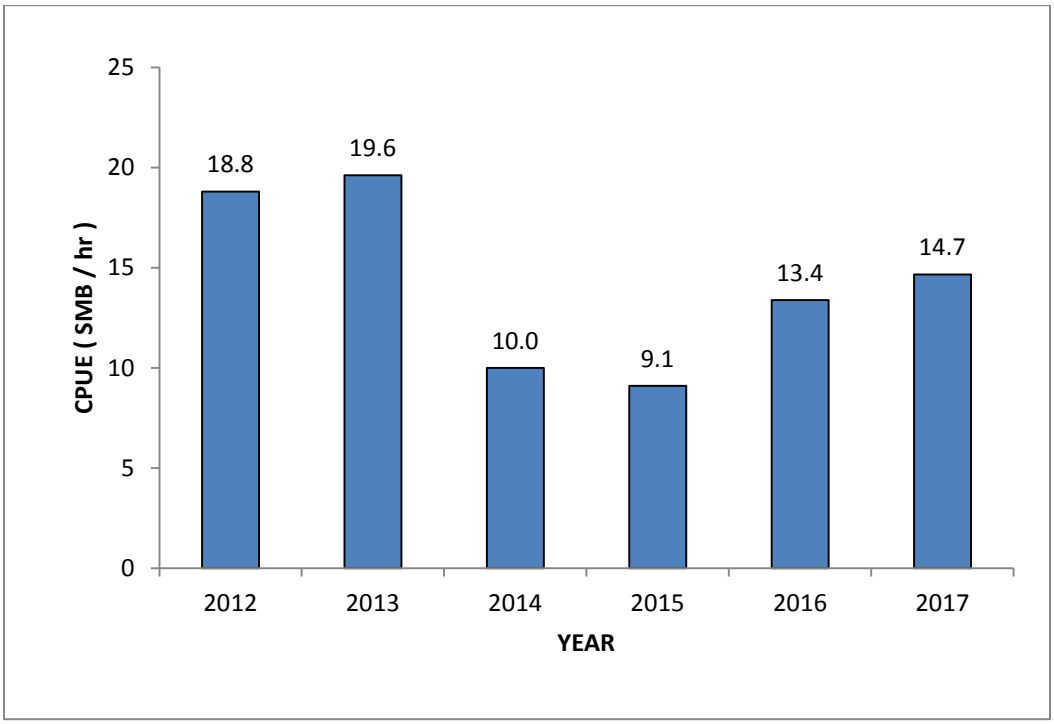

Figure 1. Catch rate for all smallmouth bass captured during Project 167 passes in the White-River in Colorado (RM 104.3-71.6), 2012-2017.

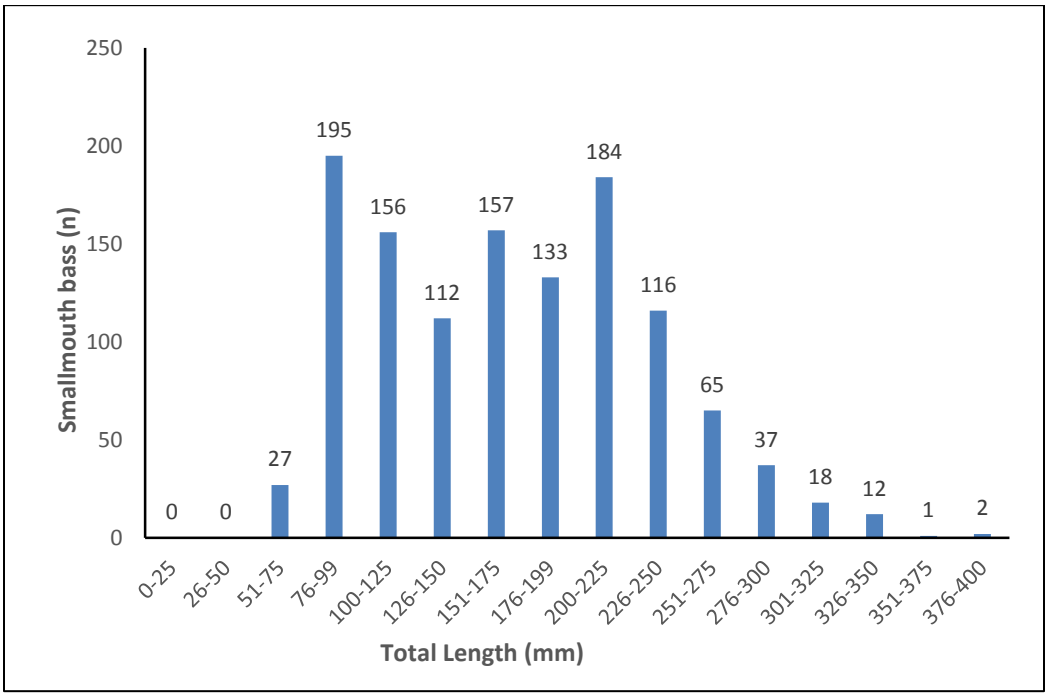

Figure 2. Length frequency of smallmouth bass removed from the White River in Colorado, 2017.

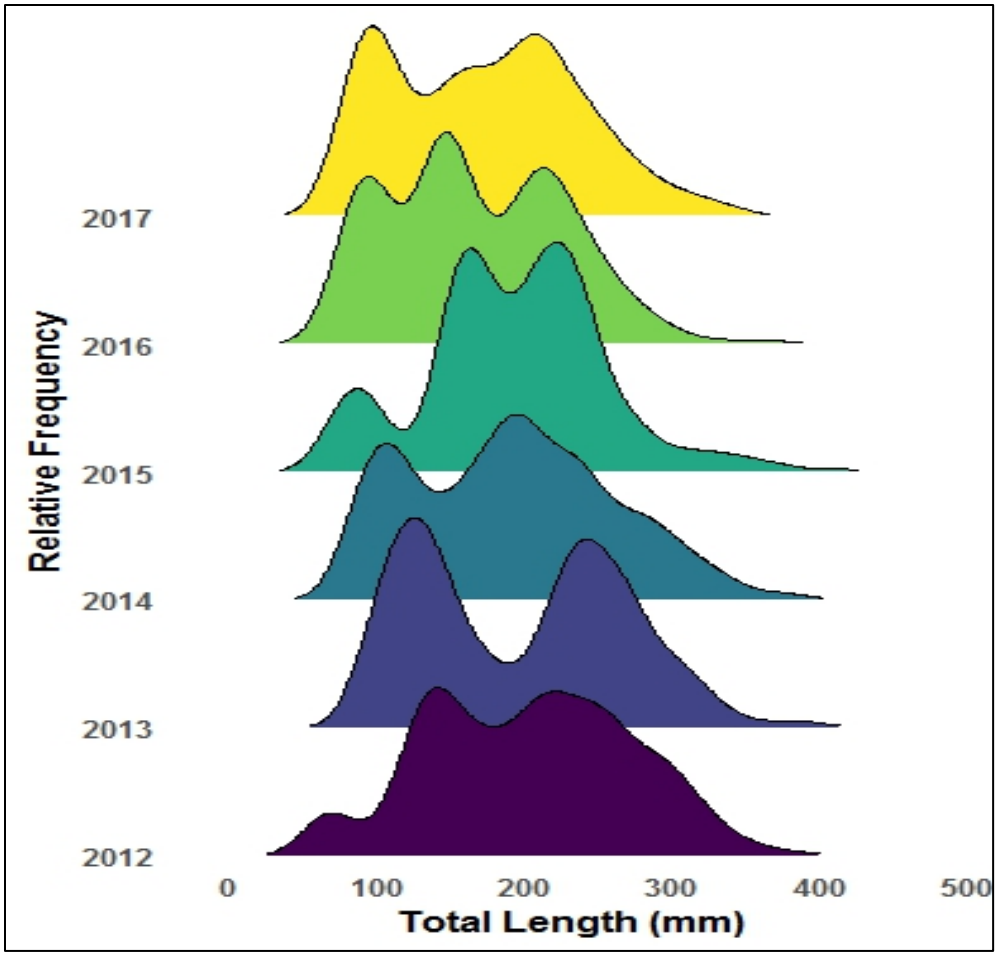

Figure 3. Relative frequency of smallmouth bass removed from the White River in Colorado, 2012-2017.

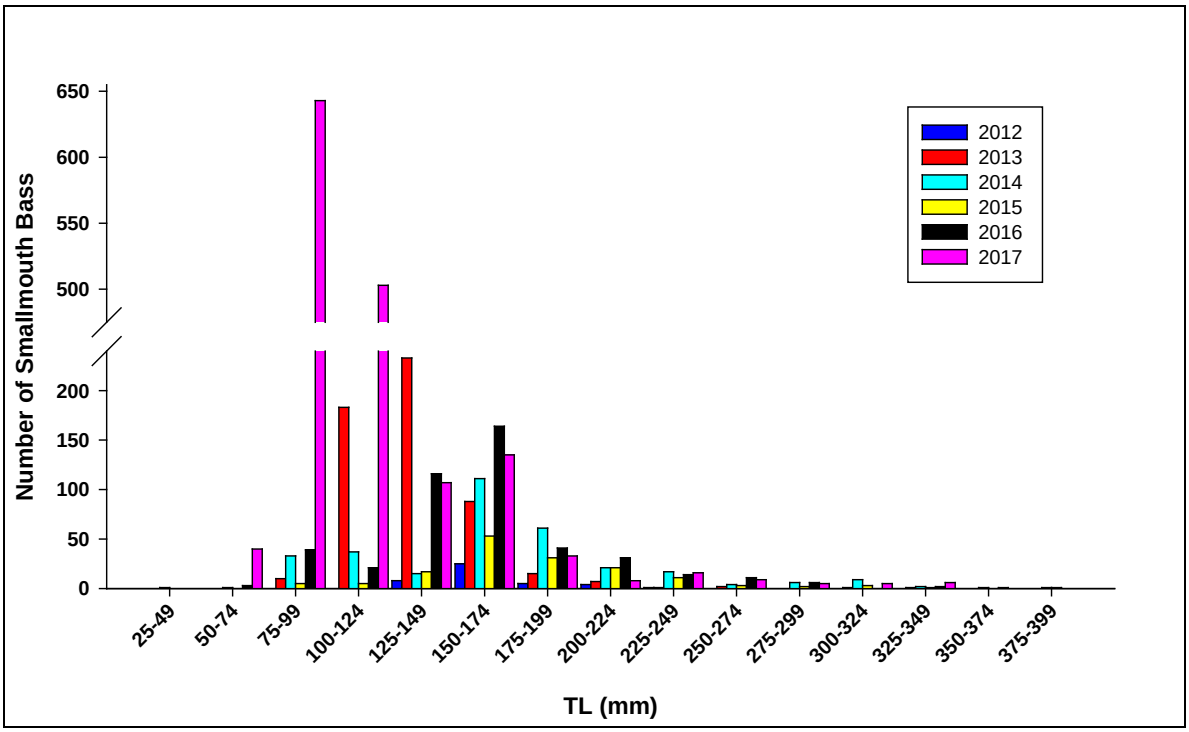

Figure 4. Length-frequency distribution of smallmouth bass collected in the Utah portion of the White River. Three 4-day passes of cataraft electrofishing were conducted from RM 66.5–24.0 in 2012, one 4-day pass from RM 75.8–24.0 in 2013, and two 4-day passes from RM 71.6-24.0 in 2014. Beyond 2014, sampling was conducted from RM 71.6-24.0 with one full pass each year and remaining effort distributed as needed in higher concentration areas; eight, 11, and 12 days of total effort in 2015, 2016, and 2017, respectively.

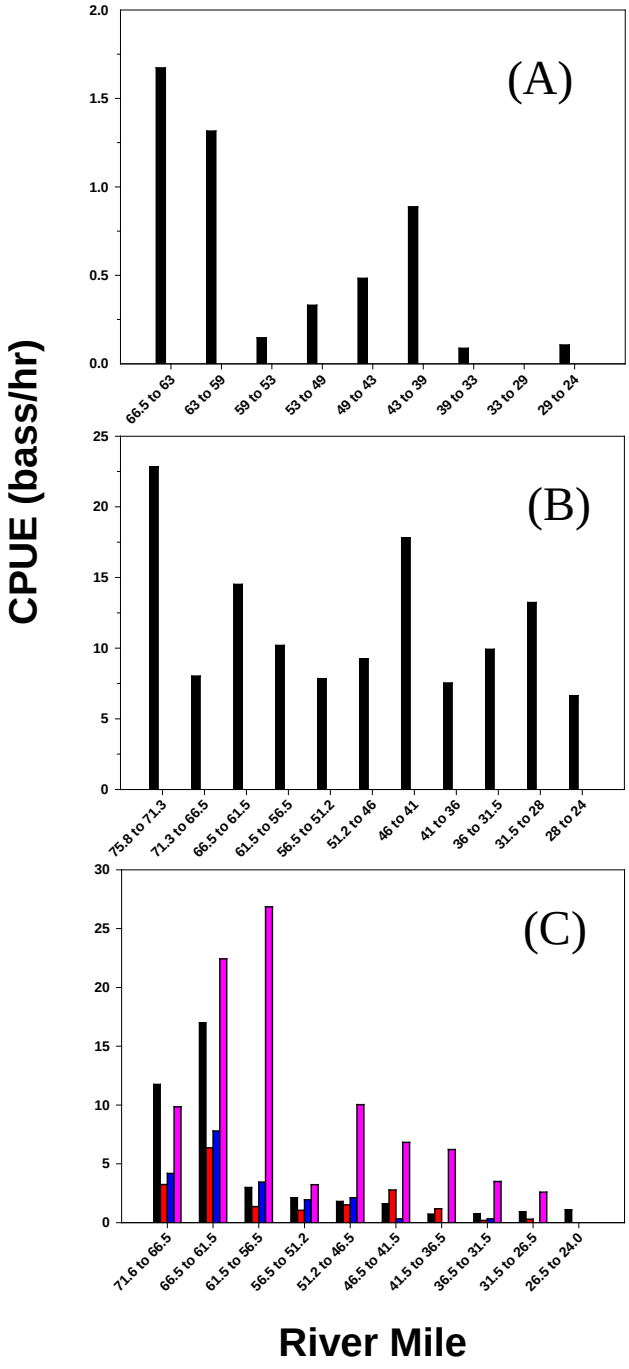

Figure 5. Catch-per-unit-effort (CPUE) of smallmouth bass collected during cataraft electrofishing in the White River from (A) three passes conducted in 2012 from RM 66.5–24, (B) one pass conducted in 2013 from RM 75.8–24, and (C) two passes conducted in 2014 from RM 71.6–24 (black bars). One full pass was conducted from RM 71.6-24 with the remaining effort distributed as needed in higher concentration areas in 2015 (red bars), 2016 (blue bars), and 2017 (pink bars). Note the difference in the Y-axis scale when comparing panels.

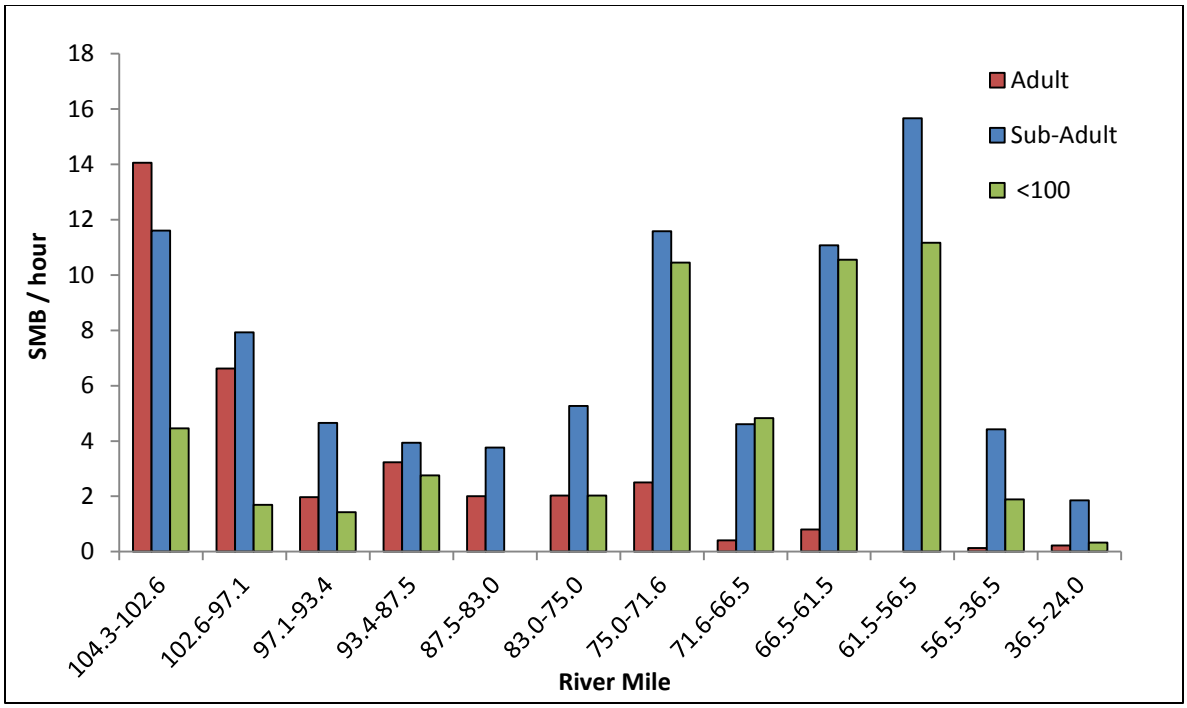

Figure 6. Catch rates for different size classes of smallmouth bass in the White River, CO and UT by river reach, 2017.

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): 9/30/2017
Is this the final report? Yes _____ No __X___

Performance:

Tasks 2–3 were accomplished as outlined in the scope of work for this project. From 2–24 June 2017 we completed three passes of cataraft electrofishing from river mile 71.6–24.0. Bass densities in the lower White River have increased drastically from 2016 levels, mainly due to marked differences in sub-adults (smallmouth bass < 200 mm TL). We removed a total of 1,510 smallmouth bass with 12 days of effort, only 49 of which were in the adult category. Annual reporting is complete under task 3 and nonnative data will be submitted to Recovery Program personnel by January 2018.