

COLORADO RIVER RECOVERY PROGRAM
FY 2016 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 123a

I. Project Title: Nonnative fish control in the Green River

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

Project/Grant Period: Start Date: 05/01/2014
End Date: 09/30/2018
Reporting period end date: 10/31/2016
Is this a final report? Yes No

III. Principal Investigator(s):
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IV. Abstract: This project consisted of two components: **a)** remove smallmouth bass on the Green River in Dinosaur National Monument between Echo Park and Split Mtn. (RM 344.5-319.5) and **b)** remove smallmouth bass in Desolation/Gray Canyons (Green River RM 215.3-129.8). All components were completed. Combined, the United States Fish and Wildlife Service (USFWS) and the Utah Division of Wildlife Resources (UDWR) completed eleven passes and one targeted sampling pass for spawning bass in the Echo-Split reach, resulting in the removal of 938 smallmouth bass. UDWR-Moab also tagged and released 78 smallmouth bass on the third pass in order to estimate abundance in this reach. A Lincoln-Petersen model produced a point estimate of 1,300 bass ≥ 100 mm, or 52 bass/mile. UDWR-Moab completed one removal pass in Desolation and Gray Canyons and removed 69 bass; catch rates were lower than 2014 and similar to 2015. Smallmouth bass distribution in Desolation/Gray Canyons continued to encompass the entire reach. An additional 76 smallmouth bass were removed in Desolation and Gray Canyons by USFWS during Project 128. Removal of walleye and other nonnative fishes in the lower Green and lower Colorado Rivers, as required in this project's scope of work, will be reported on in Evaluation of Walleye Removal in the Upper Colorado River Basin Annual Report (Michaud et al.).

V. Study Schedule: 2004-ongoing

VI. Relationship to RIPRAP:
GENERAL RECOVERY PROGRAM SUPPORT ACTION PLAN

- III. Reduce negative impacts of nonnative fishes and sportfish management activities (nonnative and sportfish management).
- III.A. Reduce negative interactions between nonnative and endangered fishes.
- III.A.2. Identify and implement viable active control measures.

GREEN RIVER ACTION PLAN: MAINSTEM

- III. Reduce impacts of nonnative fishes and sportfish management activities (nonnative and sportfish management).
- III.A. Reduce negative impacts to endangered fishes from sportfish management activities.
- III.A.4. Develop and implement control programs for nonnative fishes in river reaches occupied by the endangered fishes to identify required levels of control. Each control activity will be evaluated for effectiveness, and then continued as needed.

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

Task 1 & 2: Smallmouth bass removal-Echo Park to Split Mtn.

The two agencies completed eleven full passes, plus one earlier “surge” pass designed to target spawning adults in Island Park once temperatures reached 16°C. On the third pass, UDWR tagged 78 bass (58 adults¹, 20 sub-adults²) with green Floy tags in order to estimate smallmouth bass abundance in this reach. The other eleven passes, including the surge pass, consisted only of removal, and crews were able to remove 938 bass, including 428 fish <100 mm, 116 sub-adults, 350 adults, and 44 fish where length data were corrupted on the data logger (Table 1). Out of the 408 adults captured, 23 were large enough to be considered piscivores³ posing a competitive threat to Colorado pikeminnow. The size class catches reported above were based on total length at the time of capture.

The catch rate for all bass across passes was 4.17 fish/hour. For adults and sub-adults combined the catch rate was 2.2 fish/h, which represents a continued decrease since 2013 (Figure 1). We captured 1.68 adults/h and 0.56 sub-adults/h when using absolute size classes based on a 200 mm threshold for adult size. Catch rates were highest during the first seven passes and surge pass, and decreased beginning in late August (Fig. 2). As was seen in 2015, a single pass (pass 11) where rain storms increased turbidity during the pass showed much higher catch rates, double that of the preceding passes. This was particularly true for adult catch rates.

Length-frequency histograms show that most bass captured in the first half of sampling

¹Total length (TL) ≥200mm

² TL=100-199mm

³ TL ≥325mm

were adults, but young of year bass became more common by September (Figs. 3a-b). For all passes combined, 14% of the bass caught were 100-199 mm and 42% were ≥ 200 mm. Data from 2013-2016 show a decreasing trend for bass >100 mm over the last four years, with young of year fish representing the only notable size class for 2016 (Fig. 4). Twenty-three piscivore sized bass were captured this year, which was comparable to 2009-2011, and higher than 2015.

After tagging 78 bass on the third pass, we were able to recapture a total of 17 fish (1 sub-adult, 15 adults, and 1 of unknown length) over the remaining passes. The tagging and recapture data allowed us to estimate the abundance of bass in this reach (Table 2). The third through fifth passes occurred in a two week period, so we used data only from those passes in order to generate a Lincoln-Petersen estimate to minimize the possibility of violating the assumption of closure in the reach. The three pass data produced a point estimate of 1,300 bass ≥ 100 mm, or 52 bass/mile. The bass abundance estimates are compared to previous years' in Figure 5. No estimates were conducted in 2011-2014. Based on the point estimate of 1,300 bass, we were able to remove 31% of the fish ≥ 100 mm after the estimate. If calculated based on tag returns (% tags recaptured), we removed 22% of the marked bass. As the water cleared during base flows, adults of all species became more difficult to sample. Crews began focusing sampling on deeper water in an effort to capture more fish. Turbidity caused by flash floods on pass 11 doubled the catch rate compared to other passes late in the summer, suggesting there were more bass available for capture, but they were not readily sampled with electrofishing.

Tagging fish this year also allowed the analysis of movement and growth. The mean growth rate for all recaptured bass was 0.435 mm/day. Only one sub-adult bass was recaptured, and its daily growth rate was similar to that of adults. We did not adjust size classes for growth as in past years because there were few bass caught around the size threshold for classifying them as adults (200mm). Only three fish moved downstream after tagging, one moved upstream, and twelve were recaptured in the same reach. We recaptured four bass that were tagged in 2015. These fish had grown from sub-adult into adult size between June 2015 and July 2016⁴. Except for one fish that moved from Island Park into Whirlpool Canyon, the other fish were caught in the same reach where they were originally tagged.

Ripe fish were captured in passes 1-5 and the surge pass. These fish were found in all reaches, but were most common in lower Whirlpool Canyon and Island Park. They ranged in size from 205-394mm, with an average length of 261mm. The majority of ripe individuals noted were females spanning this size range.

We also captured five other species of nonnative fish this year (Table 3), including black crappie, green sunfish, northern pike, walleye, and white sucker and their hybrids. All nine walleye were large enough to be classified as piscivores, as well as nine of the twelve northern pike captured. One of the pike captured was a tagged fish found in Island Park on 27 July. This fish was originally tagged 6 May 2012 in Lily Park (Yampa River

⁴ Mean growth between 2015 and 2016 was 55mm.

mile 53.5). It had grown from 575mm and 1100g to 726mm and 2243g.

Island Park “surge”

This was the third year where we attempted to disrupt and remove spawning adult bass by conducting passes in Island Park during water temperatures conducive to spawning. The time period when this occurred was later than expected due to late season precipitation and run-off in conjunction with prolonged releases from Flaming Gorge dam. As a result, bass spawning was likely postponed until July. These passes were a collaborative effort between UDWR-Moab, USFWS, and UDWR-Vernal. UDWR-Vernal sampled the reach on June 30 and July 11 using hard-bottomed boats (details reported in 123b annual report). USFWS sampled the reach July 15 as an extension of Yampa Canyon smallmouth bass removal passes. UDWR-Moab started work in that reach as part of the typical sampling, July 3-21. During this time, adults were observed expressing gametes, indicating spawning was imminent or occurring. The combined passes just for this reach yielded 61 adults with a catch rate of 1.78 adults/h. Although this catch rate is similar with that for the project as a whole, there were only 38 adults captured in this reach over the rest of the sampling period (passes 5-11, CPE=0.93 adults/h). Despite relatively later spawning this year, we did begin capturing young of year bass in the reach starting around September. These fish ranged in size from 31-97mm, with an average length of 52.7mm, presumably large enough to survive over winter. Other studies on the survival of juvenile smallmouth bass suggest that these fish need to reach 50mm before their first winter in order to survive (Shuter et al. 1980, Breton et al. 2015, Bestgen and Hill 2016). During the last two passes in early September, 51% of small bass captured exceeded this size threshold. Young of year fish exhibited an increasing gradient of density moving downstream with the highest numbers in Split Mountain, which is consistent with spawning sites previously observed in Island Park. We also sampled an isolated side channel pool where bass spawning was suspected based on earlier sampling during surge passes. Angling during the base flow period produced 15 large adults (TL=255-390mm), and seining and hoop nets produced 44 young of year bass. A similar site was observed in Split Mountain, but hoop nets were not effective in catching fish there.

Task 3: Smallmouth bass removal- Desolation and Gray Canyons

Due to a shift of effort to Colorado pikeminnow monitoring (Project 128) in June 2016, UDWR-Moab completed only one of two scheduled electrofishing passes in Desolation and Gray Canyons. Prior to this targeted removal pass, USFWS-Vernal removed bass during four electrofishing passes for Project 128. Total numbers of bass removed, size structure and distribution information in this report will draw from both projects. However, sampling strategies differ between Projects 123a and 128, thus catch rate comparisons and ancillary captures refer only to targeted bass removal.

A total of 145 smallmouth bass were removed from Desolation and Gray Canyons in 2016. USFWS-Vernal removed 76 smallmouth bass between Tabyago Riffle (RM 207) and the Tusher Diversion (RM 128) during Colorado pikeminnow sampling. UDWR-Moab subsequently completed a single pass from Tabyago Riffle to Swasey's Rapid (RM 132) on June 20-26, 2016. The final pass removed 69 smallmouth bass during 39 hours of electrofishing (1.75 fish/hour). River discharge during this pass decreased from

18,900 to 14,500 cu. ft./sec. (USGS Gauge in Green River, UT) and water temperatures measured on-site ranged from 19.4-20.9 degrees Celsius.

Targeted smallmouth bass catch rate in 2016 was again far lower than 2014, and similar to the second removal pass of 2015 (1.60 fish/hour) which also occurred in the month of June. Smallmouth bass continue to be found throughout the Desolation/Gray reach.

Size structure of the bass remained consistent throughout sampling (Figure 6a) and was mainly comprised of adults 200-325mm in total length (93.8%). Piscivorous adult bass over 325 mm in length (3.4%) and juveniles 100-199 mm (2.8%) comprised the remainder of catch (Figure 6b). These data suggest that smallmouth bass recruitment has been limited since 2014 sampling yielded record-high catch rates, but also indicate the continued presence of cohort(s) first identified in 2014 and their progress into the adult size class (Figure 7).

Adult bass were observed nesting in the mouth of Range Creek (RM 151.4). Nests were raked and larvae collected were sent to CSU-LFL. Such calm off-channel habitats may provide important refuges for spawning bass when spring flows remain high late in the spring.

Tasks 4 and 5: Walleye Removal-Lower Green and Lower Colorado Rivers- These tasks will be reported on in Evaluation of Walleye Removal in the Upper Colorado River Basin Annual Report (Michaud et. al.).

Task 6: Data entry, analysis and reporting- Data has been entered and will be submitted to the database manager by January 2017. An annual progress report including a summary of the 2016 data will be submitted by November 14, 2016.

VIII. Additional noteworthy observations:

Echo-Split Reach

Out of twelve bonytail captured this year, three were stocked in August 2015 at Echo Park. These are noteworthy because they represent a rare instance of overwinter survival for bonytail in this reach. We also captured 26 razorback sucker, sixteen of which had been stocked in previous years. Out of nine roundtail chub captured, six were recaptures.

Desolation and Gray Canyons

Walleye, black crappie and green sunfish were also removed during the targeted removal pass (Table 4). Eighty-five razorback suckers were encountered during this pass and was the most abundant endangered species captured during this targeted sampling effort. Colorado pikeminnow and humpback chub were also present, though less abundant.

IX. Recommendations:

Echo-Split Reach

- Continue smallmouth bass removal at current levels.
- Continue multi-agency “surge” effort to target spawning bass in Island Park. The surge effort yielded higher catch rates and removed a significant number of adults relative to passes later in the summer.
- Continue marking smallmouth bass. Although abundance estimates yielded imprecise estimates of the bass population, it did allow some comparison to previous years. With only one marking pass devoted to tagging fish, this project has several consecutive passes where removal can be accomplished, and we are not constrained by flows in this reach.

Desolation and Gray Canyons

- Continue targeted removal of smallmouth bass and other predatory fishes by UDWR-Moab in spring. Monitoring and removal of invasive predatory fishes in this reach may delay expansion of their distribution into critical endangered fish nursery and spawning habitat of the Lower Green River.
- Consider increasing removal effort following low water-years to address correlated spikes in bass recruitment as observed in 2014.
- Target additional off-channel spawning habitats (e.g. flooded tributaries) as time allows when spring flows are sufficient to delay or depress mainstem bass nesting and reproduction.

X. Project Status:

Tasks 1-3,6: on track and on-going.

Task 4-5: on track and on-going. Progress reported in Walleye Removal in the Upper Colorado River Basin Annual Report (Michaud et. al.).

XI. FY 2016 Budget Status

A. Funds Provided: \$220,929

B. Funds Expended: \$220,929

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:

USFWS-data are compiled and will be submitted to database manager by December 2016.

UDWR- data are compiled and will be submitted to database manager by January 2017.

XIII. Signed: M. Tildon Jones, Zach Ahrens, Katherine Creighton
Principal Investigator

14 Nov. 2016
Date

Literature Cited:

Bestgen, K.R. and A.A Hill. 2016. River regulation affects reproduction, early growth, and suppression strategies for invasive smallmouth bass in the upper Colorado River basin. Final report to the Upper Colorado River Endangered Fish Recovery Program, Denver, CO. Larval Fish Laboratory Contribution 187.

Breton, A.R., D.L. Winkelman, K.R. Bestgen, and J.A. Hawkins. 2015. Population dynamics modeling of introduced smallmouth bass in the upper Colorado River basin. Final report to the Upper Colorado River Endangered Fish Recovery Program, Denver, CO. Larval Fish Laboratory Contribution 186.

Shuter, B.J., J.A. MacLean, F.E.J. Fry, and H.A. Regier. 1980. Stochastic simulation of temperature effects on first-year survival of smallmouth bass. Transactions of the American Fisheries Society 109: 1-34.

Table 1. Total bass caught in Echo-Split reach by pass and size group, 2016. Piscivores are adult fish above the 325mm threshold. Adults and sub-adults were tagged and released on pass 3. *On pass 4, length data was lost for 44 fish, which are not listed by size class.

Pass	<100mm	Sub-adults	Adults	Piscivores	Total
Surge-FWS, July 15		4	13	1	17
1-UDWR, 3-6 July		6	30	4	36
2-UDWR, 6-9 July		16	32	3	48
3-UDWR, 15-18 July	1	23	59	1	83
4-UDWR, 18-21 July		15	39	2	98*
5-FWS, 26-28 July		25	57	1	82
6-FWS, 10-12 August	1	9	25	2	35
7-FWS, 15-17 August		16	34	2	50
8-FWS, 23-25 August	3	5	29	1	37
9-FWS, 30 August-1 Sept.	93	5	21	1	119
10-FWS, 7-9 Sept.	211	3	16	1	230
11-FWS, 13-15 Sept.	119	9	53	4	181
Totals	428	136	408	23	1016

Table 2. Abundance estimates for smallmouth bass, 2016.

Size class	Method	Abundance	95% CI	SE	Fish/mile
All bass \geq 100mm	Lincoln-Petersen	1,300	573-2,027	364	51.99

Table 3. Ancillary fish captures in the Echo-Split study reach, 2016. Piscivores are northern pike >450mm and walleye >375mm.

Species	Number Captured	Piscivores
Black crappie (<i>Pomoxis nigromaculatus</i>)	1	
Green sunfish (<i>Lepomis cyanellus</i>)	49	
White sucker and hybrids (<i>Catostomus commersonii</i>)	526	
Northern pike (<i>Esox lucius</i>)	12	9
Walleye (<i>Sander vitreus</i>)	9	9
Colorado pikeminnow (<i>Ptychocheilus lucius</i>)	16	
Bonytail (<i>Gila elegans</i>)	12	
Roundtail chub (<i>Gila robusta</i>)	9	
Small unidentified <i>Gila</i>	4	
Razorback sucker (<i>Xyrauchen texanus</i>)	26	

Table 4. Project 123a ancillary fish captures in Desolation/Gray Canyons, 2016. Piscivores are channel catfish > 400mm and walleye > 375mm.

Species	Number captured	Piscivores
black crappie (<i>Pomoxis nigromaculatus</i>)	1	
channel catfish (<i>Ictalurus punctatus</i>)*	1	1
green sunfish (<i>Lepomis cyanellus</i>)	3	
walleye (<i>Sander vitreus</i>)	3	3
Colorado pikeminnow (<i>Ptychocheilus lucius</i>)	8	
humpback chub (<i>Gila cypha</i>)	6	
razorback sucker (<i>Xyrauchen texanus</i>)	85	

* sampling targeted only piscivorous channel catfish.

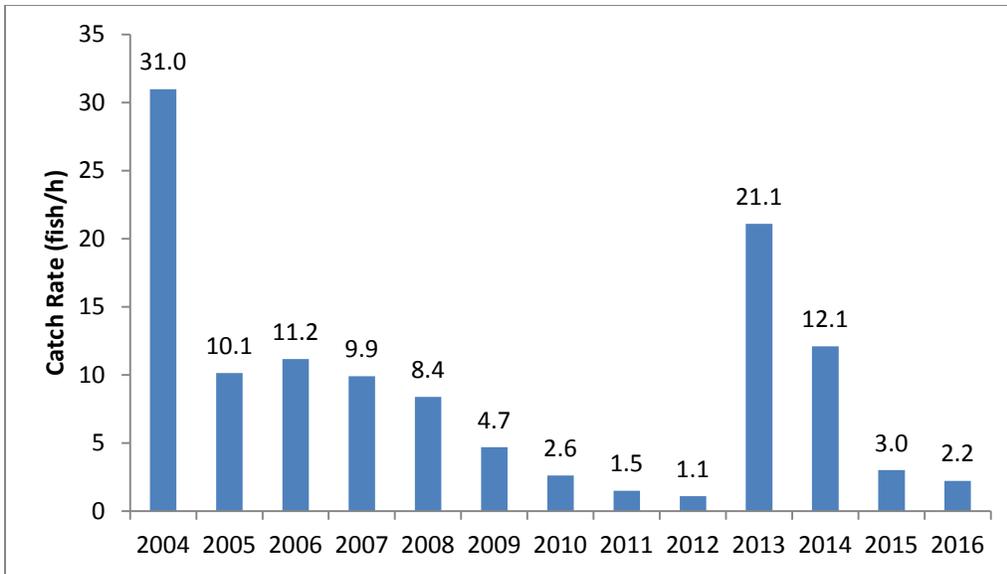


Figure 1. Catch rates for all bass ≥ 100 mm in the Echo-Split reach, 2004-2016.

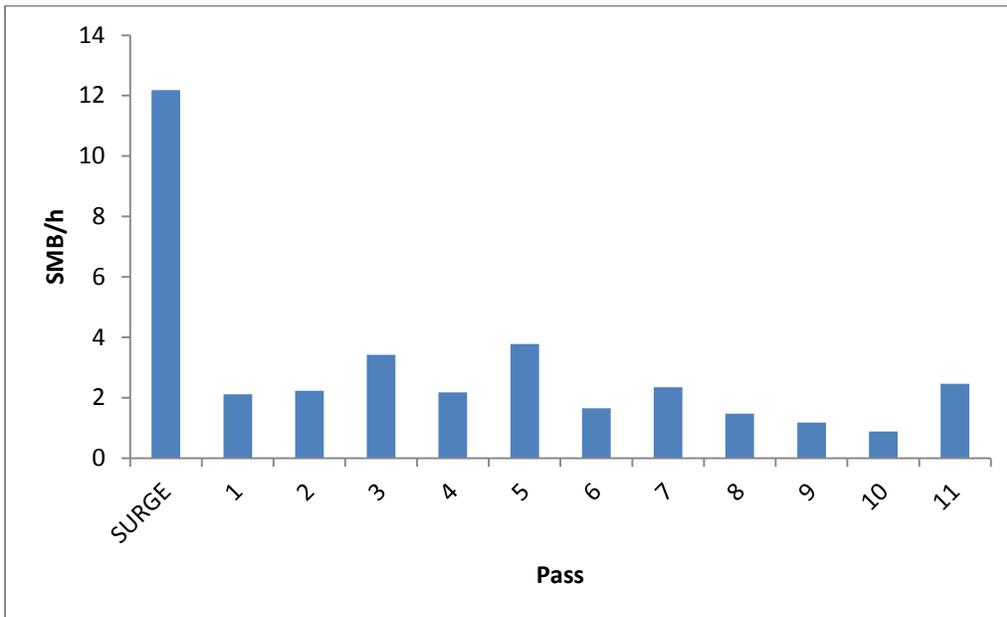


Figure 2. Catch rates by pass for all bass ≥ 100 mm, Echo-Split reach.

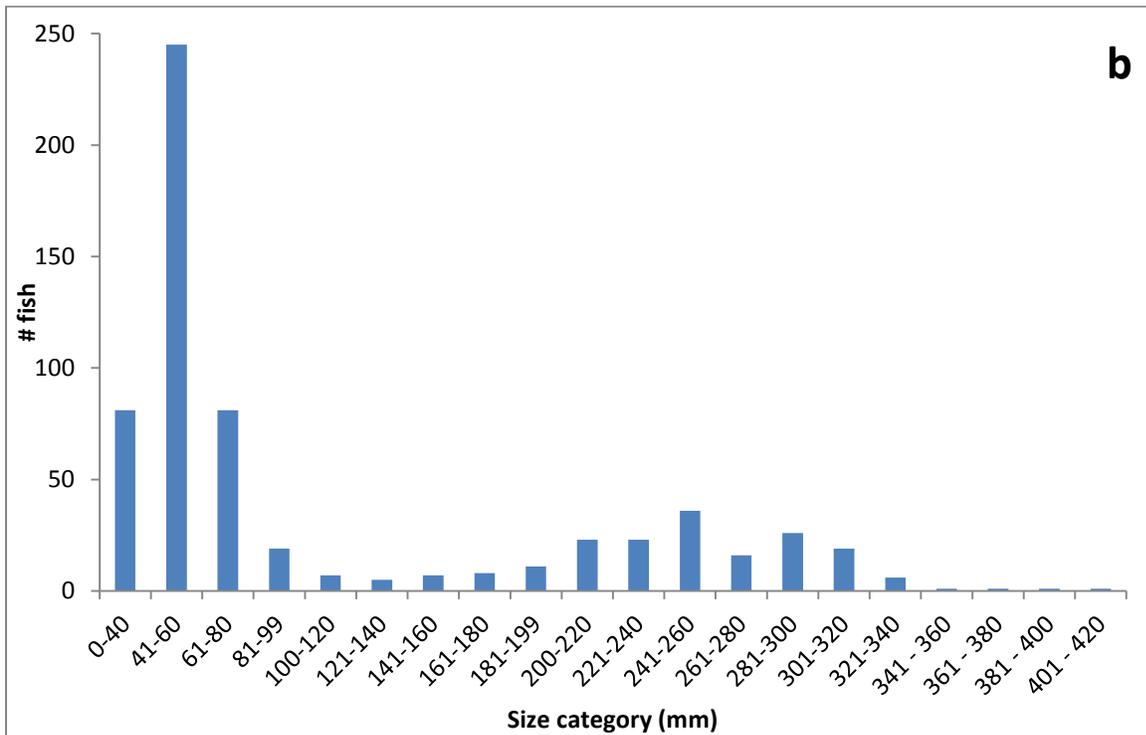
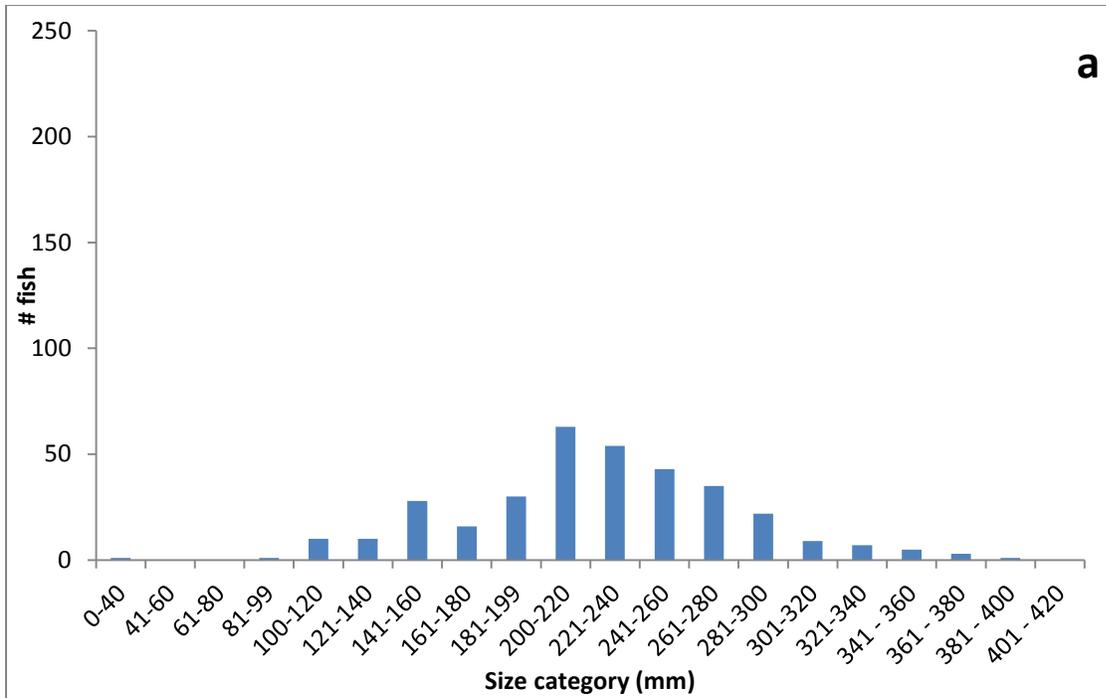


Figure 3a-b. Length-frequency histograms for smallmouth bass captured in passes 1-6 (a) and passes 7-11 (b), Echo-Split reach 2016.

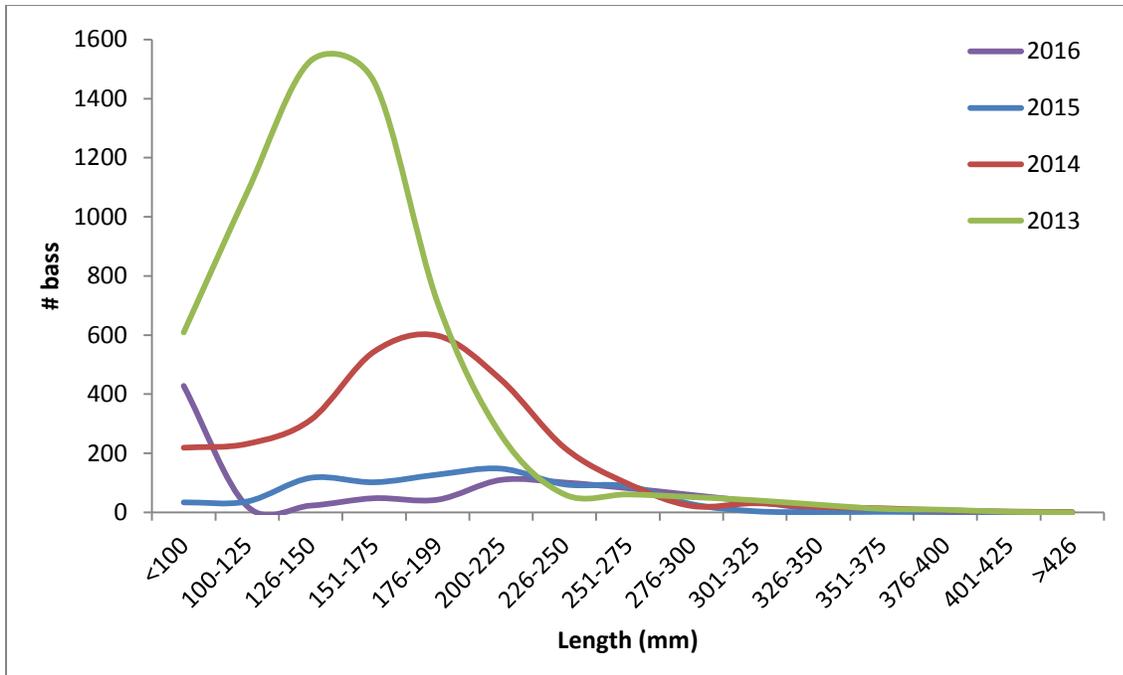


Figure 4. Length-frequency of smallmouth bass in Echo-Split, 2013-2016.

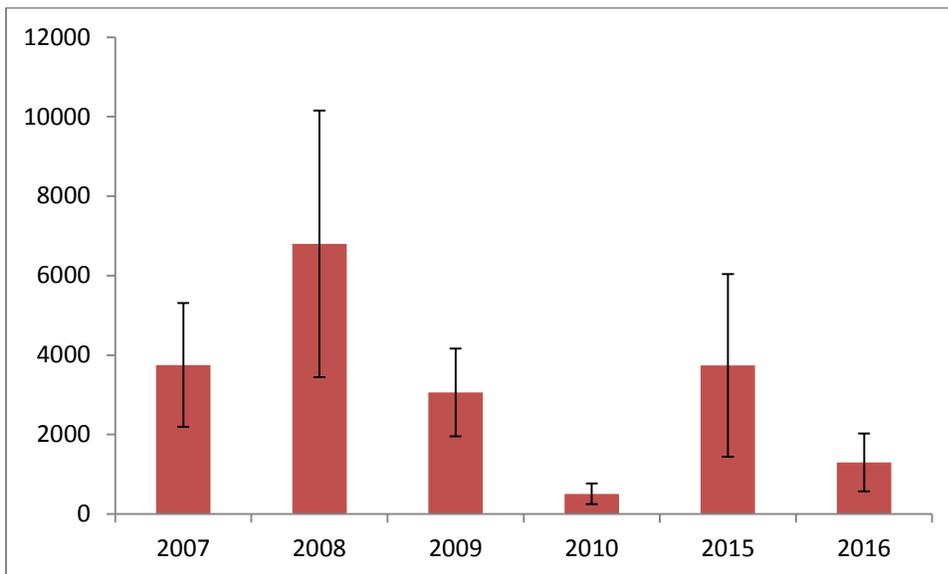


Figure 5. Abundance estimates with 95% confidence intervals for smallmouth bass in the Echo-Split reach, 2007-2010 and 2015-2016.

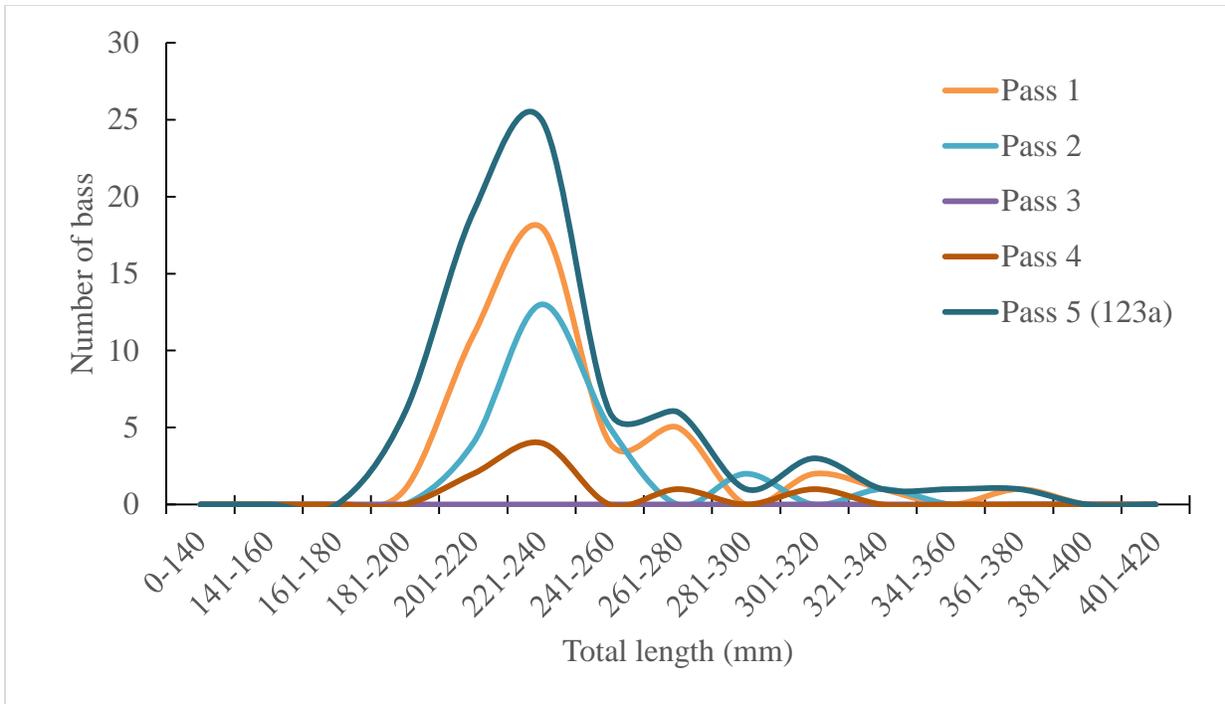


Figure 6a. Smallmouth bass length-frequency distribution by pass, Desolation/Gray Canyons, 2016. Bass removed in passes 1-4 were ancillary captures of Project 128.

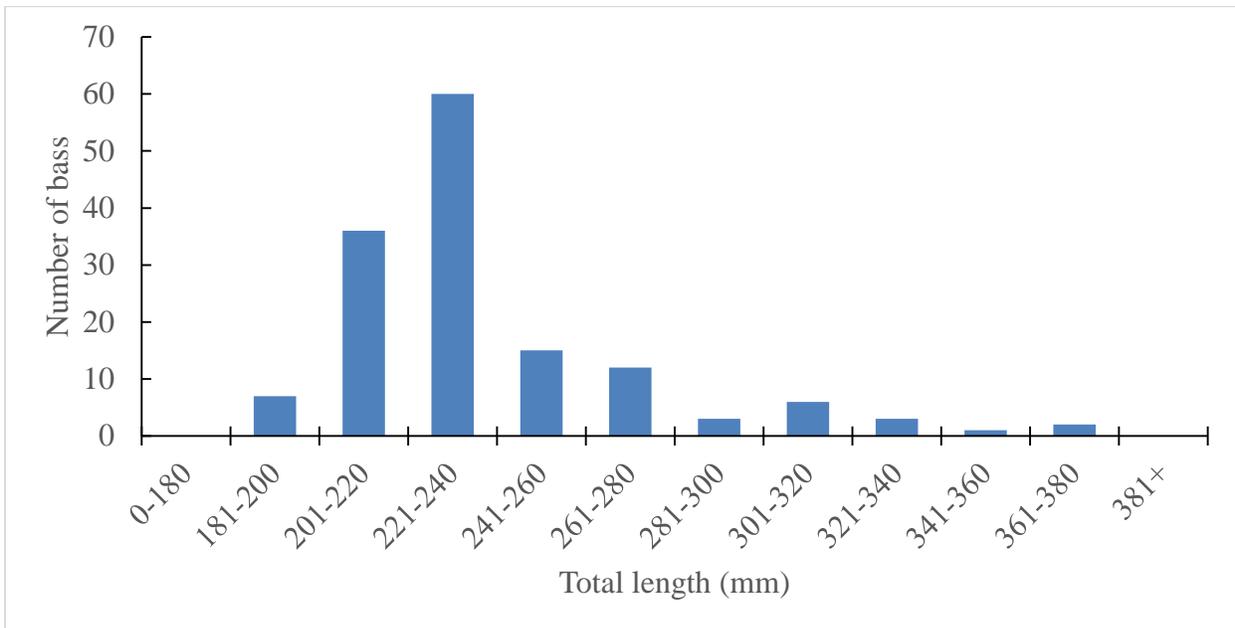


Figure 6b. Smallmouth bass length-frequency distribution in Desolation/Gray Canyons, 2016.

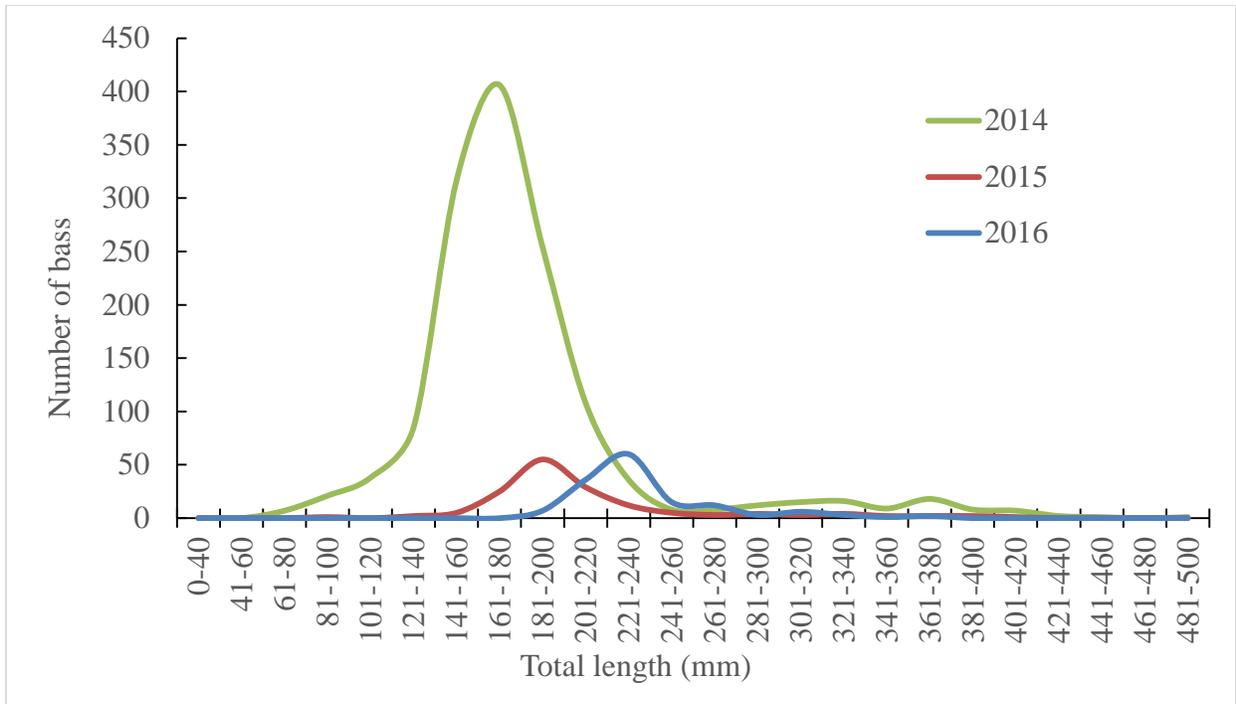


Figure 7. Smallmouth bass length-frequency distribution in Desolation/Gray Canyons, 2014-2016. Bass from large cohorts seen in 2014 continue to persist and grow.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R15PG00083

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 123a

Project Title: Smallmouth bass control in the Green River

Principal Investigator: M. Tildon Jones
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Project/Grant Period: Start date: 10/01/2014
End date: 09/30/2019
Reporting period end date: 09/30/2016
Is this the final report? Yes No

Performance:

Task 1, eight removal passes, was completed between 15 July and 15 September. We removed all smallmouth bass encountered during these passes, as well as five other nonnative species or hybrids. We were also able to document endangered and native fish species that were encountered during these passes. With the submission of this report, Task 6 is complete. There is no outstanding work remaining for which USFWS is responsible.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R14AP00007

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 123a

Project Title: Smallmouth bass control in the Green River

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Project/Grant Period: Start date: 05/01/2014
 End date: 09/30/2018
 Reporting period end date: 10/30/2016
 Is this the final report? Yes _____ No X

Performance:

Task 2 was completed: *Four passes were successfully completed (7/3-7/6/19, 7/6-7/9/16, 7/15-7/18/16, 7/18-7/21/16) on the Green River from Echo Park (RM 344.5) to Split Mountain (RM 319.5). A total of 265 smallmouth bass were captured during these passes. Of these, 73 were marked to obtain a population estimate. The remaining 192 were removed from the river along with nine green sunfish, three northern pike, two walleye, one white sucker-flannelmouth sucker hybrid, and 111 white suckers. These data were analyzed and reported within the annual report for project #123a by November of 2016 (task 6 was completed).*

Task 3 was completed: *One removal pass was successfully completed (6/20-6/26/2016) in Desolation and Gray Canyons on the Green River from Sand Wash boat ramp (RM 215.3) to Swasey's boat ramp (RM 129.8). Sixty-nine smallmouth bass were removed during this targeted removal pass. Additionally, one black crappie, three green sunfish and three walleye were captured and removed. Eight Colorado pikeminnow, six humpback chub, and eighty-five razorback sucker were also encountered during this effort. These fish were enumerated, measured, tagged and returned to the river. These data were analyzed and reported within the annual report for project #123a by November of 2016 (task 6 was completed).*

Task 4 was completed: *This effort will be reported in Evaluation of Walleye Removal in the Upper Colorado River Basin Annual Report (Michaud et. al.).*

Task 5 was completed: *This effort will be reported in Evaluation of Walleye Removal in the Upper Colorado River Basin Annual Report (Michaud et. al.).*