

COLORADO RIVER RECOVERY PROGRAM
FY 2018 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 123a

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

II. Bureau of Reclamation Agreement Numbers:

USFWS: R15PG00083
Start date: 10/01/2014
End date: 09/30/2019

UDWR: R14AP00007
Start date: 05/01/2014
End date: 09/30/2019

Reporting period end date: 09/30/2018

Is this the final report? Yes No X

III. Principal Investigators:

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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 fourteen passes in the Echo-Split reach, resulting in the removal of 2,712 smallmouth bass. UDWR-Moab also tagged and released 181 smallmouth bass on the sixth pass in order to estimate abundance in this reach. A Lincoln-Petersen model produced a point estimate of 7,346 bass \geq 100 mm, or 294 bass/mile. UDWR-Moab completed one targeted removal pass in Desolation and Gray Canyons removing 124 bass. Catch rates were similar to the past three years and much lower than 2014. Smallmouth bass distribution in Desolation/Gray Canyons continued to encompass the entire reach with fish concentrated upstream of river mile 160 in Desolation Canyon. Conditions during the past three years appear to have prevented substantial smallmouth bass spawning success in Desolation/Gray Canyons. However, hydrologic conditions during 2018 may have presented an opportunity for successful spawning and recruitment, and this should be taken into consideration when planning for 2019 targeted removal.

V. Study Schedule: 2004-ongoing

VI. Relationship to RIPRAP:

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.

III.A.4.b.(3) Smallmouth bass in middle and lower Green River.

VII. Accomplishment of FY 2018 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

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

The USFWS and UDWR collaborated to complete one marking pass (pass 6) and thirteen removal passes in the Echo-Split reach between June 14 and September 20 (Table 1). During pass 5, UDWR only sampled Island Park through Split Mtn. to avoid multiple electrofishing events in Whirlpool Canyon where CSU/USFWS were sampling under Project 115. During pass 6, UDWR marked and released 181 bass (17 adults ≥ 200 mm, 164 sub-adults 100-199mm). The remaining passes consisted only of removal, and resulted in the capture of 2,712 fish (250 adults, 1,267 sub-adults, and 1,195 < 100 mm). Unlike previous years, targeted passes to disrupt spawning smallmouth bass (SMB) in Island Park were not conducted due to a shortened run off season and other work priorities, such as removal work in the White and Yampa rivers and Colorado pikeminnow population monitoring. Despite this, removal passes did capture ripe and expressing SMB, and on at least one pass (pass 3) crews observed and removed SMB fry on a nest. We believe the first few passes covered at least part of the spawning period for SMB in this reach. Mean water temperatures at the Jensen gage consistently exceeded 16°C beginning June 4 when discharge was 7,970 cfs and decreasing, so spawning likely occurred for several days prior to the first pass.

The overall catch rate for all sizes of bass in 2018 was 9.06 fish/hour, much higher than that in 2017 (3.19 fish/h). This is largely due to high numbers of age-0 SMB being caught in the reach. The catch rate for fish ≥ 100 mm (adults and sub-adults) was 5.3 bass/hour, twice that of 2017 (Fig. 1). We captured 0.84 fish/h for adults and 4.48 fish/h for sub-adults when using absolute size classes, not adjusted for growth. Both values mark an increase in catch rates from 2017. Catch rates were variable but increasing until pass 6, and then slowly decreased as the season progressed (Fig. 2). Overall catch rates by pass were driven by sub-adult numbers; adult catch rates started relatively high, decreased through pass 8, and then slowly increased through the end of the season. This may be a result of sub-adult bass growing into adult sizes (see below). An analysis of total catch using adjusted size classes based on growth of tagged fish (not shown), does reduce the overall number of adults, suggesting sub-adults were growing into the adult size class during the last half of sampling. This same analysis resulted in similar numbers of sub-adults since fish < 100 mm were also growing into sub-adult sizes as sub-adults grew into the adult class. Finally, this analysis allowed us to partition small SMB < 100 mm into age-1 and age-0 classes, with 406 age-1 and 803 age-0 captured over the season.

The size structure of SMB captured in 2018 is shown in Fig. 3a-b, and further illustrates the influence of sub-adult and smaller bass on this year's results. A large proportion of bass captured were sub-adult (60%) or age-1 (29%) fish in the first part of the season. We believe this reflects successful spawning of SMB in the Yampa River in 2017, and these fish entered into this reach (Jones and Caldwell, 2017). By August, large numbers of age-

0 bass were captured (53%), and all fish <100mm were in this age class. There was a distinct separation in sizes between age-0 and age-1 fish until pass 12, when it appears some age-0 fish had reached lengths of 100mm or greater. Figure 4 shows the size structure of SMB from selected years. Although large numbers of small SMB were captured this year, they were not as abundant as in 2012, a benchmark year for high bass reproduction. This year differed from 2012, however, since the 2018 length-frequency histogram indicates a second year class of fish in the sub-adult size range. Smaller fish (<100mm) exhibited higher catch rates in the most upstream reach, with a decreasing downstream gradient (Fig. 5). This is similar to 2017, and also suggests that reproduction in the Yampa River is influencing the abundance of fish in this reach (Jones and Smith, 2018). In past years, smaller SMB had higher catch rates in the Island Park and Split Mtn. reaches, presumably due to spawning in those areas. We also captured 34 bass large enough to be classified as piscivores posing a competitive threat to adult Colorado pikeminnow (Table 1). This metric was slightly higher than 2017 (n=28) and 2016 (n=23).

In order to estimate the SMB population, we conducted a mark-recapture estimate using Floy tags. UDWR tagged and released 181 bass (164 subadults, 17 adults) during pass 6 (13-16 July). We then used recaptures (n=10) from passes 7-9 (24 July-3 August) to derive a Lincoln-Petersen estimate for bass ≥ 100 mm. No adults were recaptured during the recapture period, and only two adults were recaptured at all, both during pass 12. The estimate resulted in a point estimate of 7,346 fish (294 fish/mile, Table 2), with a large confidence interval and high coefficient of variation. Despite this imprecise estimate, it does appear to be significantly greater than estimates from 2016-2017 (Fig. 6), suggesting that increases in bass captures reflect an actual increase in the population abundance. A total of 19 tagged bass were recaptured across all passes, which represents 10% of the bass marked. These recaptures allowed us to estimate growth within the season, which was then used to adjust size classes to accommodate this growth. Sub-adult fish grew an average of 0.58 mm/day during the season, and we used a conservative 0.5 mm/day growth rate to adjust size classes. At this rate, a 199 mm SMB captured on pass 6 would be 231 mm by the end of the season. We also recaptured eight SMB that were tagged in previous years, dating back to 2015. These fish grew an average of 42 mm/year.

We collected eight additional species of nonnative fishes, including black bullhead, black crappie, burbot, creek chub, green sunfish, northern pike, walleye, and white sucker and its hybrids (Table 3). The capture of 41 creek chub was notable, and much higher than any previous year. Several of these fish were preserved for further study. The single burbot was captured just upstream of Jones Hole in Whirlpool Canyon. It measured 519mm and 785g. We preserved this individual for documentation and also preserved a fin clip for possible genetic analysis. Of the 22 northern pike captured, only 11 were large enough to classify as piscivores. Only one walleye was captured this year, which marks a significant decrease for this species in this reach. Several native species were also captured, including 25 Colorado pikeminnow.

Task 3: Smallmouth bass removal- Desolation and Gray Canyons

UDWR-Moab completed one targeted smallmouth bass removal electrofishing pass in Desolation and Gray Canyons. Instead of a second pass, effort was reallocated to an

additional pass in the Echo Park to Split Mountain reach. Prior to this targeted removal pass, USFWS-Vernal removed all ancillary bass captured during three electrofishing passes for Project 128. Total numbers of bass removed, size structure and distribution information in this report will draw from both projects unless otherwise stated. Because sampling strategies differ between Projects 123a and 128, catch rate comparisons refer only to targeted bass removal.

A total of 293 smallmouth bass were removed from Desolation and Gray Canyons in 2018. USFWS-Vernal removed 169 smallmouth bass (~1 fish/h) between Tabyago Riffle (RM 207) and Green River State Park (RM 120) during Project 128 sampling. UDWR-Moab subsequently completed a single targeted bass removal pass from Tabyago Riffle to Swasey's Rapid (RM 132) from June 26 – July 2, 2018. During the targeted removal pass UDWR removed 124 smallmouth bass during 61.6 hours of electrofishing (2.0 fish/hour; Figure 7). River discharge during this pass decreased from 3,200 to 2,500 cu. ft./sec. (USGS Gauge in Green River, UT) and water temperatures measured on-site ranged from 22.0 - 25.0 degrees Celsius.

Targeted smallmouth bass removal catch rate in 2018 was similar to the previous three years (Figure 7) and lower than 2014. Smallmouth bass continue to be found throughout the Desolation/Gray reach. However, fish appear to be concentrated in the upstream portion of the reach. During 2018 targeted removal 75% of bass removed were captured in Desolation Canyon upstream of river mile 170 and 76% of bass captured by the USFWS during Project 128 were in Desolation Canyon upstream of river mile 160.

Three size classes of smallmouth bass were evident in 2018 sampling (Figure 8). Piscivorous adult bass over 325 mm in total length comprised 22% of the total catch, adults from 200-324 mm comprised 52%, and juveniles 100-199 mm comprised 26%. Given that multiple size classes were present, some smallmouth bass recruitment appears to be occurring in the reach. The large cohort identified in 2014 continues to persist and have reached piscivorous size (Figure 9). No fish were observed nesting during the targeted removal pass but 11 smallmouth bass were found to be females containing eggs.

USFWS also captured 32 black crappie, 10 green sunfish, and 14 white sucker and hybrids between Tabyago Riffle and the Green River State Park. In addition, they encountered 2 grass carp below the Tusher Diversion Dam. Finally, they captured two northern pike in the Desolation reach, measuring 245mm and 317mm in total length.

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 123d (Michaud et. al.).

Task 6: Data entry, analysis and reporting- Data has been entered and submitted to the database manager. This report will serve as the annual progress report including a summary of the 2018 data.

VIII. Additional noteworthy observations:

Echo-Split Reach

UDWR-Vernal completed three passes of electrofishing in the Island Park area for Colorado pikeminnow abundance estimates (Project 128). These passes occurred earlier than the bass specific removal passes, on April 30, May 10, and May 16. During this sampling UDWR captured 51 bass in 19.2 hours of electrofishing (2.65 fish/h). These bass consisted of two piscivores ≥ 325 mm, nine adults 200-324mm, 33 sub-adults, and 7 fish < 100 mm. This sampling also resulted in the capture of one black crappie, one creek chub, nine green sunfish, four northern pike, and 358 white sucker and hybrids.

We also captured one northern pike (TL=980mm) in Island Park in which we detected a PIT tag. The tag had been implanted in a 472mm flannelmouth sucker captured just downstream of Split Mountain in 2014.

Desolation and Gray Canyons

Forty-six razorback suckers were encountered. Twelve Colorado pikeminnow were encountered, seven were recaptures. Seven humpback chub were encountered from three size classes. All of the humpback chub were untagged. A summary of ancillary captures can be found in Table 4.

Hydrologic conditions in 2018 were similar to conditions that preceded the high recruitment event for smallmouth bass in Desolation and Gray Canyons in 2014. Given that large adults were present in the reach combined with warm low flow conditions it is possible that successful spawning this year may result in a similar recruitment event in 2019.

IX. Recommendations:

Echo-Split Reach

- Continue smallmouth bass removal at current levels
- Coordinate targeted sampling to disrupt bass spawning in Island Park
- 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 annual targeted removal of smallmouth bass and other predatory fishes by UDWR-Moab. Monitoring the distribution of smallmouth bass in Desolation and Gray Canyons provides important information so appropriate management decisions can be made if smallmouth bass are found to expand their range into the critical endangered fish nursery and spawning habitat of the Lower Green River.
- Consider restoring removal effort to two passes in 2019 to 1) address potential increase in bass density resulting from 2018 hydrology (similar to that observed in 2014); and 2) compensate for no early season work being done under project 128. This component of the project was reduced to one pass because some level of

SMB removal was occurring during Colorado pikeminnow estimates. Those estimates will be on hiatus in 2019-2020.

- X. Project Status:
Tasks 1-3, 6: on track and on-going.
Tasks 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 2018 Budget Status
A. Funds Provided: \$184,082
B. Funds Expended: \$184,082
C. Difference: -0-
D. Percent of the FY 2018 work completed: 100%
E. Recovery Program funds spent for publication charges: -0-
- XII. Status of Data Submission:
USFWS-data are compiled and have been submitted to database manager.
UDWR- data have been compiled and submitted to the database manager.
- XIII. Signed: M. Tildon Jones and John Caldwell 16 Nov. 2018
Principal Investigators Date

Literature Cited:

Jones, M.T. and J. Caldwell. 2017. Nonnative fish control in the Green River. Project 123a annual report to the Upper Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service, Denver, CO.

Jones, M.T. and C. Smith. 2018. Smallmouth bass control in the lower Yampa River. Project 110 annual report to the Upper Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service, Denver, CO.

Table 1. Total bass caught in Echo-Split reach by pass and size group, 2018. Piscivores are adult fish above the 325mm threshold. ¹During pass 5, only Island Park through Split Mtn. was sampled. ²Adult and sub-adult smallmouth bass were tagged and released on pass 6.

Pass	<100mm	Sub-adults	Adults	Piscivores	Total
1-UDWR, 14-18 June	39	27	23	5	89
2-UDWR, 18-21 June	42	42	15	2	99
3-FWS, 26-28 June	157	137	37	4	331
4-FWS, 4-6 July	131	148	18	3	297
5-UDWR, 12-13 July ¹	3	29	6	4	38
6-UDWR, 13-16 July ²	34	177	17	2	228
7-UDWR, 24-27 July	12	177	17	2	206
8-UDWR, 27-30 July	4	134	7	1	145
9-FWS, 1-3 August	30	95	13	0	138
10-FWS, 15-17 Aug.	189	133	14	2	336
11-FWS, 22-24 Aug.	152	128	18	1	298
12-FWS, 28-30 Aug.	178	87	23	0	288
13-FWS, 5-7 Sept.	186	72	23	0	281
14-FWS, 18-20 Sept.	38	45	36	8	119
Totals	1,195	1,431	267	34	2,893

Table 2. Abundance estimates for smallmouth bass, 2018.

Size class	Method	Abundance	95% CI	SE	Fish/mile
All bass \geq 100mm	Lincoln-Petersen	7346	3,158-11,535	2094	294

Table 3. Ancillary fish captures in the Echo-Split study reach, 2018. Piscivores are northern pike >450mm and walleye >375mm.

Species	Number Captured	Piscivores
Black bullhead (<i>Ameiurus melas</i>)	3	
Black crappie (<i>Pomoxis nigromaculatus</i>)	7	
Burbot (<i>Lota lota</i>)	1	
Creek chub (<i>Semotilus atromaculatus</i>)	41	
Green sunfish (<i>Lepomis cyanellus</i>)	416	
White sucker and hybrids (<i>Catostomus commersonii</i>)	1,758	
Northern pike (<i>Esox lucius</i>)	22	11
Walleye (<i>Sander vitreus</i>)	1	1
Colorado pikeminnow (<i>Ptychocheilus lucius</i>)	25	
Bonytail (<i>Gila elegans</i>)	4	
Roundtail chub (<i>Gila robusta</i>)	25	
Small unidentified <i>Gila</i>	5	
Razorback sucker (<i>Xyrauchen texanus</i>)	7	
Razorback x flannelmouth hybrids (<i>X. texanus</i> x <i>Catostomus latipinnis</i>)	1	

Table 4. Ancillary fish captures in Desolation/Gray Canyons, 2018.

Species	Number Captured	Piscivores
Black bullhead	2	
Black crappie (<i>Pomoxis nigromaculatus</i>)	3	
Brown trout	3	
Channel catfish >450 mm (<i>Ictalurus punctatus</i>)	2	2
Gizzard shad	3	
Green sunfish (<i>Lepomis cyanellus</i>)	8	
White sucker	11	
Colorado pikeminnow (<i>Ptychocheilus lucius</i>)	12	
Humpback chub (<i>Gila cypha</i>)	7	
Razorback sucker (<i>Xyrauchen texanus</i>)	46	

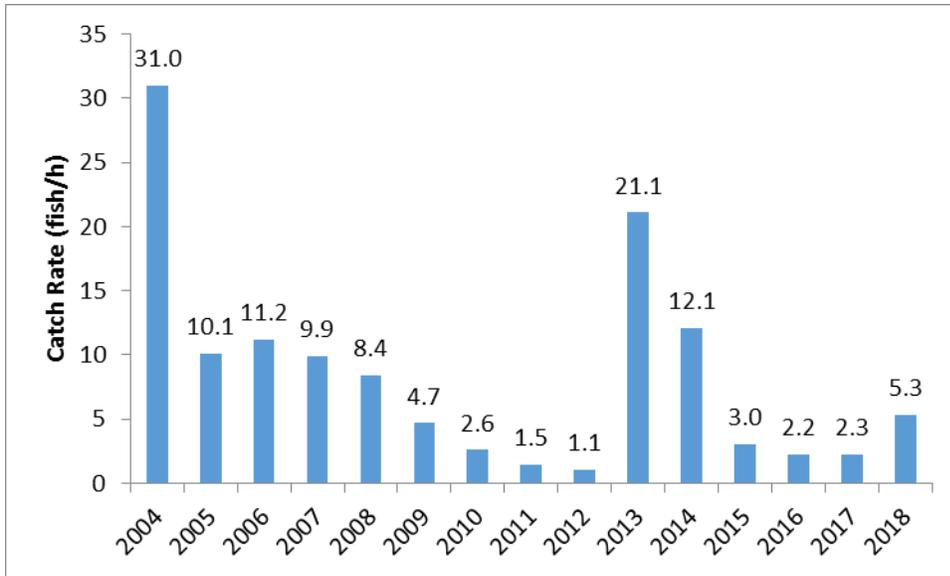


Figure 1. Catch rates for all bass >100mm in the Echo-Split reach, 2004-2018.

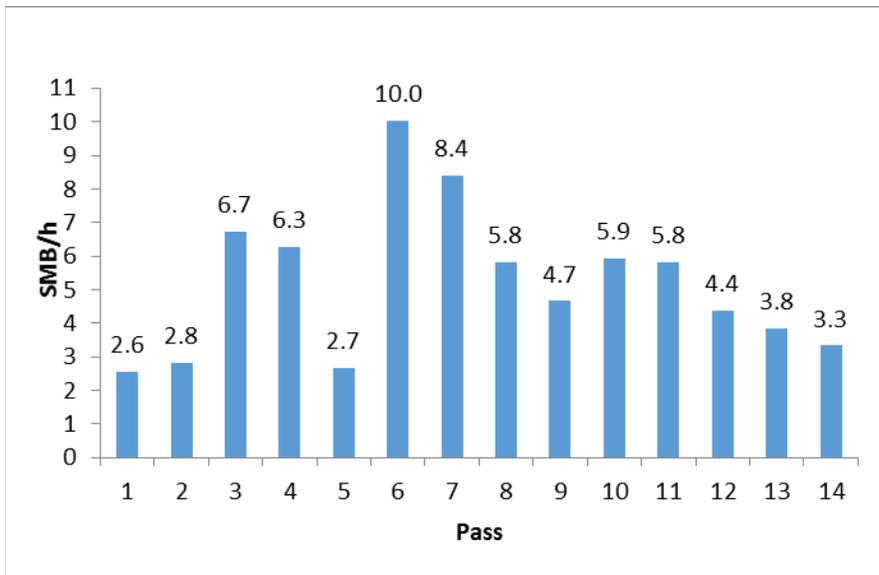


Figure 2. Catch rates by pass for all bass ≥100mm, Echo-Split reach 2018.

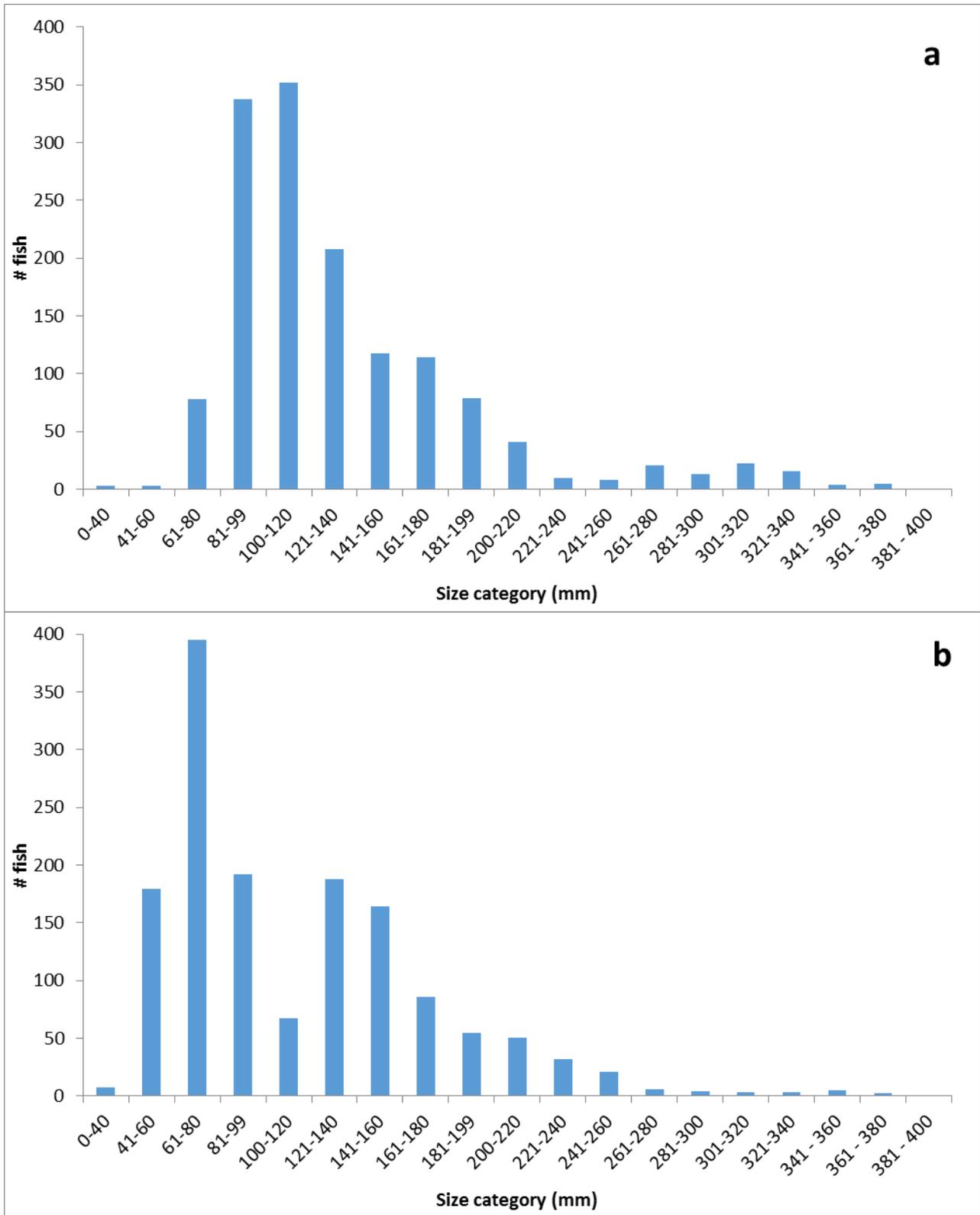


Figure 3a-b. Length-frequency histograms for smallmouth bass captured in June-July (passes 1-8, Fig. 3a) and August-September (passes 9-14, Fig. 3b), Echo-Split reach 2018.

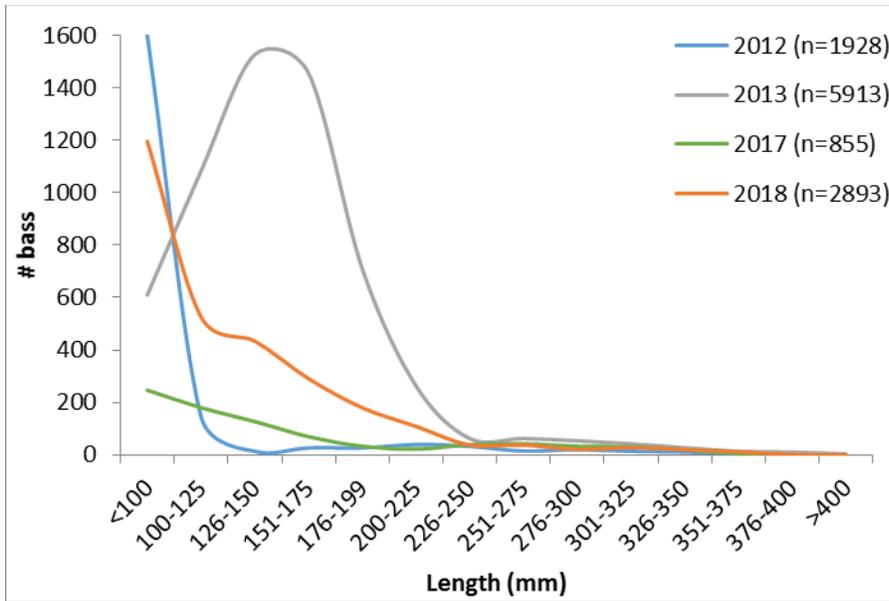


Figure 4. Length-frequency of smallmouth bass in Echo-Split, 2013-2018.

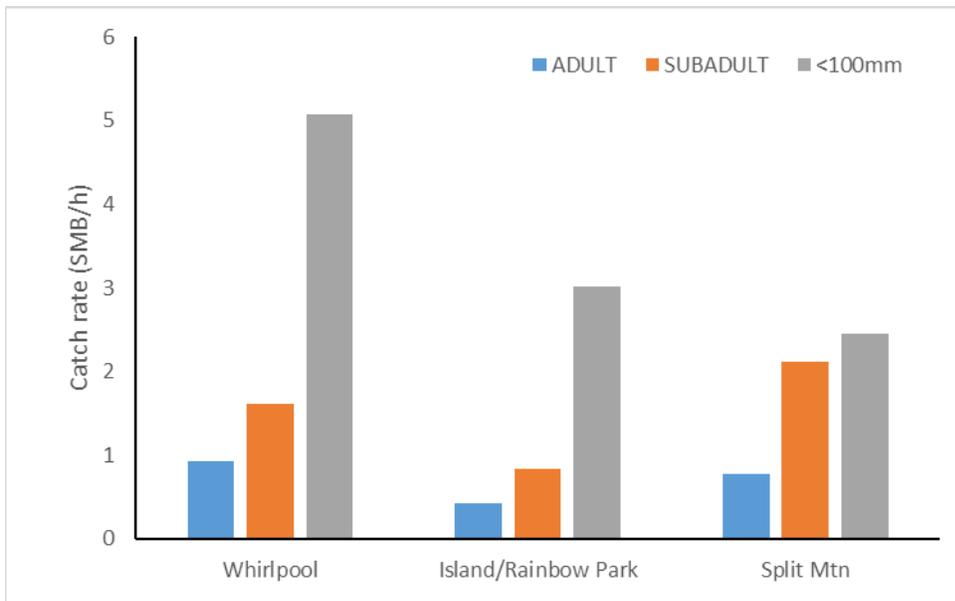


Figure 5. Catch rates by size class and reach for the Echo-Split reach, 2018.

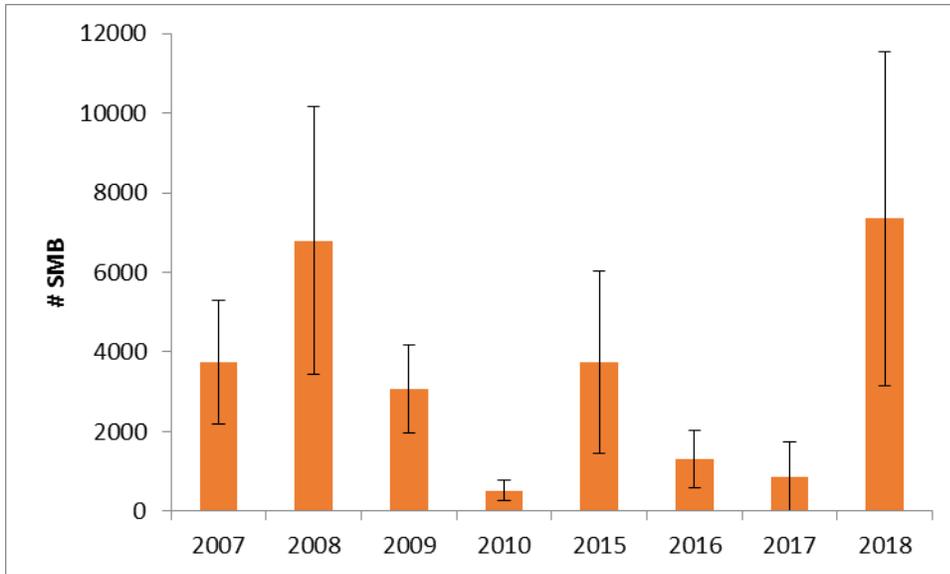


Figure 6. Abundance estimates with 95% confidence intervals for smallmouth bass in the Echo-Split reach, 2007-2010 and 2015-2018.

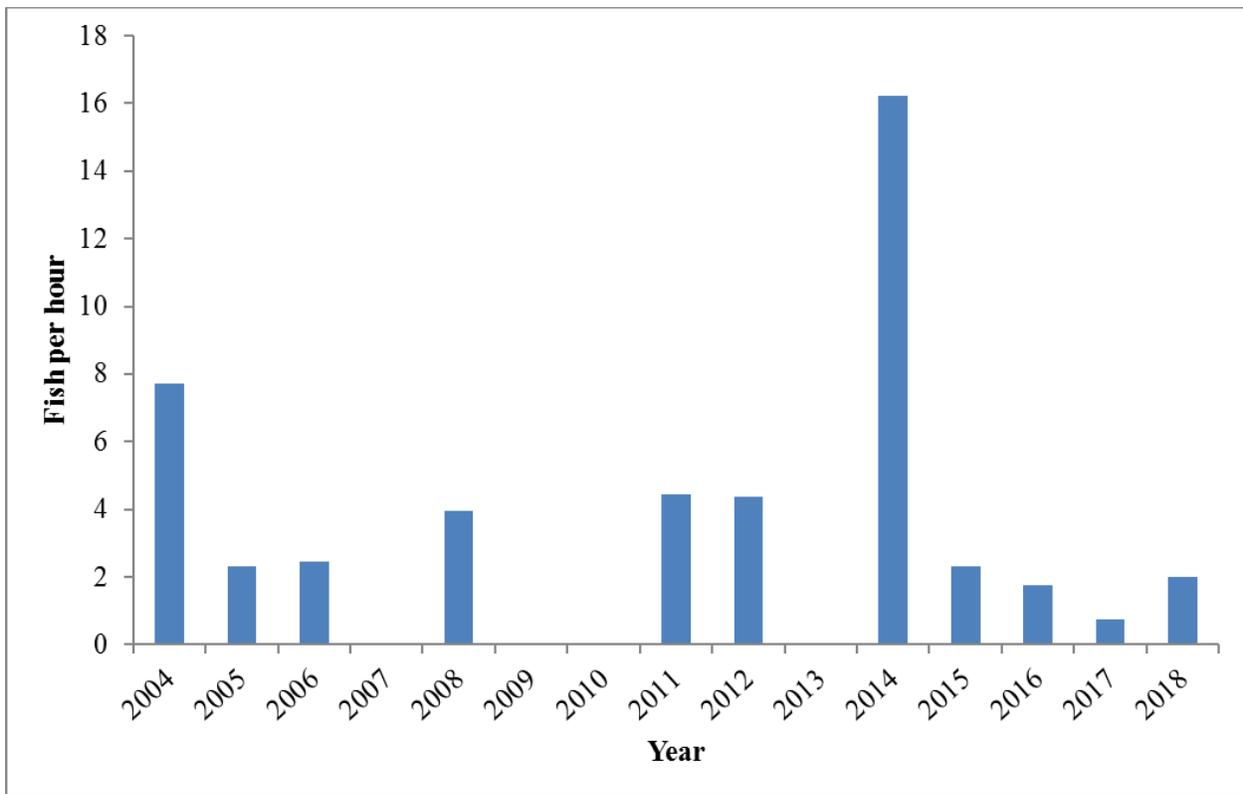


Figure 7. Catch per unit effort (fish per hour) from targeted smallmouth bass removal in Desolation/Gray Canyons.

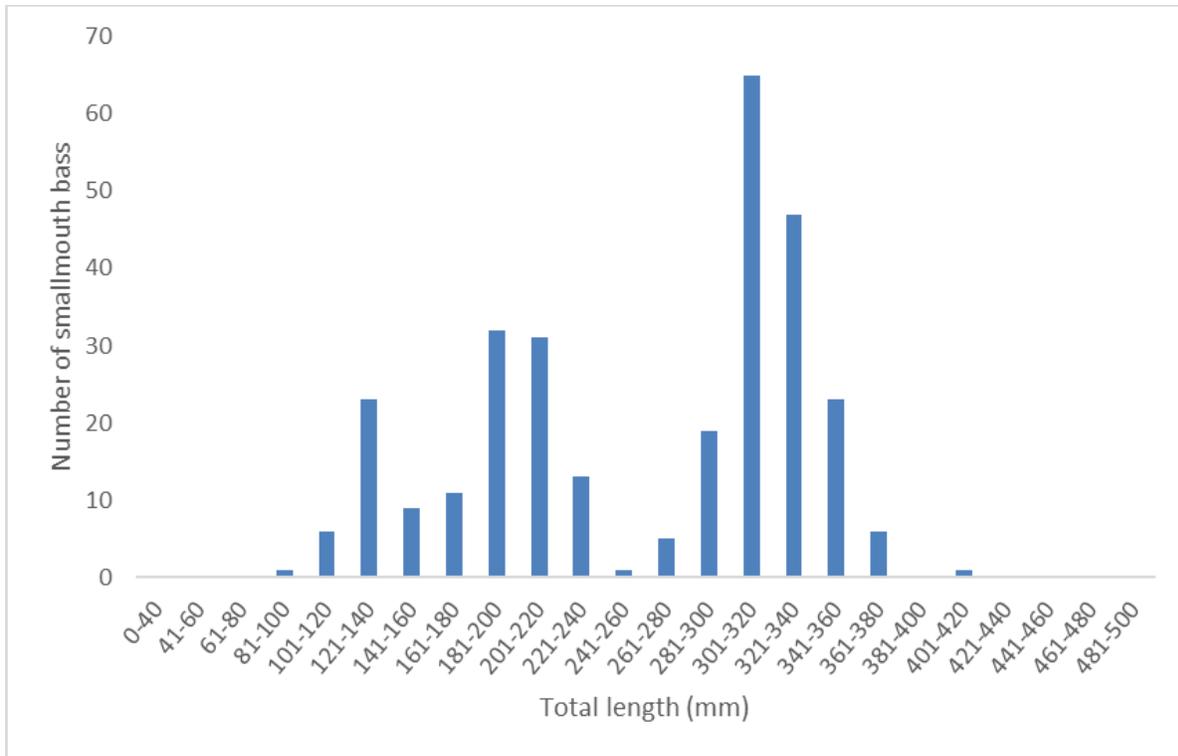


Figure 8. Smallmouth bass length-frequency distribution in Desolation/Gray Canyons, 2018. Number of fish includes captures from one UDWR Moab pass of targeted removal and the ancillary captures from three FWS Project 128 passes.

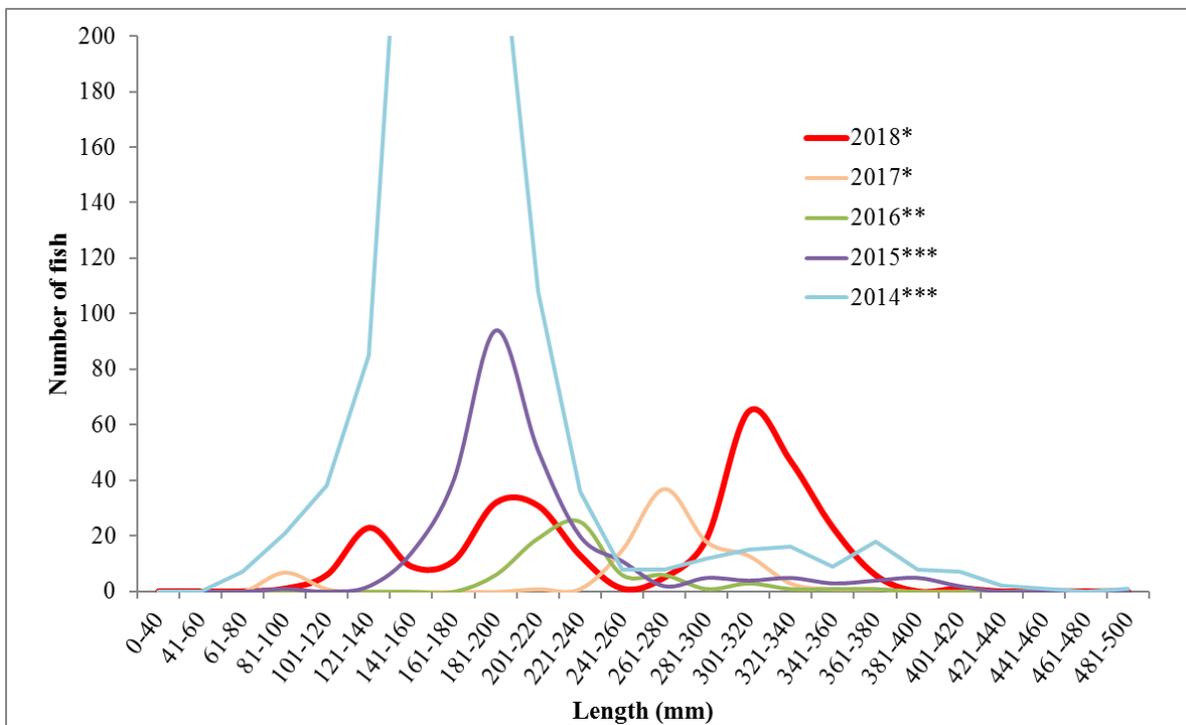


Figure 8. Smallmouth bass length-frequency distribution in Desolation/Gray Canyons, 2014-2018. *2018 and 2017 includes captures from one UDWR Moab pass of targeted removal and the ancillary captures from three FWS Project 128 passes. **2016 includes captures from one UDWR Moab targeted removal pass. ***2015 and 2014 include captures from two UDWR Moab target removal passes

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R15PG00083

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 123a

Project Title: Nonnative fish control in the Green River

Principal Investigator: M. Tildon Jones, USFWS
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Project/Grant Period: Start date: 10/01/2014
End date: 09/30/2019
Reporting period end date: 09/30/2018
Is this the final report? Yes No

Performance:

USFWS completed all eight passes identified in task 1. These passes were conducted between late June and early September, as flows were declining and water temperatures were more conducive to capturing smallmouth bass. This report satisfies the reporting and analysis requirements of task 6, and all data have been submitted to the Recovery Program database manager for inclusion into the STReaMS database. All work identified in the scope of work for 2018 has been completed.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R14AP00007

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 123a

Project Title: Nonnative fish control in the Green River

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

Performance:

Task 2 was completed: *Six passes were successfully completed (6/15-6/18/18, 6/18-6/21/18, 7/11-7/13/18, 7/13-7/16/18, 7/24-7/27/18, 7/27-7/30/18) on the Green River from Echo Park (RM 344.5) to Split Mountain (RM 319.5). A total of 805 smallmouth bass were captured during these passes. Of these, 181 were marked to obtain a population estimate. All other smallmouth bass were removed from the river along with three black bullhead, three black crappie, 84 brown trout, three channel catfish (over 450 mm), ten creek chub, 63 green sunfish, nine northern pike, 159 rainbow trout, and 632 white sucker and white sucker hybrids. These data were analyzed and reported within the annual report for project #123a by November of 2018 (task 6 was completed).*

Task 3 was completed: *One removal pass was successfully completed (6/26-7/2/2018) 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). A total of 124 smallmouth bass were removed during this targeted removal pass. Additionally, two black bullhead, three black crappie, three brown trout, two channel catfish (over 450 mm), three gizzard shad, eight green sunfish, and eleven white suckers were removed. Twelve Colorado pikeminnow, seven humpback chub, and 46 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 2018 (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.).*