

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

FY 2020 ANNUAL REPORT

PROJECT: 123a

Project Title

Nonnative fish control in the Green River

Bureau of Reclamation Agreement Number:

USFWS: R20PG00024

UDWR: R19AP00059

Project/Grant Period:

USFWS

Start date: 10/1/2019

End date: 9/30/2024

UDWR

Start date: 10/1/2018

End date: 9/30/2023

Reporting period end date: 9/30/2020

Is this the final report? Yes ___ No X

Principal Investigator:

Christian Smith, Fish Biologist

Katherine Lawry, Fish Biologist

U.S. Fish and Wildlife Service

Green River Basin Fish and Wildlife Conservation Office

1380 S 2350 W,

Vernal, UT 84078

Phone: (435) 789-0351

Email: christian_t_smith@fws.gov

John Caldwell, Fish Biologist

Utah Division of Wildlife Resources

Moab Field Station

1165 S Hwy 191, Ste. 4

Moab, UT 84532

Phone: (435) 259-3781

Email: johncaldwell@utah.gov

Abstract:

This project consisted of two components: **a)** remove smallmouth bass on the Green River in Dinosaur National Monument between Echo Park and Split Mountain. (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. The United States Fish and Wildlife Service (USFWS) and the Utah Division of Wildlife Resources (UDWR) completed a combined total of twelve boat electrofishing passes in the Echo-Split reach, resulting in the removal of 1647 smallmouth bass. USFWS also tagged and released 328

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smallmouth bass on the fifth pass in order to estimate abundance in the Echo-Split reach. A 2-sample Lincoln-Petersen model identical to that used in previous years for this report produced a point estimate of 9,191 bass ≥ 100 mm, or 367 bass/mile. An additional 32 bass were removed by UDWR via a targeted barge electrofishing effort in Island Park, and another 23 bass were removed by USFWS via angling. UDWR-Moab completed one targeted removal pass in Desolation and Gray Canyons and removed 202 smallmouth bass. Catch rates in Desolation and Gray Canyons were similar to the past five years and much lower than 2014. Smallmouth bass continued to occupy the entire Desolation/Gray reach, but fish were more concentrated in the upstream portion of the reach above river mile 160. Hydrologic conditions during 2018 were similar to those that facilitated the large cohort detected in 2014. However, low catches rates in 2019 and 2020 do not suggest large-scale successful spawning of smallmouth bass in 2018.

Study Schedule:

2004-Ongoing

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

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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.

Accomplishment of FY 2020 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

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

A total of 1,702 bass were removed from the Echo-Split reach in 2020. The USFWS and UDWR collaborated to complete one marking pass (pass 5) and eleven removal passes in the Echo-Split reach between June 24, 2020 and September 3, 2020 (Table 1). USFWS marked and released 328 bass (145 adults ≥ 200 mm and 183 Juveniles 100-199mm) during pass 5. The remaining boat electrofishing passes focused only on bass removal and resulted in the capture and removal of 1647 bass (495 adults, 513 juveniles, and 639 < 100 mm).

Additional bass removal was conducted using the Surge approach (Hawkins 2010; Breton et al. 2014) in Island and Rainbow Parks by UDWR Vernal (UDWRV) on June 30, 2020, resulting in the removal of 32 bass via barge electrofishing. Another 23 bass were removed by USFWS via angling. We believe the first two passes and surge effort 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 12, more than two weeks before the initial pass was conducted.

The overall boat electrofishing catch rate for all bass size classes was 6.9 fish/ hour, which mirrors that of 2019 (6.6 fish/hour). The boat electrofishing catch rate for fish ≥ 100 mm (adults and juveniles) was

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4.8 bass/hour, which is lower than 2018 and 2019 (Fig. 1). Catch rates remained relatively constant between absolute size classes, with fish <100mm having an overall catch rate of 2.3 fish/hour, juveniles 2.5 fish/hour, and adults 2.2 fish/hour. Size-specific catch rates varied considerably among river sections, however, with juveniles being the most variable group and displaying both the highest catch rate in the Split Mountain section and the lowest catch rate in the Island/Rainbow Park section (Figure 5). The piscivore size class was an exception, with a much lower catch rate of 0.1 fish/hour that varied little among river sections (Figure 5). These results differ from 2019 when the adult catch rate was 1.8 fish/hour and the juvenile catch rate was 4.4 fish/hour. No distinct temporal pattern existed for catch rates throughout the season (Figure 2). Barge electrofishing catch rates from the Surge are not comparable to boat electrofishing catch rates and are therefore not reported in these results.

The size structure of SMB captured in 2020 as displayed in Fig. 3a-b illustrates the influence of juvenile bass on this year's results. A large proportion of bass captured were juveniles ranging from 100-199 mm TL. This may reflect successful spawning of SMB in the Yampa River and Green River in 2018 and 2019 (Jones and Caldwell 2017; Smith et al. 2019; Jones and Smith 2018; Smith 2019). Figure 4 shows the size structure of SMB over the last nine years. A bimodal distribution illustrates the large number of small bass that were captured in 2020 (Figure 4). The majority of these small (<100mm) fish were captured during the last boat electrofishing pass (Table 1).

We conducted a population estimate using a classical closed-population 2-sample Lincoln-Petersen capture-recapture model with Chapman's correction (Chapman 1951). Although other estimation methods are available, we sought to replicate the analysis used in previous versions of this report for ease of comparison through time. The estimation methods used in 2020 exactly mirror the methods that were used in previous years for this report (Badame et al. 2007; Badame and Jones 2008; Badame and Jones 2009; Breidinger et al. 2010; Badame et al. 2011; Jones and Howard 2012; Jones and Howard 2013; Jones et al. 2014; Jones et al. 2015; Jones et al. 2016; Jones and Caldwell 2017; Jones and Caldwell 2018; Smith et al. 2019). This is true for the choice of the model used to generate the abundance estimate, the variance approximation used to calculate confidence intervals for that estimate, and the decision to include only a subset of all observed recaptures in the abundance estimation procedure.

USFWS marked and released 328 bass (145 adults ≥ 200 mm and 183 Juveniles 100-199mm) during pass 5 (July 14-July 16) using blue Floy tags. We recaptured 22 of these newly marked fish with blue tags in all subsequent removal passes. We also recaptured 5 fish that were tagged in previous years (3 fish with green tags that were marked in 2018, and 2 fish with yellow tags that were marked in 2019).

Abundance estimates used in prior editions of this report excluded all recaptured individuals observed during electrofishing passes that occurred more than 1 month after the initial marking pass. Authors reasoned that additional elapsed time between the marking event and the observation of recaptures would contribute to violations of the assumption of demographic closure implicit in the Petersen method. We followed this convention and only included 15 recaptures with blue tags from passes 6-9 (July 28- August 13). Observations from passes 6-9 were lumped together and treated as a single observation of 15 fish which was used as the second (recapture) sample in the 2-sample Lincoln-Peterson model. The remaining 7 recaptures with blue tags from passes 10-12 were excluded. The additional 5 recaptures tagged in previous years with green or yellow tags were also excluded.

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The total population of bass ≥ 100 mm in the reach was estimated to be 9,191 fish (95% CI 4,813, 13,569), or between roughly 200 and 550 fish per river mile. Overlapping confidence intervals indicate no significant change in this estimate since 2017 (Fig. 6). Confidence intervals were calculated using an informal variance approximation that was utilized in previous versions of this report (Badame et al. 2007; Badame and Jones 2008; Badame and Jones 2009; Breidinger et al. 2010; Badame et al. 2011; Jones and Howard 2012; Jones and Howard 2013; Jones et al. 2014; Jones et al. 2015; Jones et al. 2016; Jones and Caldwell 2017; Jones and Caldwell 2018; Smith et al. 2019).

We collected 13 additional nonnative fish species, including brown trout, channel catfish, creek chub, green sunfish, northern pike, rainbow trout, walleye, white sucker, and white sucker hybrids (Table 3). In general, nonnative ancillary captures increased from 2019, most notably green sunfish, white sucker and white sucker hybrid captures. Seven northern pike were captured this year, all of which were large enough to classify as piscivores. Only one walleye was captured this year, and it was large enough to be considered a piscivore.

Task 3: Smallmouth bass removal- Desolation and Gray Canyons

UDWR-Moab completed one targeted smallmouth bass removal electrofishing pass in Desolation and Gray Canyons from June 24 – June 30, 2020. The electrofishing pass began at Tabyago Riffle (RMI 207.0) and ended at Nefertiti Rapid (RMI 142.0). This pass excluded 6.3 miles of flatwater at Peter's Point (RMI 197.5 – RMI 191.2). A total of 202 bass were removed during 56.2 hours of electrofishing (3.6 fish/hour; Figure 6). On average, 3.4 bass were captured per river mile. River discharge decreased over the course of the six day pass from 4,490 cfs on June 24th to 3,330 cfs on June 30th (USGS Gauge 09315000 in Green River, UT). Water temperatures measured on-site ranged from 23.2 – 24.2 degrees Celsius. Secchi disk depths ranged from 380 – 510 mm.

Targeted smallmouth bass removal catch rates in 2020 were similar to the previous five years, and lower than 2014 (Figure 6). Smallmouth bass continue to occupy the entire Desolation/Gray reach. However, fish appear to be concentrated in the upstream portion of the reach. During 2020 targeted removal 82% of bass removed were captured in Desolation Canyon upstream of river mile 160.

Smallmouth bass from multiple size classes were captured during the 2020 removal effort (Figure 7). Piscivorous adult bass over 325 mm in total length comprised 9% of the total catch, adults from 200-324 mm comprised 69%, and juveniles from 100-199 mm comprised 22%. Smallmouth bass < 100 mm were not captured in Desolation Canyon this year. The presence of multiple size classes suggests that smallmouth bass recruitment is occurring in the reach. However, the large 2014 cohort appears to be in decline, and no substantial cohort appears to have resulted from the low flow of 2018. (Figure 7). No fish were observed actively spawning, but one gravid female was captured.

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. 2020).

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 2020 data.

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Additional noteworthy observations:

Echo-Split Reach

Several threatened or endangered species were captured including 6 Colorado pikeminnow (all 6 were recaptures), 8 roundtail chub, and 3 razorback sucker (all recaptures).

Desolation and Gray Canyons

Endangered species encounters during targeted removal passes are summarized in Table 4. A humpback chub was captured, tagged, and released. It was then recaptured 100 meters downstream in the mouth of a smallmouth bass. It was removed and released alive.

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, and consider implementing back to back removal passes immediately following the initial marking pass (as opposed to weeks apart). This may improve accuracy and precision of the Lincoln-Petersen estimates. Capture-Recapture models other than Lincoln-Petersen should also be considered, as violations of the assumptions of equal capture probabilities and demographic closure in capture-recapture studies do lead to unreliable estimates of population size. Formal confidence interval approximations for abundance estimates should be selected based on characteristics of the number of marked and recaptured fish (e.g. rules for selecting Binomial, Normal, or Poisson approximations recommended by Seber 1982).

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 is important because of the critical endangered fish nursery and spawning habitat downstream in the Lower Green River.
- We recommend continuing with a single targeted removal pass in Desolation and Gray Canyons in 2021 with the option of scheduling a second pass if the need arises (keeping two passes in the budget). A single targeted removal pass appears to be sufficient to monitor distribution and spawning success of smallmouth bass in the reach. However, situations such as poor sampling due to flow conditions, equipment malfunction, or the discovery of a concentration of non-native predators are possible instances when a second pass would be useful. If a second pass is not needed, the effort can be reallocated to the Echo Park-Split Mountain reach.

Project Status:

On track and ongoing

FY 2020 Budget Status

Funds Provided: \$117,776

Funds Expended: \$117,776

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Difference: \$0

Percent of the FY 2020 work completed, and projected costs to complete: 100%

Recovery Program funds spent for publication charges: \$0

Status of Data Submission

Compiled data will be submitted to the database manager by January 15, 2021.

Signed:

Katherine Lawry
Principal Investigator
11/20/2020

Christian Smith
Principal Investigator
11/20/2020

John Caldwell
Principal Investigator
10/9/2020

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Table 1. Total bass caught during boat electrofishing passes in Echo-Split reach by pass and size group, 2020. Piscivores are adult fish above the 325mm threshold. USFWS marked and released 327 bass (144 adults \geq 200mm and 183 Juveniles 100-199mm) on pass 5. UDWR-Vernal captured an additional 32 bass via barge electrofishing, and USFWS captured an additional 23 bass via angling (not shown).

Pass	Agency	Date	<100mm	Juveniles	Adults	Piscivores	Total
1	UDWR	June 24 - June 27	7	28	22	3	60
2	UDWR	June 27 - June 30	13	53	20	2	88
3	UDWR	July 7 - July 10	9	25	29	1	64
4	UDWR	July 10 - July 13	23	56	39	4	122
5	FWS	July 14- July 16	18	203	146	5	372
6	FWS	July 28 - July 30	3	89	74	0	166
7	UDWR	Aug. 5 - Aug. 8	33	22	16	0	71
8	UDWR	Aug. 8 - Aug. 11	37	59	42	2	140
9	FWS	Aug. 11 - Aug. 13	1	47	91	4	143
10	FWS	Aug. 18 - Aug. 20	16	53	71	1	141
11	FWS	Sep. 1 - Sep. 3	93	41	47	2	183
12	FWS	Sep. 9 - Sep. 11	386	20	18	1	425
<i>Totals</i>			<i>639</i>	<i>696</i>	<i>615</i>	<i>25</i>	<i>1975</i>

Table 2. Abundance estimates for smallmouth bass, 2020. Fish captured by angling and barge electrofishing were excluded from the analysis.

Size Class	Method	Abundance Estimate	95% CI	SE	Fish/Mile
All bass \geq 100mm	Lincoln - Petersen	10,052	5,391- 14,712	2330	402

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Table 3. Ancillary fish captures in the Echo–Split reach, 2020. Piscivores are northern pike >450mm and walleye >375mm. Boat and barge electrofishing results are shown.

Common Name	Number Captured	Piscivores
Brown trout (<i>Salmo trutta</i>)	43	
Channel catfish (<i>Ictalurus punctatus</i>)	10	
Creek chub (<i>Semotilus atromaculatus</i>)	8	
Green sunfish (<i>Lepomis cyanellus</i>)	367	
Northern pike (<i>Esox lucius</i>)	7	7
Rainbow trout (<i>Oncorhynchus mykiss</i>)	19	
Walleye (<i>Sander vitreus</i>)	1	1
White sucker (<i>C. commersoni</i>)	987	
White sucker / Bluehead sucker hybrid (<i>C. commersoni</i> / <i>C. discobolus</i>)	4	
White sucker / Flannelmouth sucker hybrid (<i>C. commersoni</i> / <i>C. latipinnis</i>)	20	
Colorado Pikeminnow (<i>Ptychocheilus lucius</i>)	5	
Razorback sucker (<i>Xyrauchen texanus</i>)	3	
Roundtail chub (<i>Gila robusta</i>)	8	

Table 4. Ancillary fish captures in Desolation and Gray Canyons, 2020.

Species	Number Captured
Channel catfish >450 mm (<i>Ictalurus punctatus</i>)	1
Green sunfish (<i>Lepomis cyanellus</i>)	10
White sucker	5
Colorado pikeminnow (<i>Ptychocheilus lucius</i>)	2
Humpback chub (<i>Gila cypha</i>)	4
Razorback sucker (<i>Xyrauchen texanus</i>)	31

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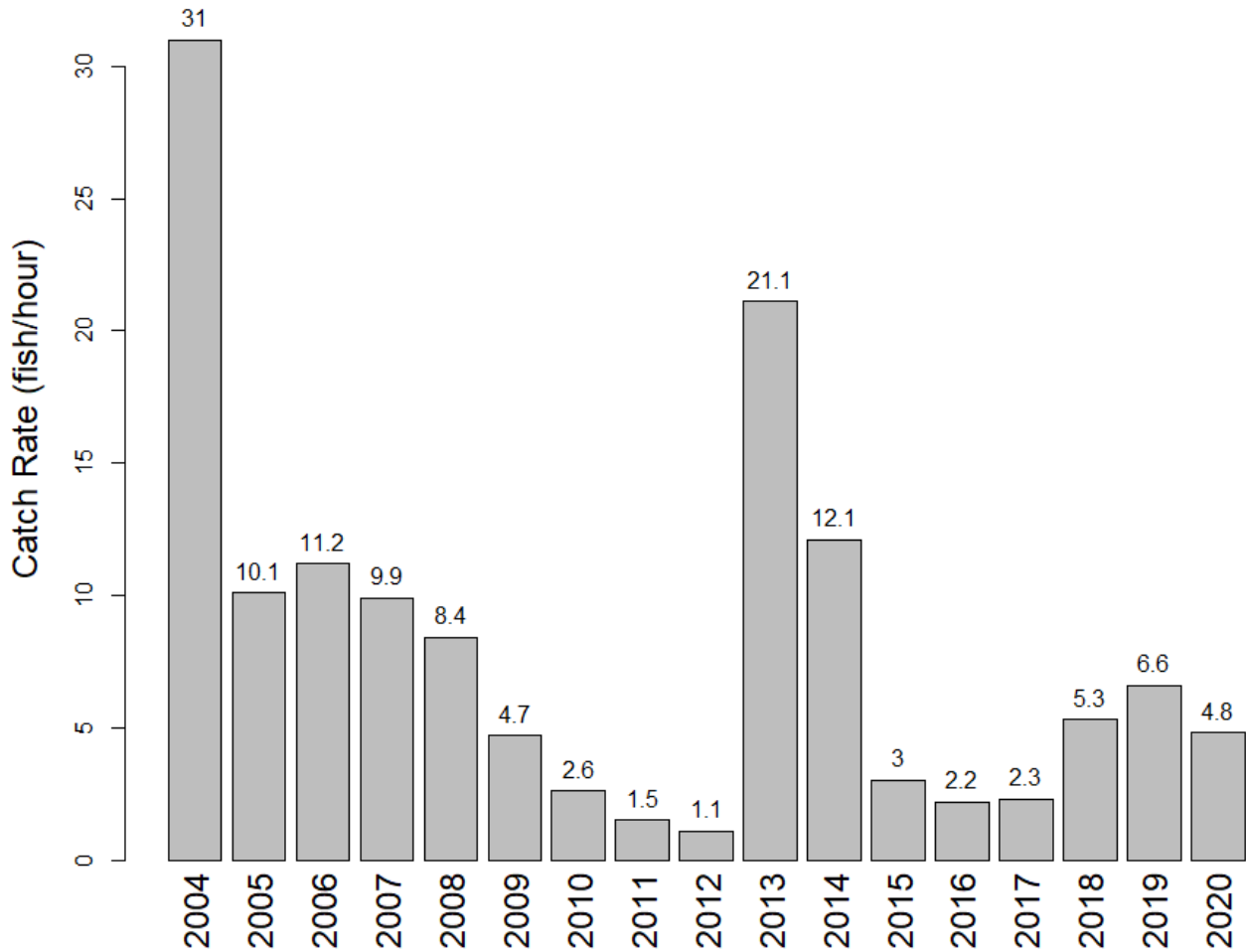


Figure 1. Catch rates for all bass >100mm in the Echo-Split reach, 2004-2020. This figure does not include bass captured by angling or barge electrofishing.

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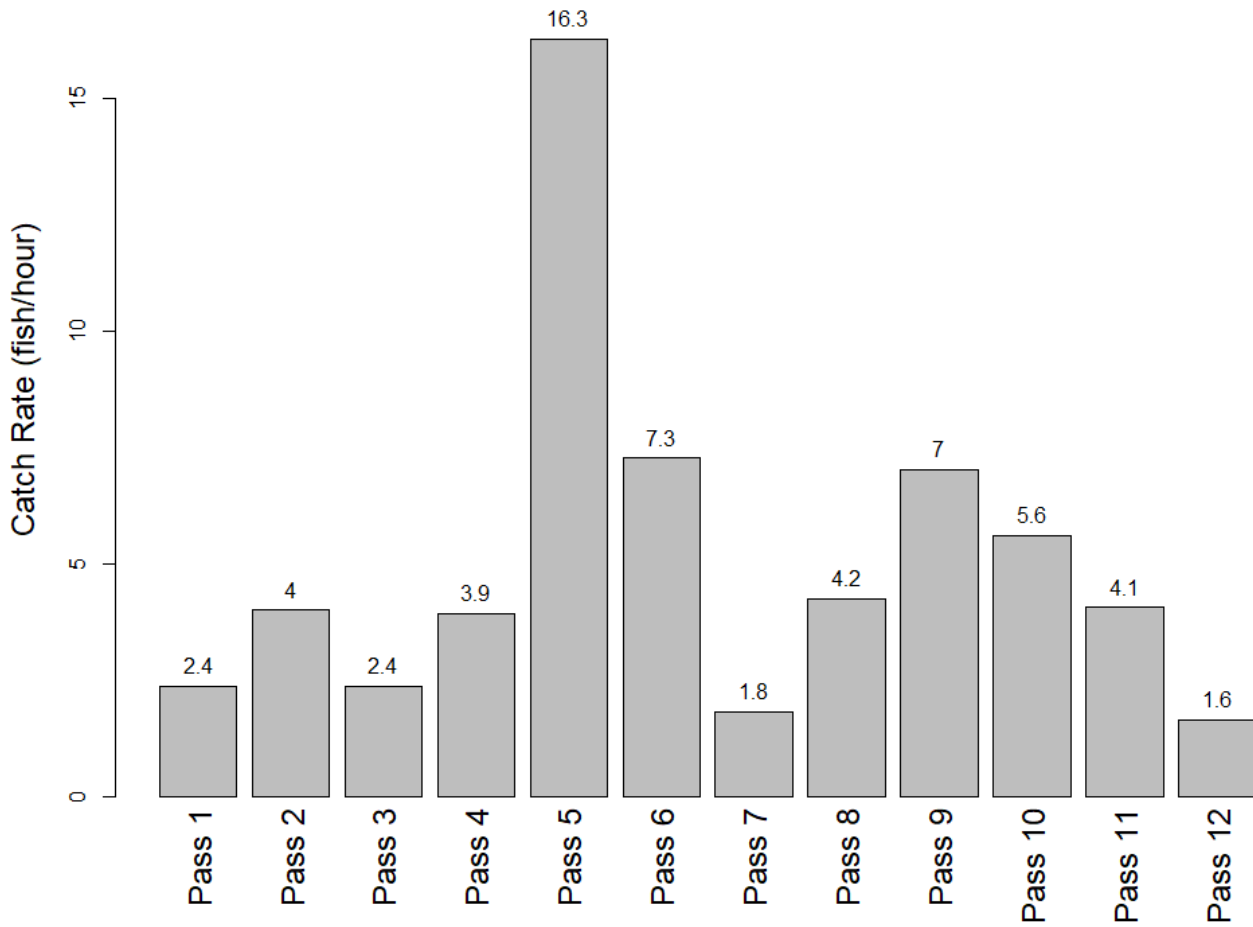
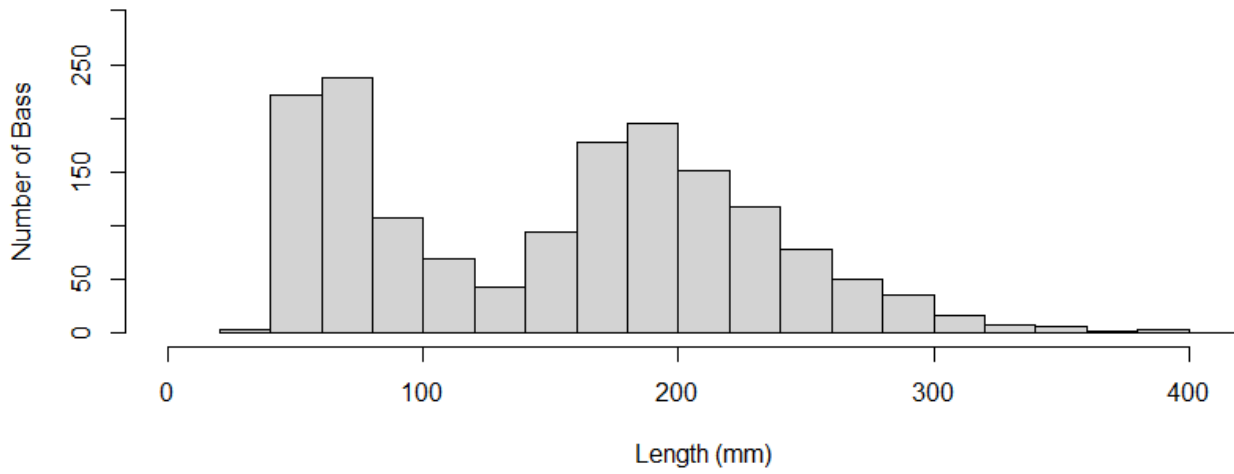


Figure 2. Catch rates by pass for all bass $\geq 100\text{mm}$, Echo-Split reach 2020. This figure does not include bass captured by angling or barge electrofishing.

(a) June - July 2020



(b) August - September 2020

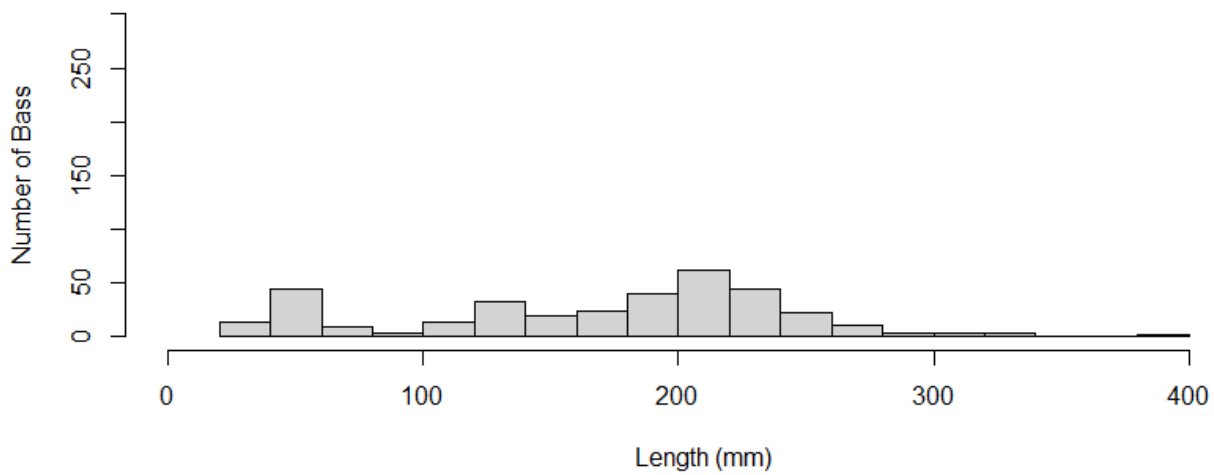


Figure 3a-b. Length-frequency histograms for smallmouth bass captured by boat electrofishing in June-July (passes 1-6 and UDWR-V Surge, Fig. 3a) and August-September (passes 7-12, Fig. 3b), Echo-Split reach 2020. This figure does not include bass captured by angling or barge electrofishing.

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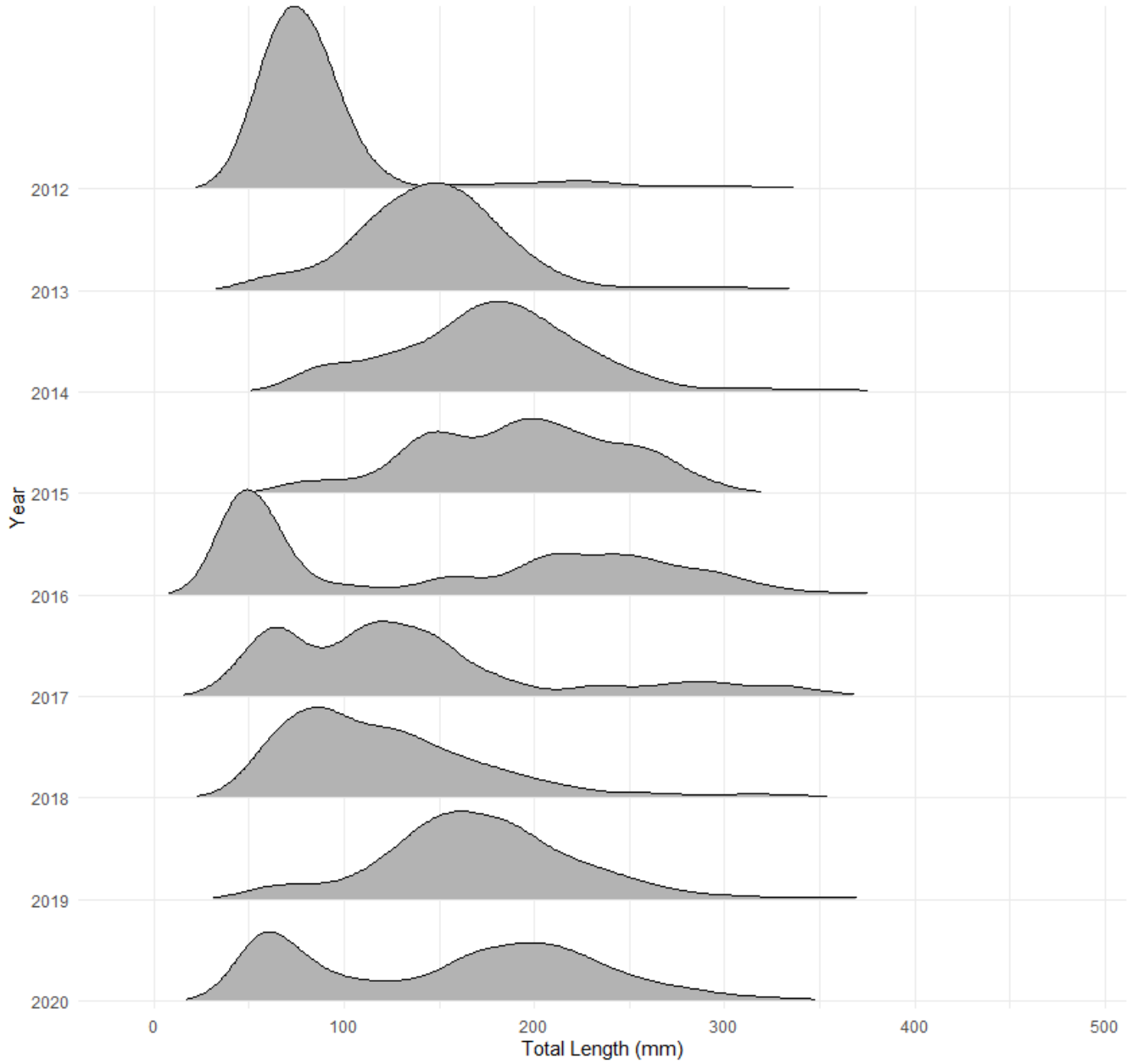


Figure 4. Length-frequency of smallmouth bass captured by boat electrofishing in Echo-Split, 2012-2020. This figure does not include bass captured by angling or barge electrofishing.

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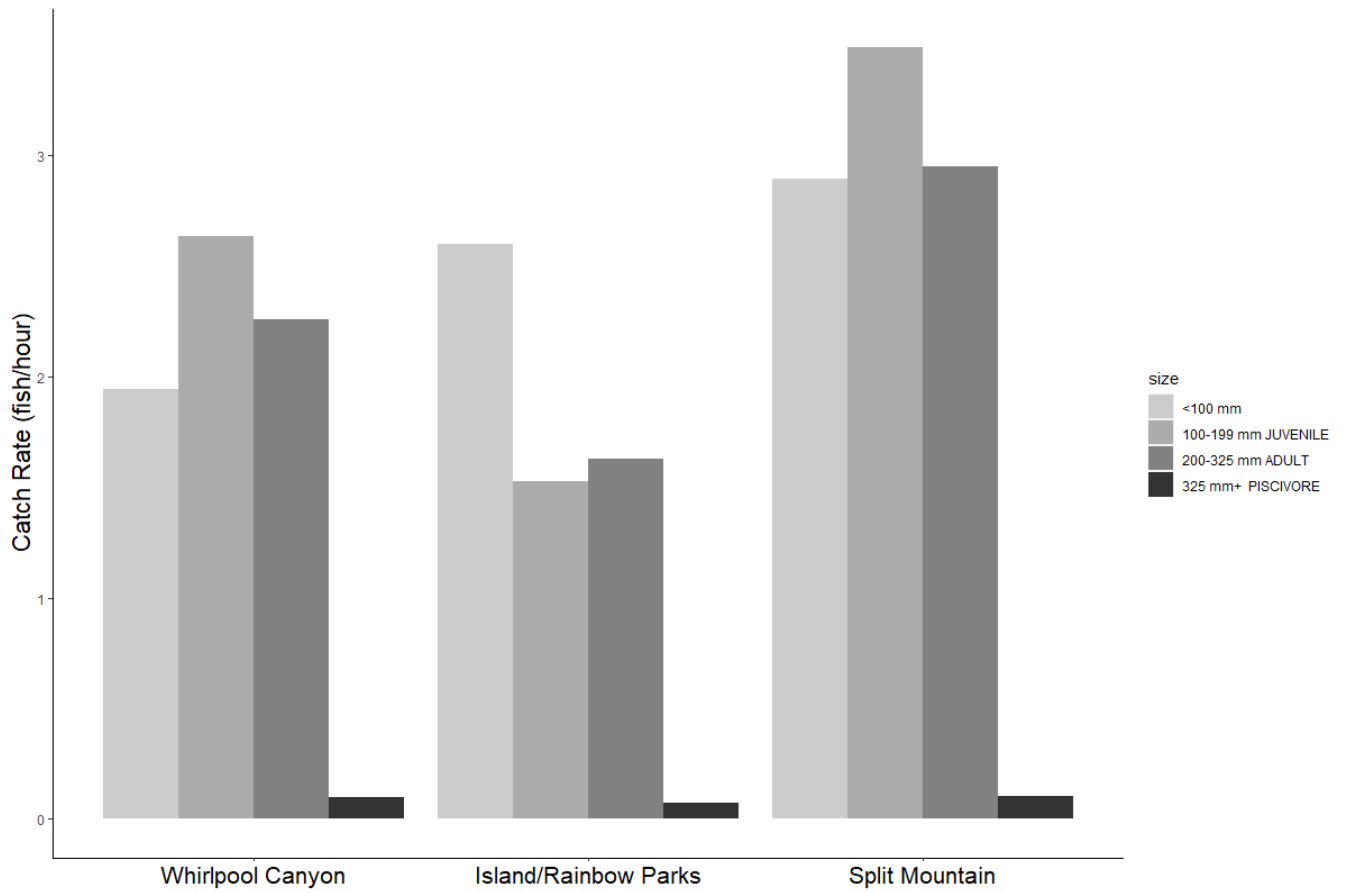


Figure 5. Catch rates by size class and river section for the Echo-Split reach, 2020. This figure does not include bass captured by angling or barge electrofishing.

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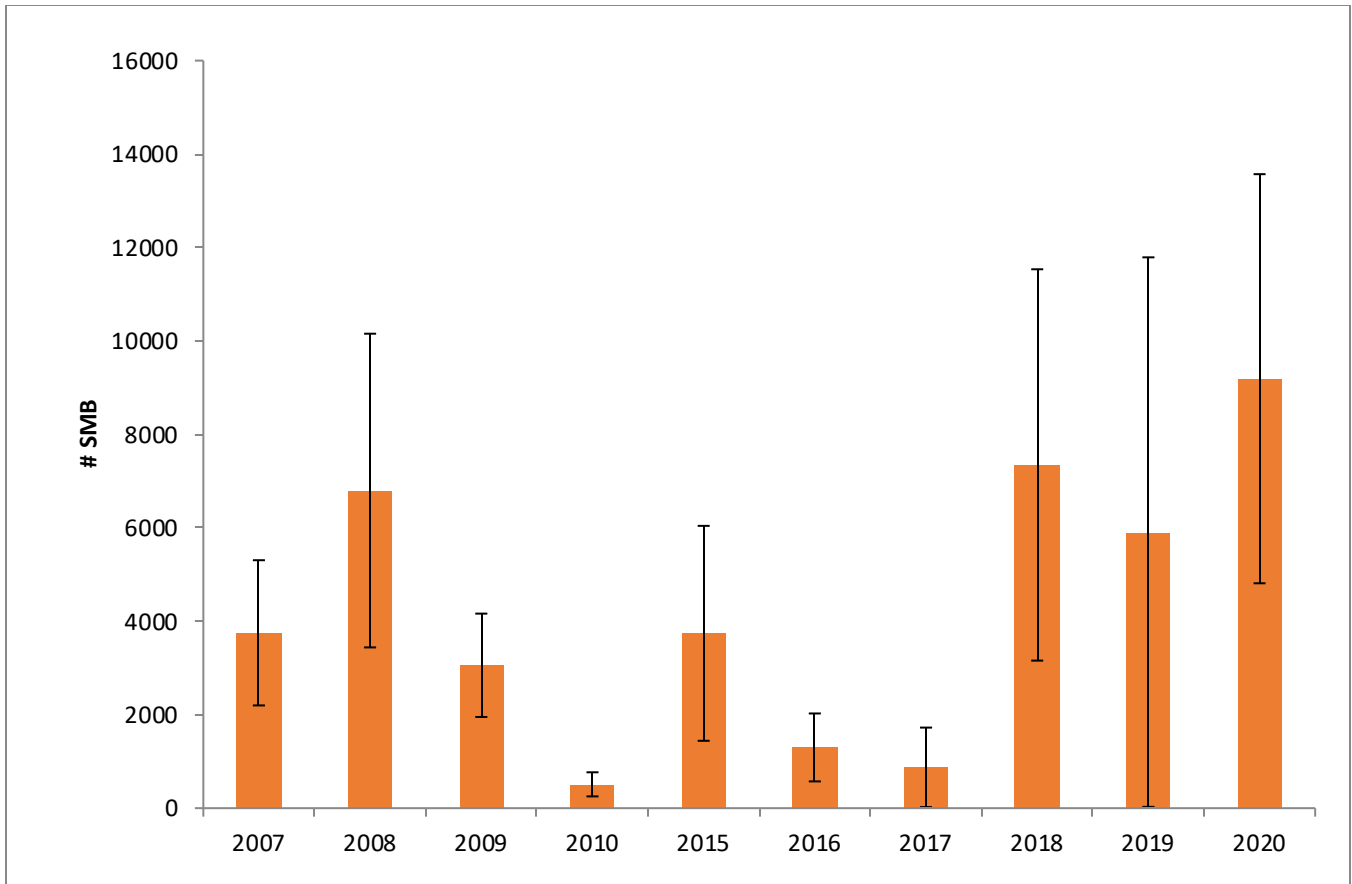


Figure 6. Abundance estimates with 95% confidence intervals for smallmouth bass in the Echo-Split reach, 2007-2010 and 2015-2020. Only fish caught by boat electrofishing were included in the analysis. Fish captured by angling and barge electrofishing were omitted. For ease of comparison with previous years, abundance estimation methods and confidence interval approximations for 2020 mirror those that were used in previous versions of this report.

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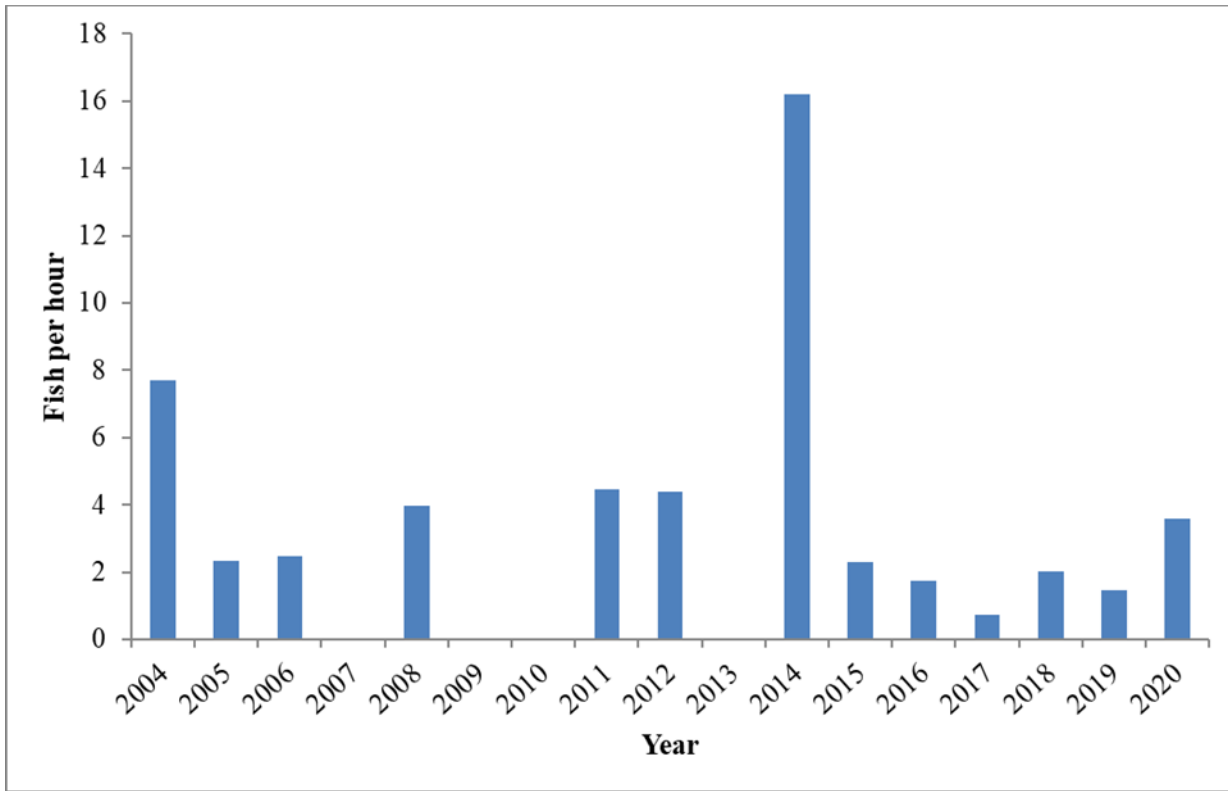


Figure 7. Catch per unit effort (fish per hour) from targeted smallmouth bass removal in Desolation and Gray Canyons, 2004 – 2020.

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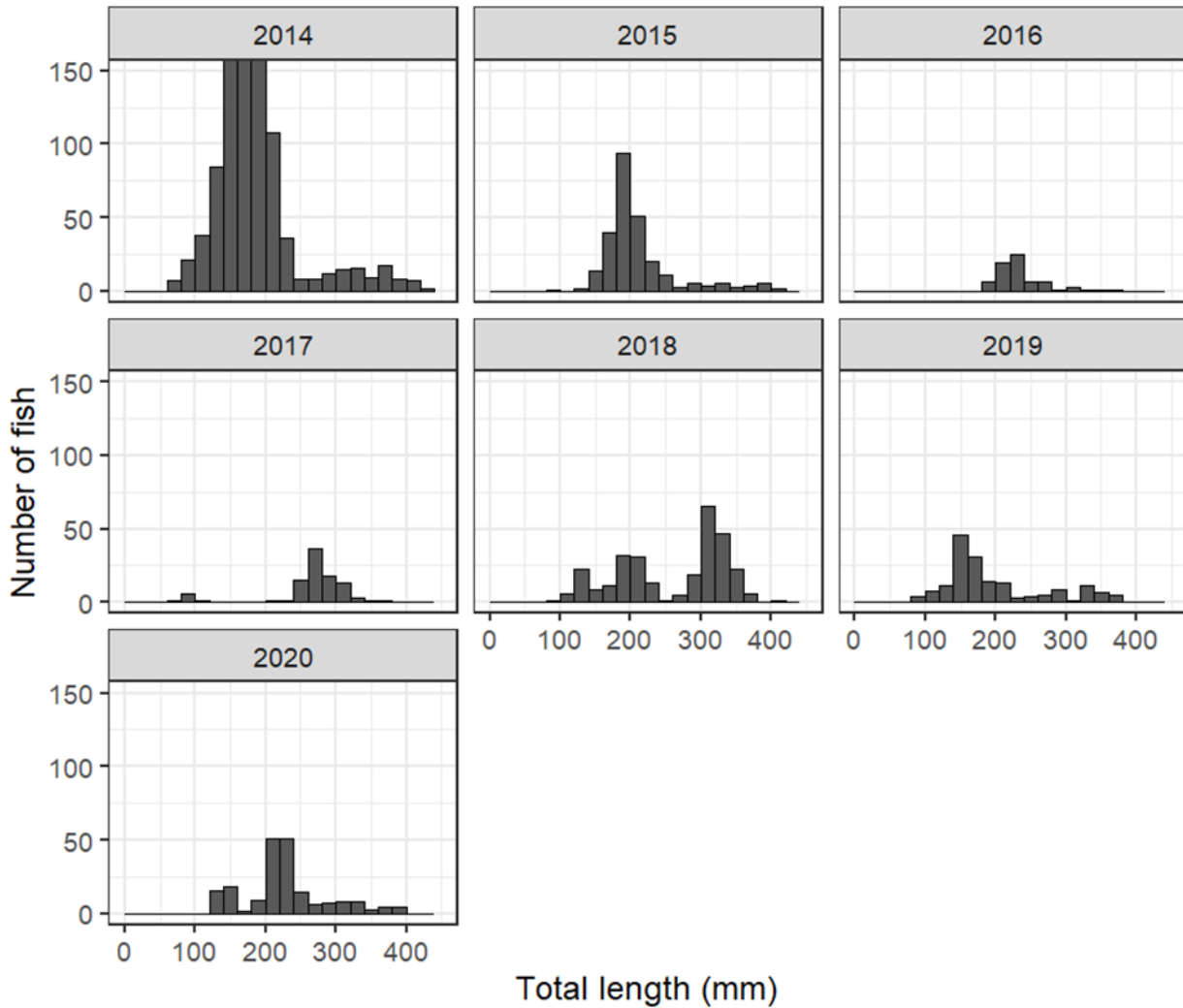


Figure 8. Smallmouth bass length-frequency distribution in Desolation and Gray Canyons, 2014 – 2020. The 2014 totals are not shown to keep scales comparable. 2020 and 2016 include captures from one UDWR Moab targeted removal pass; 2019, 2015, and 2014 include captures from two UDWR Moab targeted removal passes; 2018 and 2017 include captures from one UDWR Moab targeted removal pass and the ancillary captures from three FWS Project 128 passes.

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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*
1165 S Hwy 191 Suite 4
Moab, UT 84532
johncaldwell@utah.gov
435-259-3781

Project/Grant Period: Start date: 10/01/2018
End date: 09/30/2023
Reporting period end date: 9/30/2020
Is this the final report? Yes No

Performance:

Task 2 was completed: *Six passes were successfully completed (6/24 – 6/27/20, 6/27 – 6/30/20, 7/7 – 7/10/20, 7/10 – 7/13/20, 8/5 – 8/8/20, 8/8 – 8/11/20) on the Green River from Echo Park (RM 344.5) to Split Mountain (RM 319.5). A total of 545 smallmouth bass were captured and removed. Additionally, 42 brown trout, six channel catfish (over 450 mm), one creek chub, 92 green sunfish, three northern pike, 19 rainbow trout, and 295 white sucker and white sucker hybrids were captured and removed. These data were analyzed and reported within the annual report for project #123a by November 2020 (Task 4 was completed).*

Task 3 was completed: *One removal passes was successfully completed (6/24 – 6/30/2020) in Desolation and Gray Canyons on the Green River from Sand Wash boat ramp (RM 215.3) to Nefertiti Rapid (RMI 142.0). A total of 202 smallmouth bass were captured and removed. Additionally, one channel catfish (over 450 mm), ten green sunfish, and five white suckers were removed. Two Colorado pikeminnow, four humpback chub, and 31 razorback sucker were also encountered. Endangered species were enumerated, measured, tagged (if not already) and returned to the river. These data were analyzed and reported within the annual report for Project #123a by November 2020 (Task 4 was completed).*