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

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

Project/Grant Period: Start date (Mo/Day/Yr): 05/01/2014
End date: (Mo/Day/Yr): 09/30/2018
Reporting period end date: 09/30/2014
Is this the final report? Yes _____ No __X__

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IV. Abstract:

Nonnative fishes in the upper Colorado River basin present some of the greatest threats to native fishes. This project targets the most problematic nonnative species, including smallmouth bass, walleye, northern pike, and white sucker. For the first time, a multi-agency smallmouth bass spring surge effort was directed at prime spawning habitat in Island Park to disturb nests. Total bass catch rates in the middle Green River decreased this year, primarily a result of low age-0 catch rates which are likely due to higher spring peak flows and cooler temperatures unfavorable to young bass survival. A potential source population of white sucker has been identified in off-channel ponds in Brown's Park, and should be targeted for removal. Finally, an experimental early-spring electrofishing effort targeting walleye has demonstrated higher catch rates than other methods, and should be repeated.

V. Study Schedule: FY 2004 – FY 2018

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.
III.A.2.c.	Implement and evaluate the effectiveness of 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.
III.A.4.a.	Northern pike in the middle Green River.
III.A.4.b. (3)	Smallmouth bass in the middle and lower Green River.

VII. Accomplishment of FY 2014 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1. Northern pike, white sucker, walleye, and Island Park smallmouth bass removal.

Because 2014 was an off-year for Colorado pikeminnow population estimates, we had personnel and equipment available in the early spring to devote to other Recovery Program priorities. We devoted these resources to fishing tributary and backwater concentration areas associated with nonnative spawning and spring walleye removal.

Walleye removal was recommended by Recovery Program partners because of this species' emerging threat; our efforts were equivalent to one pass of Colorado pikeminnow population estimate effort. Based on observations of high walleye capture rates during spring pikeminnow population estimates (2011–2013) and after evaluating optimal flows and temperatures, this walleye phase comprised 80.97 hrs of electrofishing effort between 14 April – 15 May 2014. Tributary sampling targeted Brush Creek, Ashley Creek, and Stewart Lake Drain from 15 April – 7 May 2014 (when adequate depth allowed operation of boats in these areas) and comprised 13.32 hrs of effort. Fyke-netting of backwaters and tributaries was conducted between 17 March – 6 June, with 157 overnight sets. Fyke-netting locations included the Escalante Ranch outlet, Cliff Creek, Brush Creek, Ashley Creek, Stewart Lake Drain, and additional backwaters in this reach when conditions permitted.

2014 was the first year that a multi-agency partnership (UDWR-Vernal, UDWR-Moab, Vernal-CRFP) targeted prime smallmouth bass spawning habitat in Island Park with a spring electrofishing surge effort to disturb smallmouth bass nests. The partnership performed three passes per week, for three consecutive weeks, during optimal spawning temperatures (a collaborative overview of all agency data will be shared at December NNF workshop).

In addition, experimental netting originally conceived to target potential source populations of northern pike was undertaken at Brown's Park, in both the main channel and in Duck Lakes (Parson's Unit Waterfowl Management Area), which connect directly

to the river, in both May and October (see below). Total captures of both northern pike and walleye decreased slightly from 2013, but white sucker captures increased. Sampling results indicated a newly identified source population of white sucker in Duck Lakes.

Northern pike — A total of 114 northern pike were removed from the middle Green River in 2014: 66 during fyke-netting, 28 during tributary electrofishing, 16 during smallmouth bass removal, and four during walleye removal (Table 1). Eight northern pike included in our totals were collected by Vernal – CRFP partners. Three additional pike were removed during State-funded Three Species projects from Split Mountain boat ramp to Tabyago Riffle (Fiorelli and Breen, In Prep.). In terms of total captures and catch-per-unit-effort (CPUE), fyke-netting and tributary electrofishing were the most effective means of targeting pike, while main channel electrofishing (during walleye and smallmouth bass removal) achieved low CPUE values. Similar results were observed by Skorupski and Breen (2012), which previously led to the abandonment of early spring electrofishing effort in main channel habitats focused on northern pike. Size distribution was skewed toward larger individuals, with 108, or 95%, in the piscivore class ($\geq$ 450 mm TL). Fewer northern pike were captured in 2014 than in 2013 (n=177; Skorupski et al., 2013). Here and elsewhere, annual variation in capture should be considered in the context of environmental conditions, which in 2014 included a peak flow above the historical median (Figure 1) and fluctuating flows during an active monsoon season from late August through October. These conditions increased turbidity, resulting in considerably reduced water visibility (Figures 1 and 2).

Removal efforts at Brown's Park failed to identify a source population of northern pike in Duck Lakes (Parson's Unit Waterfowl Management Area), despite previous observations of at least one adult (A. Vande Voort, pers. comm.). Additionally, continued efforts at netting in the main channel were ineffective at catching pike known to be present in the reach (see also Skorupski et al., 2013). Based on interactions with successful anglers, hook and line sampling seems to be more effective for capturing pike in this habitat (R. Mosely, pers. comm.).

Walleye — Walleye captures were reduced in 2014 compared to 2013, notwithstanding dedicated main channel electrofishing effort toward walleye removal as a pilot project this spring in place of pikeminnow population estimates. 2014 walleye sampling techniques incorporated higher boat speeds and targeted habitats typically targeted during pikeminnow population estimates. This is in contrast to slower boat speeds and closer proximity to key habitats that are utilized to target smallmouth bass. In total, 149 walleye were removed in 2014 (Table 2), compared to 233 from all projects combined in 2013 (87 of those removed during smallmouth bass removal; Skorupski et al., 2013). Three additional walleye were removed during State-funded Three Species projects (Fiorelli and Breen, In Prep.). Only nine walleye were removed during spring fyke-netting and tributary electrofishing. Although the majority of walleye captures this year (n=75) occurred during main channel smallmouth bass removal electrofishing efforts, the highest CPUE (0.80 fish/hr) was obtained during the spring walleye targeting phase, arguing for the validity of this approach. This 0.80 fish/hr CPUE is similar to the 0.95 fish/hr CPUE achieved during the three Colorado pikeminnow population estimate passes in 2013, suggesting that additional walleye passes in 2014 would have led to comparable total catch numbers. In similar fashion to northern pike, the walleye size distribution was

overwhelmingly skewed toward large adults, with 147 of the 149, or 98.7%, in the piscivore class (≥ 375 mm TL), likely indicating adults are immigrating to this area from source locations.

White sucker — An effective white sucker removal strategy continues to be the early spring targeting of spawning concentrations in tributaries such as Ashley Creek. A combined total of 4,211 white suckers were removed in 2014, with 1,791 of those captured during early spring tributary electrofishing and fyke-netting (Table 3). In addition to the totals removed during Recovery Program projects, 52 white suckers and one flannelmouth x white sucker hybrid were removed during State-funded Three Species projects (Fiorelli and Breen, In Prep.). Tributary electrofishing in particular resulted in high catch rates (CPUE = 41.37 fish/hr). As in 2013 (Skorupski et al., 2013), early spring tributary concentrations represented larger size classes, with higher percentages of mature and ripe individuals than are captured during main channel smallmouth bass removal efforts (Table 3; values are intermediate during spring walleye removal). Of the white suckers removed, 33 were identified as hybrids with flannelmouth or bluehead suckers (Table 4), compared to 47 hybrids in 2013. Although fewer white suckers were removed from combined tributary and main channel sampling than in 2013 (2,851 vs. 3,544), a single experimental overnight set of assorted fyke, trammel, and gill-nets in Duck Lakes (Parson's Unit Waterfowl Management Area) in Brown's Park that was intended to search for a potential source population of northern pike, added 1,360 white suckers to this year's total. That overnight (21 – 22 October) effort totaled 403.3 hours of combined net soak time, resulting in a CPUE of 3.37 fish/hr. Unlike most fyke-netting in 2014 which used the same nets as in previous years, the Duck Lakes effort also incorporated some directional fyke-nets due to their increased effectiveness during Stirrup wetland sampling this fall. (Duck Lakes were also sampled with 6 x 200 ft long experimental gill nets during < 4 hr daylight sets on 28 May, resulting in capture of only one white sucker; R. Mosely, pers. comm.). The high abundance of white suckers in these upstream ponds—with outlet structures that in their current design allow for easy escapement back to the Green River—represents a troubling potential source population that should be targeted for removal.

Task 2. Smallmouth bass removal passes from Split Mountain boat ramp to Tabyago Riffle.

Smallmouth bass — Electrofishing efforts targeted smallmouth bass in the middle Green River from Split Mountain boat ramp (RM 319.3) to Tabyago Riffle (RM 206.8) from 16 June – 10 October 2014. As mentioned above, UDWR-Vernal also participated in a collaborative surge effort aimed at disrupting bass nesting in Island Park by means of repeat electrofishing passes over three weeks in late June / early July (pending further collaborative analysis, this data, representing 18.06 hours electrofishing effort, is combined here with our standard smallmouth bass data). The combined annual CPUE of 16.97 fish/hr is compared with previous years in Table 5. During this period, as in 2013, two complete removal passes at different points in the season were used to guide subsequent fishing efforts, so that bass concentration areas with high CPUE values could be fished preferentially. As can be seen in Table 6, highest values for fishing effort broken down by five-mile sections correspond to sections with high bass CPUE values shown in Figure 3. During the smallmouth bass targeting phase, 5,539 bass were

captured. Including the additional bass captured during tributary electrofishing (n=60), fyke-netting (n=5) walleye electrofishing (n= 291), and UDWR Three Species surveys (n=326; Fiorelli and Breen, In Prep.), the 2014 total is 6,221 individuals, considerably fewer than were captured in 2013.

Catch rates. — Figures 3 and 4 illustrate smallmouth bass CPUE values for three different size classes across five-mile reach sections and across months, respectively. Unlike in both 2012 and 2013 (Skorupski and Breen, 2012; Skorupski et al., 2013), when low spring flows were insufficient to disrupt nests and a mid-season surge in captures of young-of-year (YOY) bass vastly outnumbered captures of larger size classes and inflated the annual total, there was no surge in year-0 bass captures in 2014. Higher spring flows are likely responsible for this favorable result (Bestgen et al., 2006). Hotspot sections of higher catch rates identified in 2013 (including A, B, C, and G-M) were still comparatively more productive than the lowest concentration sections, though the lack of an abundant recruiting class of YOY in sections A-C made those sections appear unremarkable in 2014. Highest catch rates this year were in sections H, I, K, and L, with the sub-adult size class predominating, presumably representing the surviving remnant of the large 2012 and 2013 recruiting classes. Catch rates by month (Figure 4) increased after June and July to peak levels in August – October, in spite of increased turbidity from frequent storm events beginning in August (Figure 2). For sections A and B specifically, early season electrofishing was quite productive, but dropped precipitously by September—during which, in our last pass through those sections on 22 September, bass capture rates plummeted while large numbers of juvenile carp were observed. It may not be a coincidence that large numbers of juvenile carp had recently been released into the main channel during the draining of Stewart Lake in the first half of September (Schelly et al., 2014).

Population size structure. — Figure 5 illustrates the size distribution of smallmouth bass captured in the middle Green River in 2014, visualized in the context of previous years' size distributions (since 2007) in Figure 6. As alluded to above, a small recruiting class is represented by low numbers of bass <125 mm TL. The overwhelming majority of the 2014 catch falls between 126-250 mm TL, and within that window the majority are sub-adults, with the highest frequency size class being 151-175 mm TL. After a successful spawn in 2013 and correspondingly high numbers of age-0 fish, many of these could be age-1 fish that survived through the winter, depending on the contribution from age-2 fish that have not outgrown this range. Only 134 smallmouth bass, or 2.3% of the total, fell into the piscivore class (≥325 mm TL).

Movement. — No mark-recapture studies of bass are currently being conducted by Vernal-UDWR, but tagging records have been found for a subset of the seven recaptures in 2014 (queries will be made of partners in the region about the unidentified tags when time allows). None of these recaptures indicate movement beyond adjacent five-mile reaches. One individual tagged in section A in 2011 was recaptured by Vernal-CRFP this year in the section upstream of A (Split Mountain Canyon). A second bass was recaptured this year in section R, immediately downstream of section Q where it was tagged in 2012. The final bass for which a tagging record was found was tagged in 2011 in section B, and remained in section B upon recapture in 2014. This evidence of site fidelity, or at least disinclination toward long migrations, is consistent with previous

recapture data (i.e. Skorupski et al., 2013), and suggests that high-density bass areas will remain consistent from year to year, simplifying our efforts to target hotspots.

Task 3. Data entry, analysis, and reporting

Recovery Program annual progress report submitted in November 2014.

VIII. Additional noteworthy observations:

Ancillary captures. — Table 4 lists counts of additional nonnative species removed during smallmouth bass electrofishing. Predatory green sunfishes, which are a threat particularly to small-bodied native fishes, show a downward trend in 2014 vs. 2013 totals (Skorupski et al. 2013) that mimics smallmouth bass numbers, suggesting that higher flows this year were similarly limiting for the two species. Although no burbot have been captured during our nonnative removal efforts, one confirmed capture by an angler this summer in the region of the Split Mountain boat ramp is concerning. In addition, 9 walleye otoliths were collected for microchemistry and/or other analyses.

IX. Recommendations:

- A large population of white suckers identified in Duck Lakes (Parson's Unit Waterfowl Management Area) in Brown's Park may be regularly escaping and serving as a source population for the middle Green River. This pond system was originally designed for waterfowl management, without consideration for nonnative fishes. Following further research, we recommend modification or replacement of the current structure at the inlet to prevent further colonization by problematic nonnative species, like white sucker and northern pike. After mechanical isolation has been achieved, rotenone treatment would be advisable to remove established nonnatives.

- Having determined that main channel removal efforts for northern pike in Brown's Park are ineffective, we recommend discontinuing further main channel sampling for pike in this reach. We suggest continuing to identify and sample off-channel habitats that may harbor source populations, in concert with efforts to resolve inlet structure design issues as described in the previous recommendation.

- We suggest a synthesis of data from this first attempt at a spring Island Park surge (UDWR-Vernal portion combined with smallmouth bass data herein) with UDWR-Moab and Vernal-CRFP at the Nonnative Fishes workshop to evaluate the effectiveness of these efforts at disrupting bass spawning. Ultimate reporting of these efforts should be under Project 123a, which includes Island Park in its smallmouth bass removal efforts.

- This was our first season of targeted main channel electrofishing for walleye in the early spring, and CPUE values for walleye this season were considerably higher during this period. We recommend repeating this effort in off-years for pikeminnow population estimates. In addition, we recommend continuing with spring fyke-netting and tributary electrofishing, which are the most effective means of removing northern pike and white suckers, and which target higher percentages of ripe adult white suckers capable of hybridizing with native suckers.

X. Project Status: On track and ongoing.

XI. FY 2014 Budget Status

A. Funds Provided: $225,549
B. Funds Expended: $225,549
C. Difference: $0
D. Percent of the FY 2014 work completed, and projected costs to complete: 100%
E. Recovery Program funds spent for publication charges: $0

XII. Status of Data Submission (Where applicable):

We will submit our data to the Recovery Program database manager in December 2014.

XIII. Signed: *Robert Schelly* 11/11/14
Principal Investigator Date

XIV. References.

Bestgen, K.R., Zelasko, K.A., Compton, R.I., and T. Chart. 2006. Response of the Green River fish community to changes in flow and temperature regimes from Flaming Gorge Dam since 1996 based on sampling conducted from 2002 to 2004. Final Report to Colorado River Recovery Implementation Program, Project Number 115.

Schelly, R.C., Herdmann, J.T., and M.J. Breen. 2014. Use of Stewart Lake floodplain by larval and adult endangered fishes. Annual Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Skorupski, J.A., Kiefer, B.P., and M.J. Breen. 2013. Nonnative fish control in the middle Green River. Annual Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Skorupski, J.A., and M.J. Breen. 2012. Nonnative fish control in the middle Green River. Annual Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Table 1. – **NORTHERN PIKE**. Total abundance, catch-per-unit-effort (CPUE; electrofishing (fish/hr) and fyke-netting (fish/overnight set)), and total length (mm) means and ranges for three projects during 2014.

Project	Abundance	ELECTRO. CPUE	FYKE. CPUE	Mean TL	Range TL
Spring Tributary Sampling	94	2.10	0.42	659.2	336-900
Spring Walleye Removal	4	0.049		623.8	539-727
Smallmouth Bass Removal	16	0.048		604.5	210-860

Table 2. – **WALLEYE**. Total abundance, catch-per-unit-effort (CPUE; electrofishing (fish/hr) and fyke-netting (fish/overnight set)), and total length (mm) means and ranges for three projects during 2014.

Project	Abundance	ELECTRO. CPUE	FYKE CPUE	Mean TL	Range TL
Spring Tributary Sampling	9	0.23	0.04	482.9	302-572
Spring Walleye Removal	65	0.80		487.2	280-711
Smallmouth Bass Removal	75	0.23		503.8	381-636

Table 3. – **WHITE SUCKER**. Total abundance, catch-per-unit-effort (CPUE; electrofishing (fish/hr) and fyke-netting (fish/overnight set)), total length (mm) means and ranges, and biological data for three projects in 2014. Note that only 674 individuals out of 1791 were measured and dissected during spring tributary sampling; ranges and percentages are calculated from this subset of the total.

Project	Abundance	ELECTRO. CPUE	FYKE CPUE	Mean TL	Range TL	% Mature	% Ripe	% ≥275mm
Spring Tributary Sampling	1791	41.37	7.95	236	66-525	41.2	17.2	35.2
Spring Walleye Removal	208	2.57		198.2	65-430	19.2	1.9	18.3
Smallmouth Bass Removal	852	2.61		165.8	53-471	12.7	1.4	8.9

Table 4. — Totals for additional nonnative species removed during smallmouth bass removal electrofishing efforts in the middle Green River in 2014.

Species	Abundance
Black crappie	38
Bluegill	5
Bluehead x white sucker*	4
Brown trout	58
Creek chub	1
Flannelmouth x white sucker*	29
Green sunfish	464
Gizzard shad	14
Rainbow trout	8
Yellow perch	1

*these hybrids are included in white sucker counts given in text

Table 5. — Smallmouth bass total rates of catch-per-unit-effort (CPUE; fish/hr) from 2004 – 2014.

Year	CPUE (fish/hr)
2004	9.33
2005	4.02
2006	4.71
2007	26.04
2008	8.56
2009	7.96
2010	9.6
2011	7.4
2012	34.1
2013	48.6
2014	16.97

Table 6. — 2014 electrofishing effort totals for 5-mile sections of the middle Green River during walleye removal (14 April – 15 May) and smallmouth bass removal (16 June – 10 October).

SECTION	RIVER MILES	WE HRS EFFORT	SMB HRS EFFORT
I.P.			18.06
A	319-316	10.43	28.29
B	316-311	13.37	42.06
C	311-306	1.52	11.73
D	306-301	6.04	12.82
E	301-296	5.01	3.29
F	296-291	4.54	6.61
G	291-286	3.97	14.16
H	286-281	4.39	23.69
I	281-276		16.52
J	276-271		17.28
K	271-266	4.86	19.34
L	266-261	4.22	15.51
M	261-256		19.14
N	256-256	8.24	19.78
O	251-246	10.23	8.54
P	246-241	4.15	7.56
Q	241-236		5.57
R	236-231		6.95
S	231-226		5.80
T	226-221		6.39
U	221-216		5.18
V	216-211		6.77
W	211-207		5.36
	TOTAL	**80.97**	**326.39**

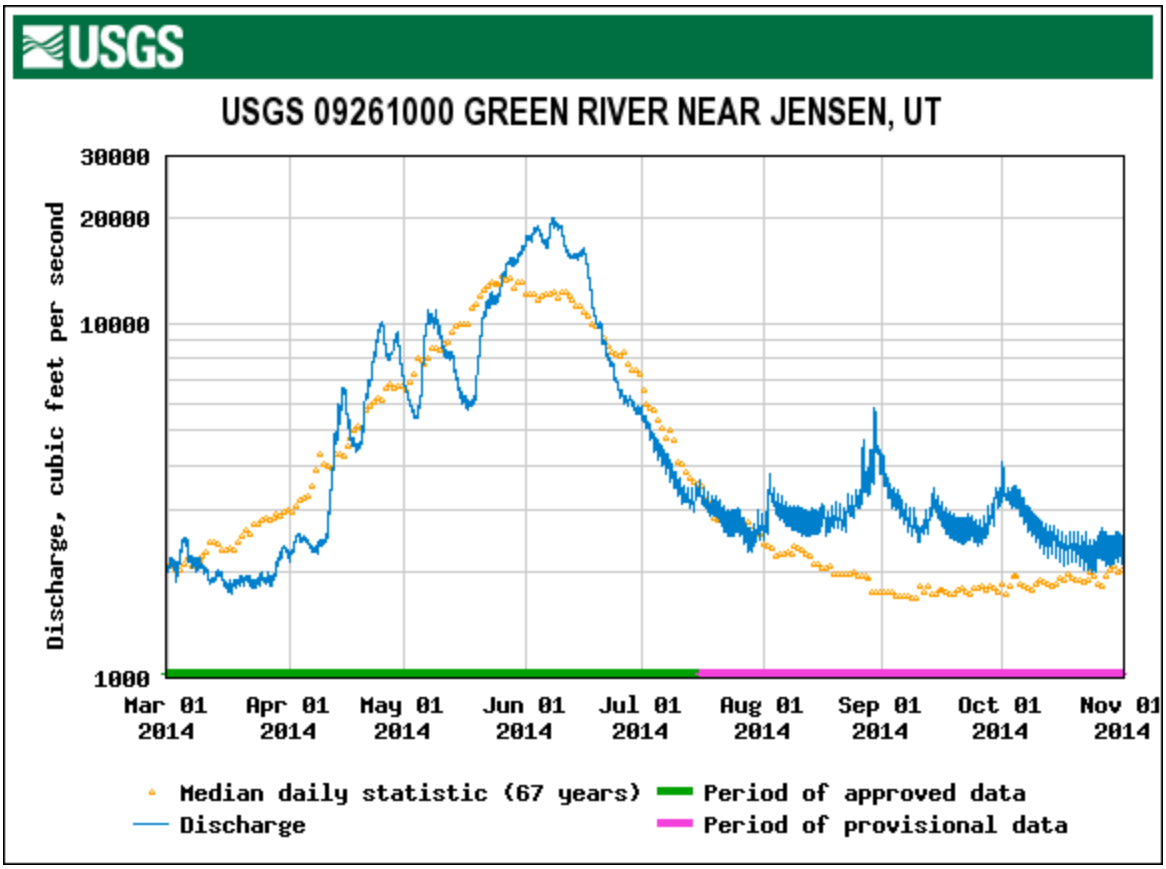

Figure 1. Green River hydrograph at Jensen, Utah, for March – October, 2014.

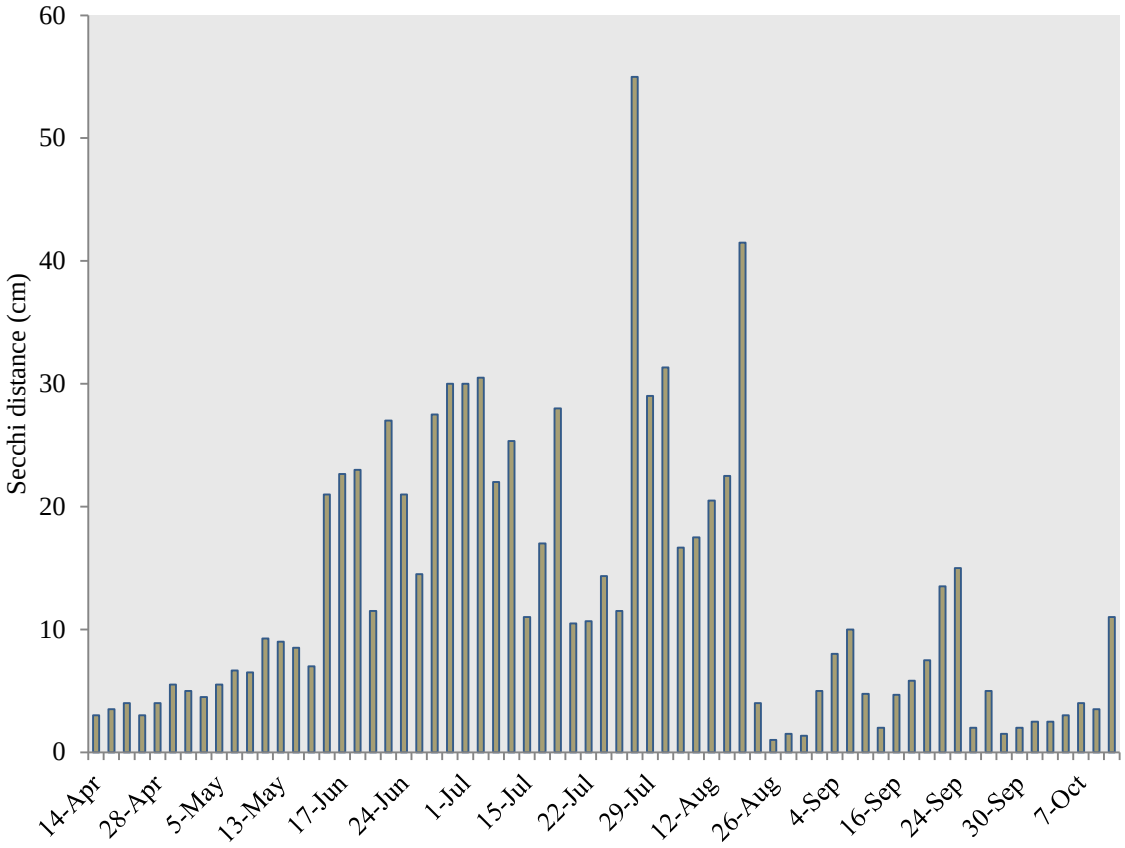

Figure 2. Water clarity, expressed in daily average Secchi distances (cm), in the middle Green River from April – October 2014.

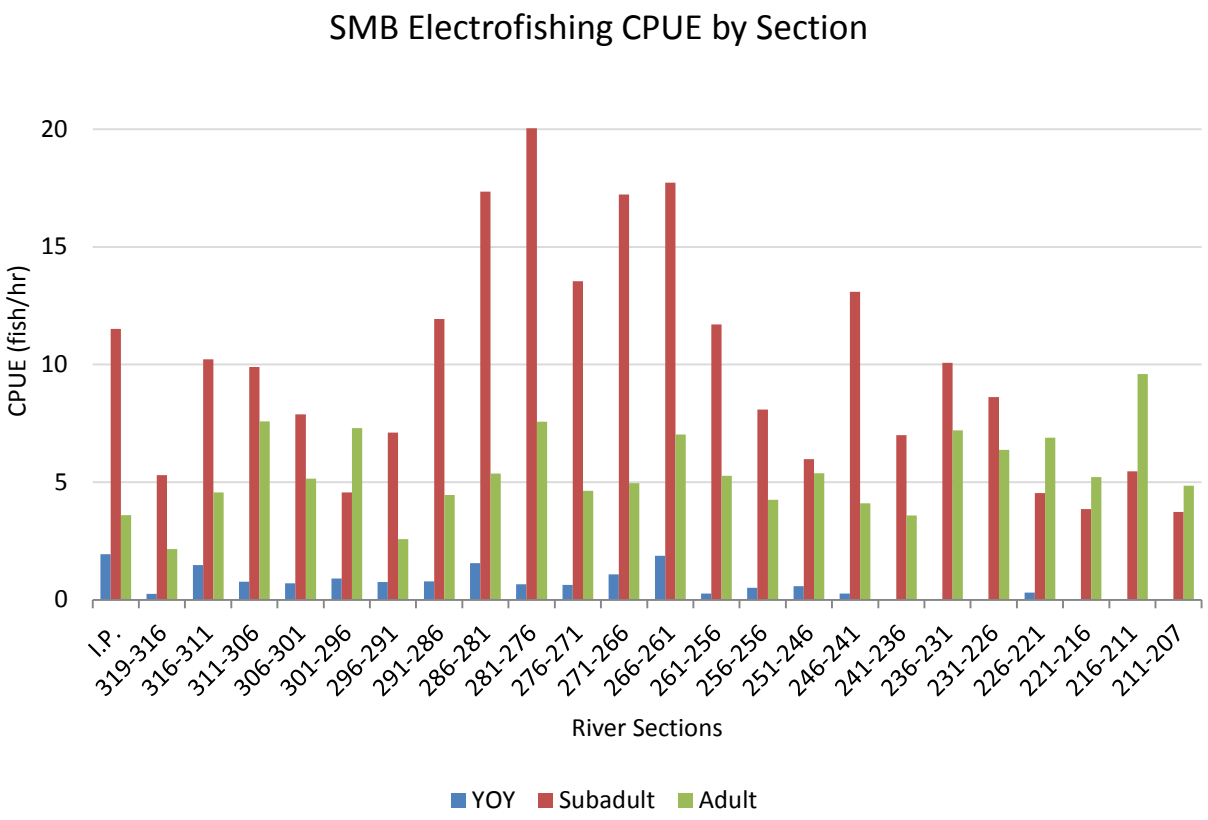

Figure 3. — 2014 smallmouth bass young-of-year (YOY; <100 mm TL), sub-adult (100-200 mm TL) and adult (>200 mm TL) catch rates for Island Park (I.P.) and from Split Mountain boat ramp to Tabyago Riffle, middle Green River, 16 June – 10 October (excluding walleye sampling).

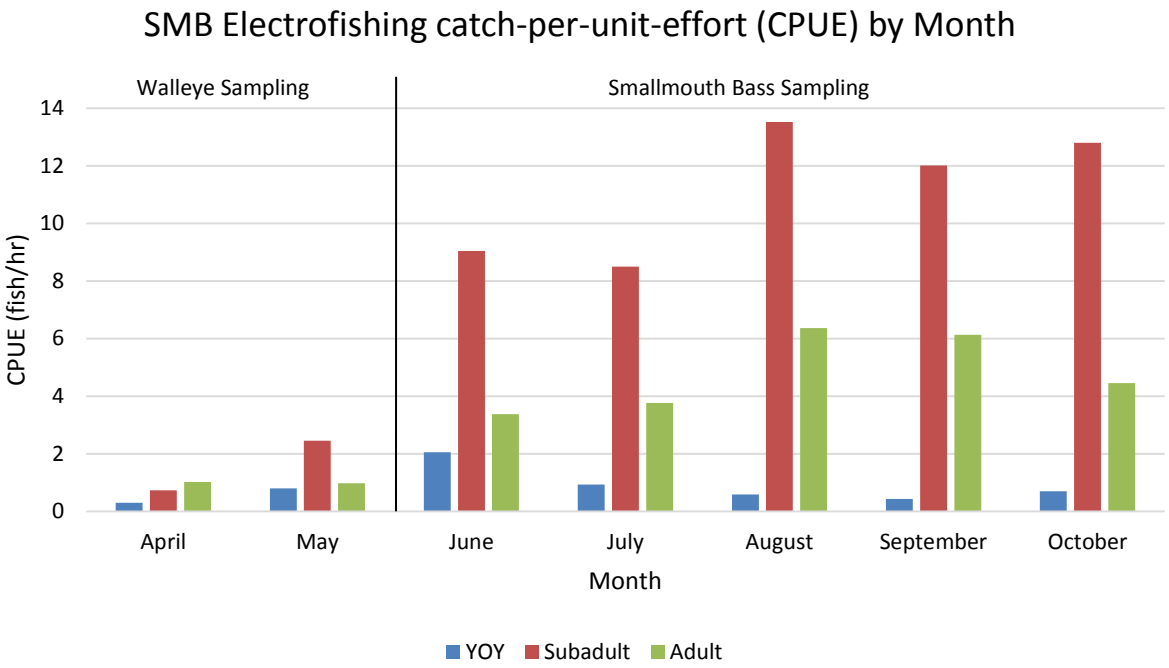

Figure 4. — 2014 smallmouth bass young-of-year (YOY; <100 mm TL), sub-adult (100-200 mm TL) and adult (>200 mm TL) catch rates by month in the middle Green River. Lower bass catch rates in April and May (left of dark line) correspond to pilot project sampling that specifically targeted walleye; rates from June – October (right of dark line) correspond to sampling that targeted smallmouth bass.

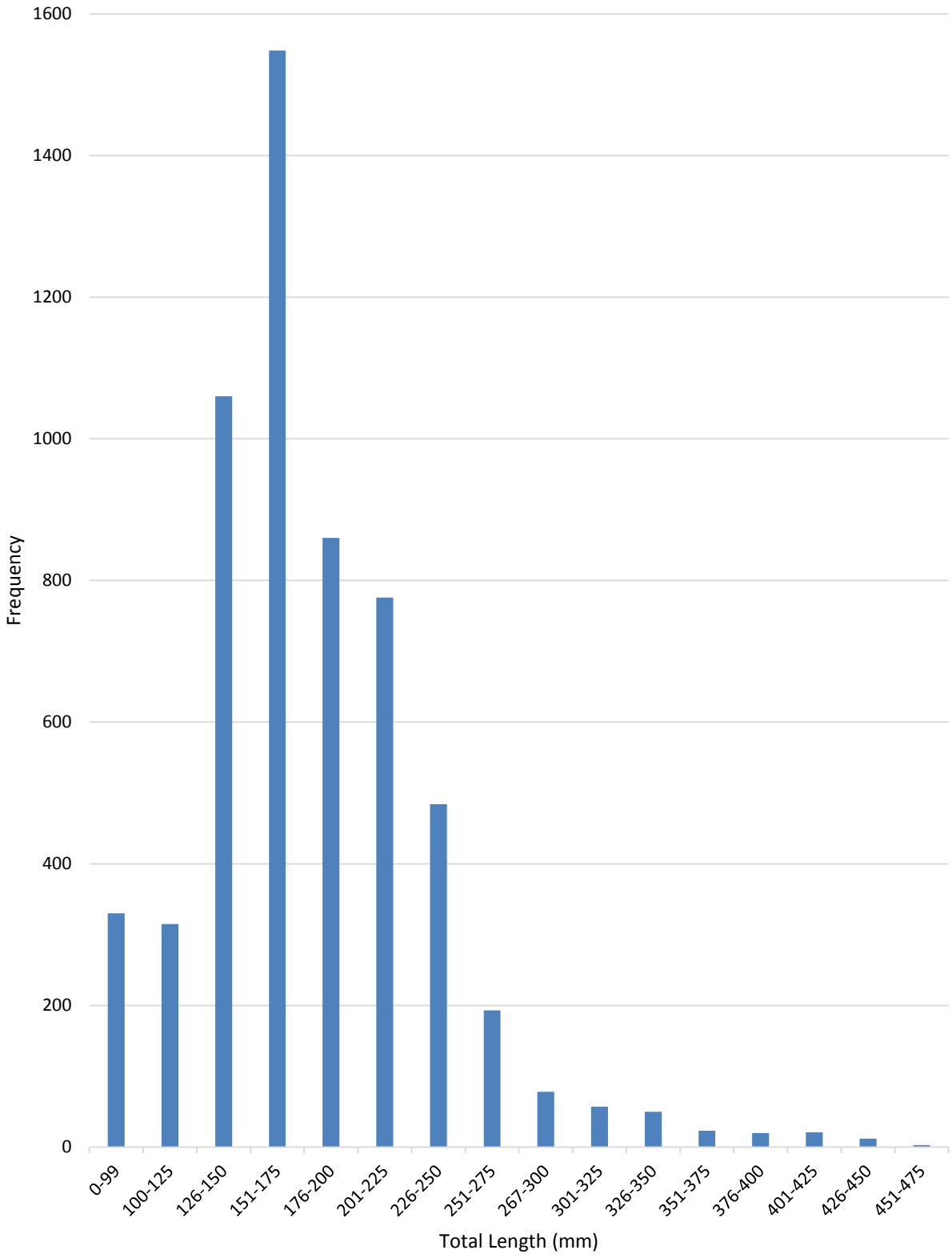

Figure 5. — 2014 size distribution of smallmouth bass electrofishing captures in the middle Green River (includes both walleye sampling and smallmouth bass sampling periods).

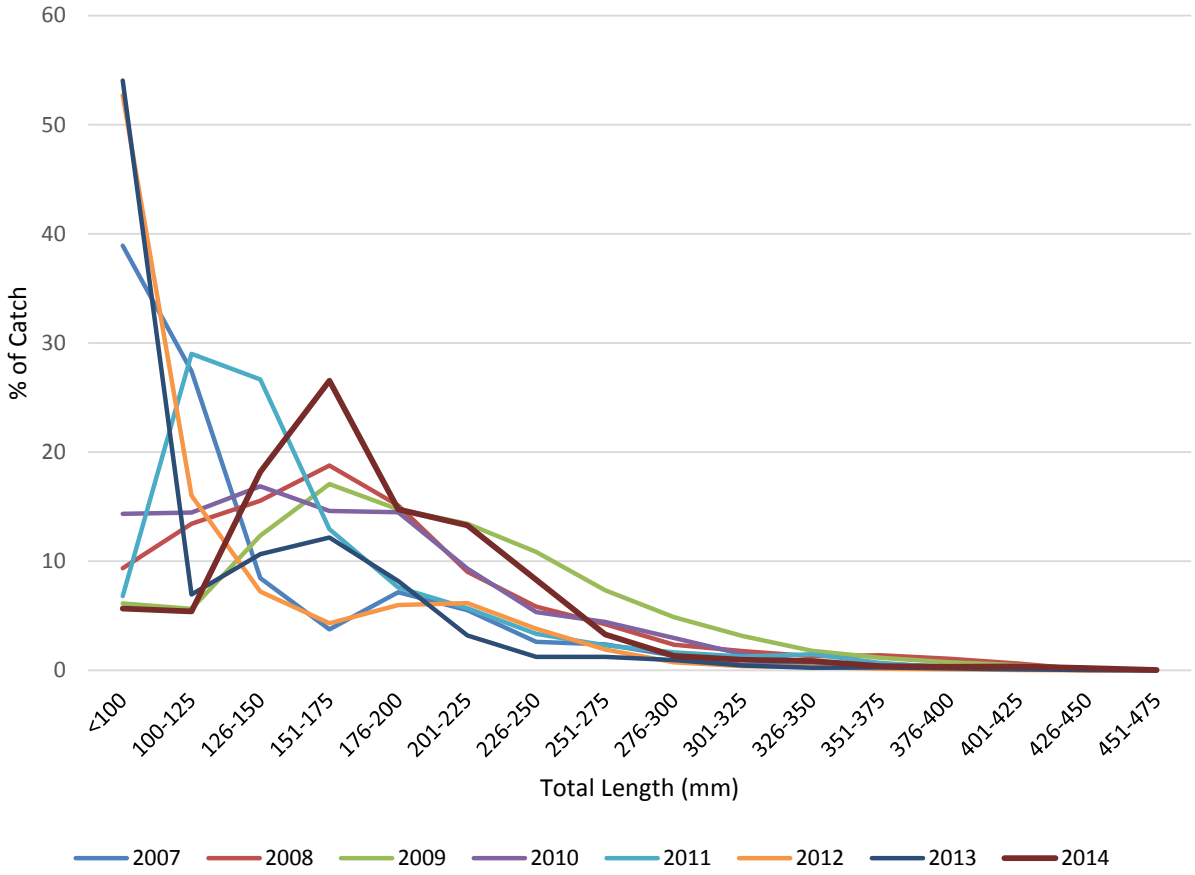

Figure 6. — Smallmouth bass size-class frequency comparisons across years from 2007-2014 in the middle Green River.