

COLORADO RIVER RECOVERY PROGRAM  
FY 2018 ANNUAL PROJECT REPORT

RECOVERY PROGRAM  
PROJECT NUMBER: 123b, 123d, 126a

I. Project Title: **Evaluation of walleye removal in the upper Colorado River Basin**

II. Bureau of Reclamation Agreement Number(s):  
USFWS Grand Junction: R15PG400083  
USFWS Vernal: R13PG40020  
UDWR Moab: R14AP00007  
UDWR Vernal: R14AP00007

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Is this the final report? Yes \_\_\_\_\_ No  X

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IV. Abstract:

**Green River Sub-basin:** Researchers removed 271 walleye during 2018. This figure is up 15% from the total Green River Sub-basin captures in 2017. Increased encounters on the lower Green River account for the entirety of this increase. All individuals were captured using boat mounted electrofishing gear in 2018. Targeted efforts on the lower Green River achieved the highest CPUE in the basin (1.66 fish/hour), however were short in duration (7.2 hours). Targeted efforts on the middle Green River yielded substantially lower catch rates, similar to the basin wide average (0.01 fish/hour). Consistent with past years, catch rates were higher in the spring than summer within the Green River Sub-basin. Agencies cooperating in targeted walleye removal efforts experienced a period of budget uncertainty in fall of 2018, resulting in logistical and personnel issues during the field season. While all agencies were able to complete the majority of their fieldwork obligations, targeted removal efforts were reduced in 2018.

**Colorado River sub-basin:** In 2018, field crews removed a total of 76 adult walleye, primarily under targeted walleye removal efforts. Logistical problems resulting from personnel issues in the spring, the Colorado River experiencing low base flows, and budget uncertainty led to reduced work in FY18 for project 123D. Targeted efforts to remove walleye included one complete pass in the spring from Bighorn Camp (lower Westwater Canyon; RM 114.0) to Potash, UT (RM 47.2). The summer and fall work included 2 passes in the reach from Cisco (RM 111.0) to Dewey Bridge (RM 94.6) and one pass from Dewey Bridge to Takeout Beach (RM 74.2). Additional targeted work included 12 more removal passes, spring through fall, from Bighorn Camp to Fish Ford (RM 105.8). Utah Division of Wildlife Resources (UDWR) Price Office completed one full pass for 3-species work from Cisco to Moab Bridge during the end of August and removed non-native fish. Total effort expended in FY18 was 69.41 hours electrofishing in the spring and 128.58 hours in the late summer and early fall. Our fall catch rates declined from 1.04 fish/hr in 2015 to 0.45 fish/hr in 2016, and increased to 0.80 fish/hr in 2017. Our fall catch rates decreased to 0.40 fish/hr, similar to our spring catch rate of 0.36 fish/hr, in 2018. Anecdotal evidence suggests large monsoonal events may increase walleye catchability in the fall.

V. Study Schedule: 2014-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.

#### COLORADO RIVER ACTION PLAN: MAINSTEM

III. Reduce 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. Develop basinwide aquatic management plan to reduce nonnative fish impacts while providing sportfishing opportunities.

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

Initial findings and preliminary results for 2018 are provided in the attached report, but are subject to change as data are further analyzed.

VIII. Additional noteworthy observations: See attached report

IX. Recommendations:

#### **Basin Wide**

- Analyze historic data on walleye distributions throughout the Upper Colorado River Basin and compile a comprehensive technical report. This report would summarize past walleye distribution throughout the upper Colorado River Basin and present status of this invasive species. The goal of this effort is to locate critical gaps in our knowledge while providing a more robust source of data to inform future management decisions.
- The contribution of Lake Powell to the fluvial walleye populations in the upper basin should continue to be investigated.
- Complete USGS otolith microchemistry analyses to determine the origin of walleye collected in the Colorado River and supply report to the Recovery Program. Consider management actions at specific locations based on the results of the study. Evaluate other potential habitable locations these fish may have occupied beyond their origination.

#### **Colorado River Sub-basin**

- Continue targeted walleye removal as a component of Projects 126a and 123d.
- Increased effort to maximize exploitation may warrant further consideration.

#### **Green River Sub-basin**

- Continue walleye removal as a component of existing projects, especially Project 128: Abundance estimates for Colorado pikeminnow in the Green River.
- Continue targeted walleye removal as a component of Projects 123b and 123d particularly in years when Project 128 is not occurring.

#### *Lower Green River*

- Additional effort should be applied between Tusher Diversion and Green River State Park (RM 128-120) as this segment has the highest catch rates for walleye in the reach. Removal should be conducted in early spring (as early as flows allow)

through mid-May and again in October as flows allow.

*Desolation and Gray Canyons*

- Although catch rates do not currently warrant targeted removal in this reach, continued removal of walleye under existing projects, especially 128 and 123a, is justified.

*Middle Green River*

- Continue walleye-specific removal efforts between the White River confluence and Sand Wash during spring sampling, with more extensive efforts in Project #128 off years. Specifically, in years we conduct Project #128, our spring walleye targeting will only focus on the reach mentioned above and the Split Mountain spawning riffles in Dinosaur National Monument.

*Upper Green, Yampa and White Rivers*

- Targeted walleye removal efforts are not warranted at this time. Continue the removal of walleye as ancillary captures through ongoing sampling efforts.

*Duchesne River*

- We recommend conducting walleye-specific removal efforts in the lower Duchesne River during spring peak flows, which is the only time that passage by electrofishing boats/rafts is possible in this system. The Ute Indian Tribe expressed interest in conducting a nonnative removal project in the Duchesne River in the future, otherwise UDWR can only sample this reach on an opportunistic basis as state funds and tribal access allow.

X. Project Status: on track and ongoing

XI. FY 2018 Budget Status

See annual reports for Projects 123a, 123b, 123d and 126a for budget descriptions.

XII. Status of Data Submission: Data are compiled and will be submitted to the database manager by January 2019.

XIII. Signed: Christopher Michaud 11/19/2018  
Principal Investigator Date

APPENDIX:

A. Preliminary results of walleye removal in the upper Colorado River Basin.

## ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R14AP00007  
UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 123d

Project Title: Walleye control in the lower Green and Colorado Rivers

Principal Investigator:

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Project/Grant Period:

Start date (Mo/Day/Yr): 05/01/2014  
End date: (Mo/Day/Yr): 09/30/2018  
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Is this the final report? Yes \_\_\_\_\_ No  X

Performance:

### *Walleye removal on the Green River*

Seven hours of electrofishing effort, targeting walleye on the lower Green River, was completed between 12 February and 10 April, 2018. All effort was focused on high value walleye habitat between Tusher diversion and Green River State Park (RM128-120). A total of 12 walleye were removed from the Green River (CPUE=1.66) in 2018. Razorback sucker (n=2, CPUE=0.49), black bullhead (n=3, CPUE=0.41) and white sucker (n=2, CPUE=0.28) were also encountered.

### *Walleye removal on the Colorado River*

Utah Division of Wildlife Resources crews completed two hours of targeted walleye removal on the Colorado River between Big Hole and Cisco boat ramp (RM 115.8-110.5) in 2018. Sampling occurred on 11 April, 2018. No walleye were encountered over the sampling period. Notable ancillary encounters included razorback sucker (n=1, CPUE=0.49), black bullhead (n=3, CPUE=1.47), green sunfish (n=2, CPUE=0.98), gizzard shad (n=3, CPUE=1.47), smallmouth bass (n=5, CPUE=2.45) and a single white sucker/flannelmouth sucker hybrid (CPUE=0.49).

All work was completed under Tasks 1, 2 and 3 of the FY18 123d scope of work.

## ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R15PG00083

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 126a

Project Title: Removal of Non-native Fish in the Upper Colorado River between Grand Valley Water User's Dam [Government Highline Diversion Dam] near Palisade, Colorado, and Potash, Utah.

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Project/Grant Period: Start date (Mo/Day/Yr): 10/1/2014  
End date: (Mo/Day/Yr): 9/30/2019  
Reporting period end date (Mo/Day/Yr): 9/30/2018  
Is this the final report? Yes \_\_\_\_\_ No X

### Performance:

GJ FWCO was tasked with completing 4 full passes of targeted walleye removal from Cisco to Potash, UT. During the spring (2018), one full pass was completed; and during the fall (2018) 2 passes were completed in the reach from Cisco (RM 111.0) to Dewey Bridge (RM 94.6) and one pass from Dewey Bridge to Takeout Beach (RM 74.2). An additional 11 days of effort (two e-fish boats per day) was applied to the reach from Bighorn Camp to Fish Ford. A total of 60 walleye were removed. For additional details pertaining to other non-native fishes removed please see annual report for project 126a.

**ANNUAL PERFORMANCE PROGRESS REPORT (PPR)**

BUREAU OF RECLAMATION AGREEMENT NUMBER: #R14AP00007

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 123b

Project Title: Nonnative fish control in the middle Green River

Principal Investigator:

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  End date: (Mo/Day/Yr): 9/30/2018  
  Reporting period end date (9/30/2017):  
  Is this the final report? Yes \_\_\_\_\_ No   X  

Performance:

All walleye removal effort for the middle Green River described in this report occurred under the Upper Colorado River Recovery Program's Project #123b, which also includes mechanical removal efforts for other species not mentioned here (northern pike, white sucker, and smallmouth bass). All work was completed under Tasks 1 & 3 of the Project#123b scope of work.

Appendix A:

**Preliminary results of the removal of walleye from the upper Colorado River Basin, 2018.**

Michaud C. & M. Partlow (UDWR), T. Francis, T Jones & C. Smith (USFWS), & E. Kluender (CSU).

**Background**

The introduction, establishment, and proliferation of nonnative fishes is considered the primary threat to the recovery of four Colorado River large bodied endangered fishes: Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*). Warm water game fish, primarily stocked in reservoirs for recreational purposes and then establishing in downstream river reaches, are thought to have the greatest adverse effect on endangered native fishes. Of those species, large bodied predators are considered the most problematic, specifically smallmouth bass, northern pike, and walleye.

Walleye (*Sander vitreus*) are a large bodied, highly piscivorous fish native to the Mississippi and several coastal northeastern drainages (Etnier and Starnes 1993). This species is often potadromous, residing mainly in lakes and reservoirs and making seasonal spawning migrations into rivers during early spring. Spawning occurs just post ice-off when temperatures reach 6–11°C over gravel or cobble substrates (Paragamian, 1989; McMahon and Terrell 1984). Adult walleye pose a particularly high threat to native species recovery in the upper Colorado and Green River sub-basins because of their overlapping niche (with Colorado pikeminnow) and their high predatory threat (with all native fishes). This was demonstrated by the discovery of three juvenile Colorado pikeminnow (2014 (n=2), 2015 (n=1)) and seven bonytail (2014 (n=1); 2015 (n=3), 2016 (n=3)) in the stomachs of walleye (Francis et al. 2015). In fact, abundance estimates for Colorado pikeminnow have declined in the upper Colorado River basin since walleye numbers have increased in both sub-basins.

There is scant evidence of the initial introduction of walleye into the Upper Colorado River Basin. In their 1966 publication: Glen Canyon Reservoir Post Impoundment Investigation, Roderick Stone and Kent Miller reference a stocking report noting the introduction of walleye into Strawberry reservoir in the 1950s. This impoundment, located on the Strawberry River, a tributary of the Green River, was a likely early source population of walleye in the upper Colorado River basin. By 1962, walleye were encountered on the Green River within Dinosaur National Monument (Azevedo 1962) and on the Colorado River in the nascent waters of Lake Powell (Stone and Miller, 1966). Between both state sanctioned and illegal introductions, walleye populations had been established in ten reservoirs in the upper Colorado River basin by 1990. Then, in 1998, gizzard shad (*Dorosoma cepedianum*) were accidentally stocked into Morgan Lake in the San Juan River basin. Gizzard shad are a preferred prey species for walleye and are known to support robust walleye populations; as such, gizzard shad are used by fishery managers to bolster walleye condition and populations where they are desired. Gizzard shad escaped Morgan Lake and colonized Lake Powell by 2000. Annual gill net surveys, provided by George Blommer (UDWR; Figure 1), in Lake Powell provide evidence that the walleye population in Lake Powell responded as expected and has grown substantially over the past 15 years. By the mid 2000s gizzard shad populations had expanded upstream, invading both the Green and Colorado Rivers (Figure 2). Between 1962 and 2006 walleye were encountered in the Colorado River and its tributaries; however, numbers remained relatively low. Researchers noted a dramatic increase in walleye encounters, first on the Green River in 2007 then on the

Colorado River in 2010 (Figure 3). Therefore, a dominant hypothesis is that the introduction and expansion of gizzard shad in the upper Colorado and Green River sub-basins has led to increased walleye numbers in endangered fish habitats.

Research efforts have shown that walleye reach various portions of endangered fish habitat through escapement from multiple reservoirs in the upper Colorado and Green River sub-basins. Researchers used chemical fingerprinting (strontium isotopes laser ablated from otoliths), to identify three reservoir sources of walleye (Red Fleet and Starvation in the Green River sub-basin and Rifle Gap in the upper Colorado River sub-basin) as well as in river reproduction (Green River) from samples collected through 2008 (Johnson et al, 2014). In response to this escapement, both the states of Utah and Colorado have been proactive in containing these sources through various means. Colorado Parks and Wildlife installed a downstream screen on Rifle Gap Reservoir and is managing against the fertile walleye population. Utah Division of Wildlife Resources (UDWR) chemically treated Red Fleet Reservoir and replaced fertile walleye with a sterile population. UDWR also installed a downstream screen on Starvation Reservoir and is investigating if sterile stocking can replace the existing fertile population.

### **Ongoing Research**

Unfortunately, all of the tissues analyzed by Johnson et al. (2014) were collected before large numbers of walleye were discovered in the lower Green and Colorado Rivers. Therefore questions remained as to the source of the increased abundance of riverine walleye, especially in light of in the increasing walleye population in Lake Powell. In 2015, U.S. Fish and Wildlife Service funded the U.S. Geological Survey to analyze more recent otoliths collected from these reaches and both McPhee Reservoir and Lake Powell which could be potential source populations. The results of this study should be available in early 2019, at which time more management options can be considered. Based on the findings of the study, we expect that stakeholders may consider the following management options:

1. If walleye are coming from McPhee Reservoir, management decisions for the reservoir will be informed to disadvantage escapement (such as screens, in reservoir removal, etc.). If walleye are shown to definitively not be coming from McPhee Reservoir, managers could focus efforts on other locations.
2. If walleye are coming from Green River sources, in concert with the new escapement prevention systems at Starvation and Red Fleet Reservoirs, managers could apply an increase in electrofishing removal effort that may drive the river population of walleye down.
3. If the walleye are coming from Lake Powell, managers will be more informed and will need to find solutions to manage this species in a large reservoir. For example, managers may need to better understand the life history of this species and focus removal effort on out-migrating individuals during reservoir population expansions.

### **In-river Mechanical Removal Efforts**

#### **Green River Sub-basin**

Walleye encounters on the Green River began increasing in 2007 and, although they have leveled off in recent years, encounters remain at meaningful levels. Both the middle and lower Green River have consistently yielded higher catch rates and a greater number of encounters than other reaches within the sub-basin. Both reaches are also considered especially important

habitats for Colorado pikeminnow recovery as they serve as nursery habitat for younger age classes. Survival of young age classes is important to preserve recruitment into the adult population. Beginning in 2014, the Upper Colorado River Endangered Fish Recovery Program added a targeted walleye removal element to Projects 123a and 123b within the lower and middle Green River. In 2017, targeted walleye removal under project 123a was assigned a separate scope of work. This effort is now directed under project 123d. These targeted walleye efforts have thus far been successful in that they consistently yield higher catch rates than do other projects operating within these reaches. Also, they provide an early spring removal effort in years in which Colorado pikeminnow abundance estimate sampling does not take place and additional effort in sub-reaches containing high value walleye habitat.

### **Colorado River Sub-basin**

After a two year (2011 and 2012) hiatus from sampling the lower 112 miles of the upper Colorado River sub-basin, our 2013 catch of walleye significantly increased during our springtime Colorado pikeminnow sampling from 46 individuals in 2010 to 268 in 2013 (Figure 3). In response, walleye specific removal began during the summer and fall. Experimental removal in 2013 provided evidence that summer efforts provided minimal success as walleye were most likely occupying a thermal niche that placed them in deeper habitat than our gear could effectively reach. It was also documented that our best success during the fall occurred in the reach from Cottonwood Wash (RM 112.3) to Potash (RM 47.2). Beginning in 2014, in years when Colorado pikeminnow abundance estimate work is occurring during the spring, all targeted walleye removal work will occur in the fall. During years when Colorado pikeminnow estimate work is not occurring, targeted walleye removal work will be split between the spring and fall. The first of a two year break from Colorado pikeminnow sampling began in 2016 and was extended through 2018 because of personnel (seasonal employee hiring) issues. Targeted efforts to remove walleye included one complete pass in the spring from Bighorn Camp (lower Westwater Canyon; RM 114.0) to Potash, UT (RM 47.2). The summer and fall work included two passes in the reach from Cisco (RM 111.0) to Dewey Bridge (RM 94.6) and one pass from Dewey Bridge to Takeout Beach (RM 74.2; spring work began 11<sup>th</sup> April and concluded 14<sup>th</sup> June; summer/fall work began 11<sup>th</sup> July and concluded 23<sup>rd</sup> August). Additional sampling occurred in lower Westwater Canyon (Bighorn Camp to Cisco) in response to 2016 findings of many non-native piscivores in this reach (these additional passes began 11<sup>th</sup> April and continued through the end of September). The UDWR Price Office conducted 3 species monitoring from Cisco to Moab Bridge, removing all non-native fish they encountered (27<sup>th</sup> through 30<sup>th</sup> August).

### **Study Area**

For the purpose of this study, the “Green River Sub-basin” has been broken down into eight reaches (Table 1, Figure A). Reaches are designated based on geologic or habitat transitions or commonly used access points and do not necessarily reflect the starting and stopping points of individual projects. Consequently, figures contained in this report may differ from those published in individual annual reports. Targeted walleye removal occurred on a limited four-mile reach of the Duchesne River and three relatively small sub-reaches within the main-stem Green River – a twenty-mile reach near Jensen, Utah, a forty-mile reach near Ouray, Utah and a thirty-mile reach near Green River, Utah (Table 2).

Within the “Colorado River sub-basin” Walleye are targeted in the Colorado River from lower Westwater Canyon to the confluence with the Green River; this effort has been broken down into

four reaches where walleye are currently encountered (Figure A). The four reaches are: 1. lower Westwater Canyon (RM 116) to Dewey Bridge (RM 94.6), 2. Dewey Bridge to Takeout Beach (RM 74.2; Professor Valley), 3. Takeout Beach to Potash (RM 47.2), and 4. Potash to the confluence of the Green River (RM 0.0).

## **Methods**

Data from all reaches was collected using electrofishing gear mounted on a variety of watercraft with the exception of a small fyke netting effort on the middle Green River and trammel netting during Colorado pikeminnow and humpback chub sampling in the Colorado River. Aluminum jonboats, rafts and catarafts were all employed on different river reaches. Data from three types of projects are summarized in this report: targeted walleye removal projects (123d, 123b and 126a), projects targeting smallmouth bass and northern pike (123a, 123b, 126a, 125, 98c, 110 and 167) and endangered fish monitoring projects (127, 128 and 130). Detailed methodologies may be found in the annual reports for each project.

## **Results and Discussion**

### **Green River Sub-basin**

During 2018, researchers encountered walleye throughout the Green River Sub-basin. However, similar to 2017, no walleye were encountered in the White River or the Yampa River upstream of the lower Yampa Canyon reach. Field crews removed 271 walleye through 1,565 hours of electrofishing within the sub-basin. Basin-wide catch rates were 0.17 fish/hour, up slightly from 2017 (0.13 fish/hour). Sampling began on 12 February 2018 and continued through 18 September 2018.

Similar to prior years, catch rates on the lower Green River were the highest within a 30-mile sub-reach previously identified as a probable spawning site. A similar potential spawning site on the middle Green River showed no differences in catch rates when compared to the remainder of the reach (Figures 4 and 8).

Targeted walleye removal and Colorado pikeminnow abundance estimation passes (Project 128) on the lower Green River produced the highest catch rates in the sub-basin during 2018 (Figure 5). The success of targeted efforts at effectively removing walleye stems from a number of factors. First, sampling is concentrated within sub-reaches that have yielded high catch rates for walleye in the past. Second, researchers maintain the flexibility to modify timing and location of sampling as well as sampling methods with the goal of maximizing walleye captures. Third, our effort is focused in early spring, a time when catch-rates are consistently higher in the Green River sub-basin. Fourth, the Tusher Diversion Dam at river mile 128 may become an obstacle to upstream passage during years when the fish ladder is blocked by debris, concentrating walleye within its tail waters. Consistent with data from 2016 and 2017, Colorado pikeminnow abundance estimate passes achieved better than average CPUE. The effectiveness of abundance estimate sampling at removing walleye is likely due to two factors. First, Project 128 runs from April through June, a time we achieve the highest catch rates for walleye across all projects. Second, walleye and the target species, Colorado pikeminnow, display considerable niche overlap and consequently occupy similar habitats during sampling.

Overall, both numbers of walleye encountered and catch-rates rose in 2018. Increases in walleye encounters on the lower Green River accounts for the majority of this change.

#### *Lower Green River*

Researchers with the Utah Division of Wildlife Resources Moab Field Station (UDWR-Moab) completed 295 hours of electrofishing effort on the lower Green River in 2018 (Table 3). Crews removed 196 walleye through both targeted efforts and ancillary captures during Colorado pikeminnow abundance estimate passes (Figure 6). Overall catch on the lower Green River increased from 101 walleye in 2017 and CPUE increased from 0.34 fish/hour to 0.66 fish/hour. A total of four bonytail and one Colorado pikeminnow were identified within the stomach contents of walleye encountered within this reach.

Targeted walleye removal on the lower Green River (Project 123d), began on 12 February 2018 and concluded on 10 April 2018. Removal was focused between Tusher Diversion and Green River State Park (RM 128-120). Twelve walleye were removed over 7.2 hours of electrofishing effort; catch-per-unit-effort was 1.66 walleye/hour a marked increase over 2017 (32 walleye and 1.28 walleye/hour).

All additional sampling in this reach occurred under Project 128 (Colorado pikeminnow abundance estimates). Sampling for Project 128 began on 17 April and concluded on 30 May 2018. Three passes were completed during this time interval; 184 walleye were removed from the lower Green River (RM 128-0) during 288 hours of electrofishing yielding a catch rate of 0.64 walleye/hour (Figure 5). Catch rates were higher (1.48 walleye/hour) in the upper 31 miles of this reach than the lower 97 miles (0.36 walleye/hour). This data lends support to the current practice of restricting targeted walleye removal effort to the uppermost 31 miles of the lower Green River.

#### *Desolation and Gray Canyons*

Researchers with U.S. Fish and Wildlife Service Vernal Office (USFWS- Vernal) and UDWR-Moab began sampling in Desolation and Gray Canyons (RM 206.5-128) on 19 April and finished on 2 July 2018 under Projects 128 and 123a. Crews completed 203.5 hours of electrofishing effort, encountering nine walleye and yielding a CPUE of 0.04 walleye/hour (Table 4, Figures 5 and 6). Both the number of fish encountered and catch rates in Desolation and Gray Canyons were similar to 2017.

#### *Middle Green River*

Utah Division of Wildlife Resources Northeast Region (UDWR-Vernal) and USFWS-Vernal crews completed 530.9 hours of electrofishing effort in the middle Green River in 2018. Researchers removed 57 walleye from this reach between 13 March and 5 September 2018 yielding a catch rate of 0.11 walleye/hour (Table 5, Figures 5 and 6).

Crews completed 24.1 hours of targeted effort under project 123b, in the middle Green River between 15 March and 17 June 2018. One walleye was removed, yielding a CPUE of 0.04 fish/hr. All targeted effort was applied between Split Mountain boat ramp and Spring Hollow (RM 319.3-295.8) and between Wyasket Bottom and Sand Wash boat ramps (RM 255.8-215.8). These sub-reaches have produced substantial walleye captures in the past and are therefore the focus of targeted walleye efforts under Project 123b. Low captures in 2018 warrant tracking of future captures in this reach to determine if targeted effort continues to be needed. An additional

three walleye were encountered in the middle Green River during 248.8 hours of targeted smallmouth bass removal and tributary electrofishing under Project 123b (Table 5).

Pikeminnow abundance estimate sampling (Project 128) began on 16 April and concluded on 29 May 2018 in the middle Green River. Fifty-three walleye were removed over 255.7 hours of sampling yielding a catch-rate of 0.21 walleye/hour (Figures 5 and 6). No apparent difference in environmental or ecological conditions account for the lower catch rates between targeted walleye sampling and Colorado pikeminnow abundance estimation sampling.

#### *Upper Green River*

Sampling in the upper Green River began on 30 April and concluded on 18 September 2018. Consistent with past years, catch rates for walleye in the upper Green River were the lowest recorded on the Green River (0.01 walleye per hour). Researchers with USFWS-Vernal, UDWR-Moab and Vernal and Colorado State University (CSU) removed a total of 3 walleye over 407.7 hours of effort (Table 6, Figures 5 and 6).

#### *Yampa River*

Sampling in lower Yampa Canyon began on 5 June and concluded on 22 June 2018 under Project 110. Researchers encountered three walleye on the Yampa River (Figures 5 and 6). Electrofishing effort (Project 110) within the lower Yampa Canyon totaled 111.4 hours, yielding a CPUE of 0.03 walleye per hour (Table 7). Additional effort was completed in middle and upper Yampa River (Projects 125, 98c), however no walleye were encountered and this effort was excluded from CPUE calculations for the Green River Basin.

#### *White River*

Crews from USFWS-Vernal, UDWR-Vernal and CPW encountered no walleye on the White River in 2018. Effort from the White River was excluded from CPUE calculations for the Green River Basin.

#### *Duchesne River*

UDWR-Vernal conducted several electrofishing passes between the confluence of the Green River and a location 3.4 miles upstream. This reach has not been sampled regularly in the past. Crews completed 15.9 hours of electrofishing, removing 3 walleye and yielding CPUE of 0.19 fish/hour (Figures 5 and 6). This is down considerably from 2017 where researchers removed 38 walleye and achieved catch rates of 1.25 fish/hour. Low flows on the Duchesne River precluded upstream navigation to the extent allowed in 2017. This likely limited the effectiveness of this effort during 2018.

#### *Size Structure*

Mean total length for walleye removed in 2018 was 470 mm, lengths ranged from 286 mm to 742 mm (Figure 7). Mean total length in the lower Green (441 mm) differed significantly from the middle Green River (550 mm) based on a Wilcoxon rank sum test with continuity correction ( $W = 1137.5$ ,  $p < 0.05$ ). Only one individual smaller than 300 mm was encountered within the sub-basin. This walleye was removed from the Duchesne River. Overall, this size structure supports the assumption that the lotic walleye population is not able to consistently recruit at this time and is therefore supported by escapement from reservoir populations.

#### *Spawning Observations*

Twenty walleye in spawning condition (7.4% of the total catch) were encountered in the Green River between 12 February and 17 May 2018. The majority of these fish were male (89%). Aggregations of ripe fish were noted in three discrete sub-reaches of the Green River, consistent with previous years. These sub-reaches include the uppermost section of the middle Green River (RM 320 – 300), the confluence of the Green and White Rivers (RM 250 – 220) and an area immediately downstream of the Tusher Diversion on the lower Green River (RM 128-100). Successful walleye reproduction has been documented in the Green River. In 2014, two larval walleye were identified within light trap samples taken from the lower Green River (Howard, 2014). However, the notable lack of recruit sized walleyes supports the assumption that this species has not been able to consistently reproduce and recruit successfully within the Green River sub-basin.

### **Colorado River Sub-basin:**

From 2016 through 2018, two offices have cooperated to conduct targeted walleye removal in the Colorado River. Colorado pikeminnow population estimate work (project 127) was not occurring during these years; therefore, efforts were roughly half of the total electrofishing effort expended in 2015 when Colorado pikeminnow sampling was conducted (Figure 9). The Grand Junction Fish and Wildlife Conservation Office (GJ FWCO) conducted one full walleye removal pass in the spring, 2018, in all three reaches (Cottonwood Wash to Dewey Bridge {RM112.3 to RM94.6}, Dewey Bridge to Takeout Beach {RM94.6 to RM74.2}, Takeout Beach to Potash {RM74.2 to RM47.2}) for a total of 51.29 hours of electrofishing effort. During the summer and fall, 2018, GJ FWCO work included 2 passes in the reach from Cisco (RM111.0) to Dewey Bridge (RM 94.6) and one pass from Dewey Bridge to Takeout Beach (RM74.2) for a total of 54.03 hours of electrofishing effort. Eleven additional mini passes from Bighorn Camp (RM114.0) to a variety of ending points upstream of Fishford (RM105.8) were conducted during the spring, summer and fall, for a total of 57.41 hours of electrofishing effort. Beginning in 2015, UDWR Moab provided additional removal effort in the Colorado River sub-basin. Their efforts are targeted to specific walleye areas, and are thus shorter in duration and length than GJ FWCO. In 2018, UDWR Moab contributed 2.04 hours of electrofishing effort. In 2018, UDWR Price conducted 3 species monitoring from Cisco to Moab Bridge (RM64.2) while also removing non-native fish, from the 27<sup>th</sup> through the 30<sup>th</sup> August, for a total of 33.23 hour of electrofishing effort.

In 2018, 76 adult walleye were removed with a mean total length of 450 mm and lengths ranging from 357-666 mm (Figure 10). Our 2018 walleye spring catch rate was similar (0.36 fish/hr) to our summer/fall catch rate (0.40 fish/hr). These were an increase when compared to our 2017 spring catch rate (0.15 fish/hr) and a decrease to our summer/fall 2017 catch rate (0.64 fish/hr). Walleye catch rates varied amongst reaches when comparing the spring and fall (Table 9, Figure 11). Anecdotal evidence suggests that higher magnitude flows from monsoonal inputs may increase walleye captures, as they may take refuge closer to shore where electrofishing is more effective. The 2016 fall hydrograph didn't receive the large monsoonal pulses experienced in fall 2014, 2015, and 2017; thus, likely reducing the catch rate in 2016 (Figure 12). Logistical constraints and lack of staffing didn't allow for typical fall efforts in 2018; thus, an informed comparison to other year's efforts was not possible related to monsoonal pulses.

Extra effort was expended in the Lower Westwater Canyon to Coates Creek reach (at various lengths {3-10 mile} within the reach) in response to UDWR-Moab's finding of a large number of non-native piscivorous fish in Lower Westwater Canyon in 2016. This same additional effort

was not expended in any of the other reaches occupied with walleye, so comparing catch rate indices between reaches is not warranted. This effort produced a high catch rate of 0.61 walleye per hour (n=36 walleye). Most of these walleye were collected within four to five miles of the Westwater Canyon humpback chub population which is of particular concern and supports the same additional effort in the future.

Most walleye collected since 2014 have been dissected to determine gonadal development, sex and diet of the fish occupying the Colorado River. All walleye have been scanned with a PIT tag reader to determine predation of endangered fishes. All of these results can be found in Table 9. New for 2016, while UDWR Moab and Grand Junction FWCO were doing their annual razorback sucker monitoring in the Colorado River arm of Lake Powell fifty walleye were PIT tagged. Expectations were to tag many more fish; however, the site closest to the river/lake mixing zone became covered in high water debris and made it impractical to sample with trammel nets early during the season. This work was completed in hopes to determine if fish in the lower sections of the Colorado and Green Rivers were originating in Lake Powell. Fortunately, UDWR out of Wahweap continued tagging more Colorado arm of Lake Powell walleye in 2017.

In 2018, UDWR out of Wahweap and Moab sonic tagged walleye collected in Lake Powell. This project is possible in conjunction with a Bureau of Reclamation funded project to monitor razorback sucker use of Lake Powell. Sonic tags have been surgically implanted into razorback sucker collected in the San Juan and Colorado Arms of Lake Powell since 2011. Submersible Ultrasonic Receivers are placed throughout Lake Powell and in upstream rivers that can detect these tags from up to three kilometers away. This is an attempt to better understand the phenology of razorback sucker, and now, walleye throughout the Colorado River Basin. Preliminary results are not available at this time because of low recaptures, but will be reported in the future.

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**Table 1: Location of study reaches in the Upper Colorado River Basin.**

River	Reach	Projects	Agency	River miles	Length (miles)
Green River	Upper Green	123a, FR-115, 128	CSU, UDWR, USFWS	380 - 319.3	60.7
	Middle Green	123b, 128	UDWR, USFWS	319.3 - 206.5	112.8
	Desolation	123a, 128	UDWR, USFWS	206.5 - 128	78.5
	Lower Green	123a, 128	UDWR	128 - 0	128
Yampa River	Middle Yampa	125, 98c	CPW, CSU, USFWS	189.2 - 46	143.2
	Lower Yampa	110	USFWS	46 - 0	46
Duchesne River	Lower Duchesne	123b	UDWR	15 - 0	15
White River	White River	167, 128	CPW, UDWR, USFWS	104 - 0	104
Colorado River	Lower Colorado	127, 126a	UDWR, USFWS	116 - 0	116
	Cataract Canyon	130	UDWR	-4.5 - -10	5.5

**Table 2: Locations of targeted walleye removal projects.**

<i>Project</i>	<i>River</i>	<i>Reach</i>	<i>River miles</i>	<i>Length (miles)</i>
123b	Green River	Middle Green	319.3 - 295.8	23.5
		Middle Green	255.8 - 215.8	40
	Duchesne River	Lower Duchesne	15 - 0	15
123d	Green River	Lower Green	128 - 97	31
126a	Colorado River	Lower Colorado	116 - 47.2	68.8

**Table 3. Walleye captures on the lower Green River (RM 128-0) under Project 128 are ancillary captures, while captures under 123d are targeted captures.**

<i>Lower Green River</i>	<i>Effort (hr)</i>	<i>Number of walleye</i>	<i>CPUE (Fish/hr)</i>
123d	7.24	12	1.66
128	287.86	184	0.64
Total	295.1	196	0.66

**Table 4. Walleye captures on the Green River within Desolation and Gray Canyons (RM 206.5-128). All captures are ancillary captures under existing projects.**

<i>Desolation Canyon</i>	<i>Effort (hr)</i>	<i>Number of walleye</i>	<i>CPUE (Fish/hr)</i>
123a	59.28	0	0
128	144.22	9	0.06
Total	203.5	9	0.04

**Table 5. Walleye captures on the middle Green River (RM 319.3-206.5). Captures under Projects 128 and 123b are ancillary captures. Captures under 123b(t) are targeted removal efforts.**

<i>Middle Green River</i>	<i>Effort (hr)</i>	<i>Number of walleye</i>	<i>CPUE (Fish/hr)</i>
123a	2.37	0	0
123b	248.79	3	0.01
123b(t)	24.09	1	0.04
128	255.68	53	0.21
Total	530.92	57	0.11

**Table 6. Walleye captures on the upper Green River (RM 380-319.3). All captures are ancillary captures under existing projects.**

<i>Upper Green River</i>	<i>Effort (hr)</i>	<i>Number of walleye</i>	<i>CPUE (Fish/hr)</i>
123a	319.19	1	0
123b	0.87	0	0
128	19.24	0	0
FR-115	68.41	2	0.03
Total	407.71	3	0.01

**Table 7. Walleye captures on the lower Yampa River (RM 46-0). All captures are ancillary captures under existing projects.**

<i>Lower Yampa River</i>	<i>Effort (hr)</i>	<i>Number of walleye</i>	<i>CPUE (Fish/hr)</i>
110	111.35	3	0.03

**Table 8. Walleye captures on the Duchesne River (RM 15-0).**

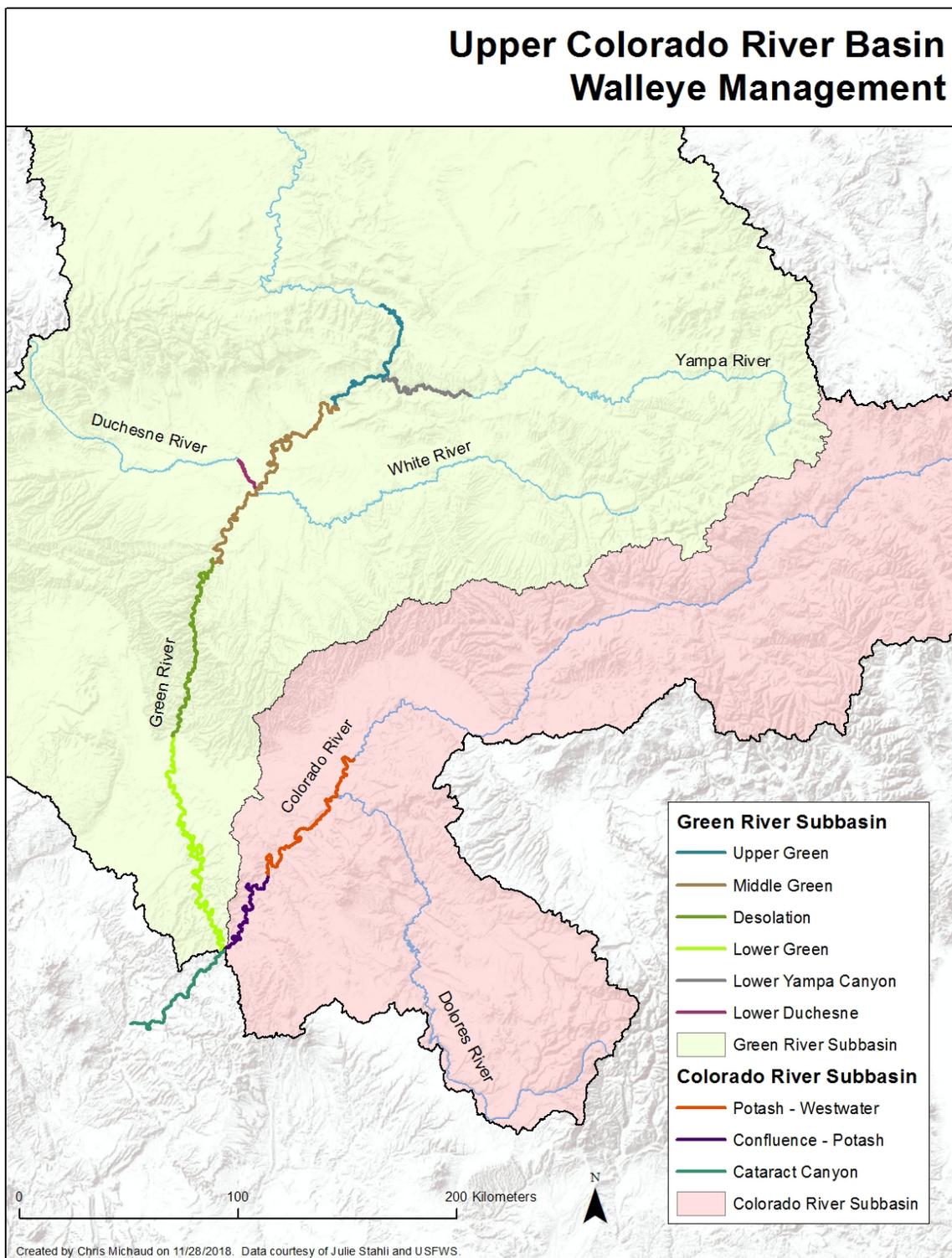
<i>Duchesne River</i>	<i>Effort (hr)</i>	<i>Number of walleye</i>	<i>CPUE (Fish/hr)</i>
123b	15.93	3	0.19

**Table 9. Catch/effort (CPE, fish/hr) comparison by year for four different length classes (total length) of walleye (< 200mm = age-0; 200-299 mm = juveniles; 200-374mm = adults, > 375 = piscivore) for the Colorado River Sub-basin's four reaches. Catch/effort data is partitioned by season. Note: a) Effort hasn't been electronically entered into a spreadsheet for Spring 2013 data, and b) spring collections occur by two methods; electrofishing and backwater scare and snare with trammel nets, catch/effort is reported only for electrofishing.**

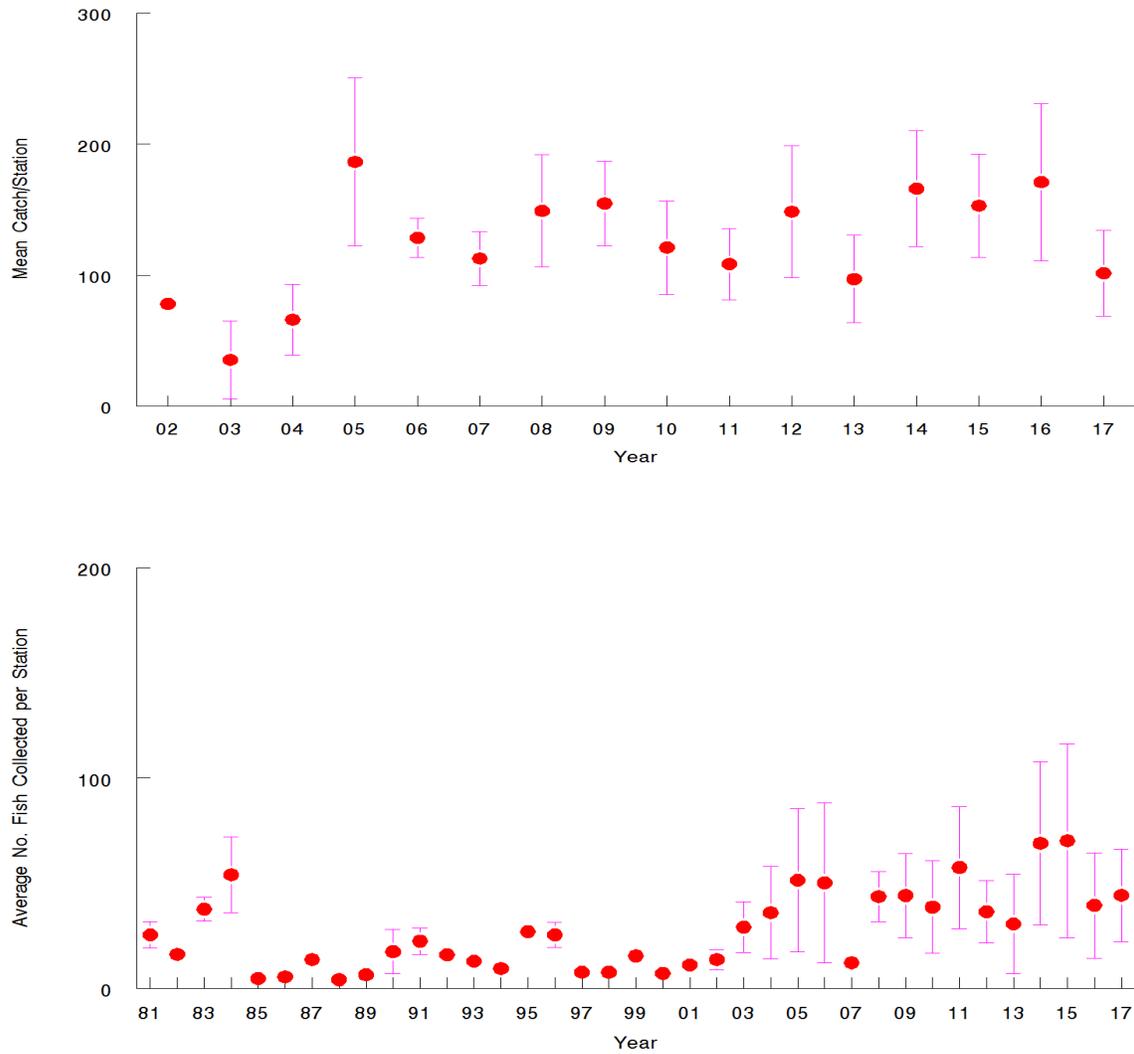
River Section	Length Class (mm)		Walleye											
			Time Period											
			Fall 2018	Spring 2018	Fall 2017	Spring 2017	Fall 2016	Spring 2016	Fall 2015	Spring 2015	Fall 2014	Spring 2014	Fall 2013	Spring 2013 No Effort Key Punched
Lower Westwater Canyon to Dewey Bridge	< 200	No. of fish	0	0	0	0	0	0	0	0	0	0	0	0
		E-fish C/E												
	200-299	No. of fish	0	0	0	0	0	0	0	0	0	0	0	0
		E-fish C/E												
	300-374	No. of fish	3 E-fish	0	4 E-fish	0	1 E-fish	0	0	0	1 E-fish	0	0	0
		E-fish C/E	<b>0.03</b>		<b>0.04</b>		<b>0.02</b>				<b>0.02</b>			
> 375	No. of fish	44 E-fish	14 E-fish	67 E-fish	0	7 E-fish	4 E-fish	30 E-fish	18 E-fish	64 E-fish	(5 total) 4 E-fish	19 E-fish	20	
	E-fish C/E	<b>0.5</b>	<b>0.41</b>	<b>0.71</b>		<b>0.13</b>	<b>0.14</b>	<b>0.46</b>	<b>0.46</b>	<b>1.32</b>	<b>0.1</b>	<b>0.62</b>	NA	
Dewey Bridge to Takeout Beach (Professor Valley)	< 200	No. of fish	0	0	0	0	0	0	0	0	0	0	0	
		E-fish C/E												
	200-299	No. of fish	0	0	0	0	0	0	0	0	0	0	0	
		E-fish C/E												
	300-374	No. of fish	1	0	1 E-fish	0	0	0	3 E-fish	0	0	0		0
		E-fish C/E	<b>0.03</b>		<b>0.03</b>				<b>0.04</b>					
> 375	No. of fish	2 E-fish	9 E-fish	9 E-fish	0	7 E-fish	8 E-fish	25 E-fish	18 E-fish	8 E-fish	(19 total) 18 E-fish	3 E-fish	67	
	E-fish C/E	<b>0.06</b>	<b>0.6</b>	<b>0.31</b>		<b>0.16</b>	<b>0.24</b>	<b>0.34</b>	<b>0.28</b>	<b>0.44</b>	<b>0.29</b>	<b>0.18</b>	NA	
Takeout Beach to Potash, UT	< 200	No. of fish	0	0	0	0	0	0	0	0	0	0	0	
		E-fish C/E												
	200-299	No. of fish	0	0	0	0	0	0	0	0	0	0	0	
		E-fish C/E												
	300-374	No. of fish	0	0	5 E-fish	0	0	2 E-fish	2 E-fish	0	0	1 E-fish	0	0
		E-fish C/E			<b>0.14</b>			<b>0.04</b>	<b>0.02</b>			<b>0.02</b>		
> 375	No. of fish	1	2 E-fish	14 E-fish	16 E-fish	4 E-fish	23 E-fish	15 E-fish	(18 total) 14 E-fish	34 E-fish	(45 total) 39 E-fish	1 E-fish	94	
	E-fish C/E	<b>0.27</b>	<b>0.1</b>	<b>0.39</b>	<b>0.32</b>	<b>0.14</b>	<b>0.44</b>	<b>0.18</b>	<b>0.22</b>	<b>0.35</b>	<b>0.74</b>	<b>0.04</b>	NA	
Potash, UT to the confluence of the Green River	< 200	No. of fish	No sample	No sample	No sample	0	No sample	0						
		E-fish C/E												
	200-299	No. of fish	No sample	No sample	No sample	0	No sample	1						
		E-fish C/E												
	300-374	No. of fish	No sample	1 E-fish	No sample	0	No sample	2						
		E-fish C/E								<b>0.01</b>				
> 375	No. of fish	No sample	(28 total) 26 E-fish	No sample	(39 total) 31 E-fish	No sample	84							
	E-fish C/E								<b>0.23</b>		<b>0.35</b>			

**Table 10. Walleye dissection results from the Colorado River 2014-2018.**

<b>Year</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
# WE removed	216	158	56	116	76
# WE dissected	70	156	53	113	60
# gender identified	70	104	39	103	49
% Male	53	38	28	48	53
% Female	47	62	72	52	47
# WE empty stomachs	28	102	34	80	44
# WE unidentifiable fish remains in stomach	34	24	6	14	10
# WE with NNF in stomachs	6	21	3	13	4
# WE with T&E fish in stomachs	2	4	3	0	0
# WE with other native fishes in stomachs	0	4	7	6	1
# WE with mammals or crustaceans in stomach	0	1	0	0	0
# WE with aquatic vegetation in stomach	0	0	0	0	1
% positively identified stomach contents native	25	28	77	32	20
% positively identified stomach contents non-native	75	72	23	68	80

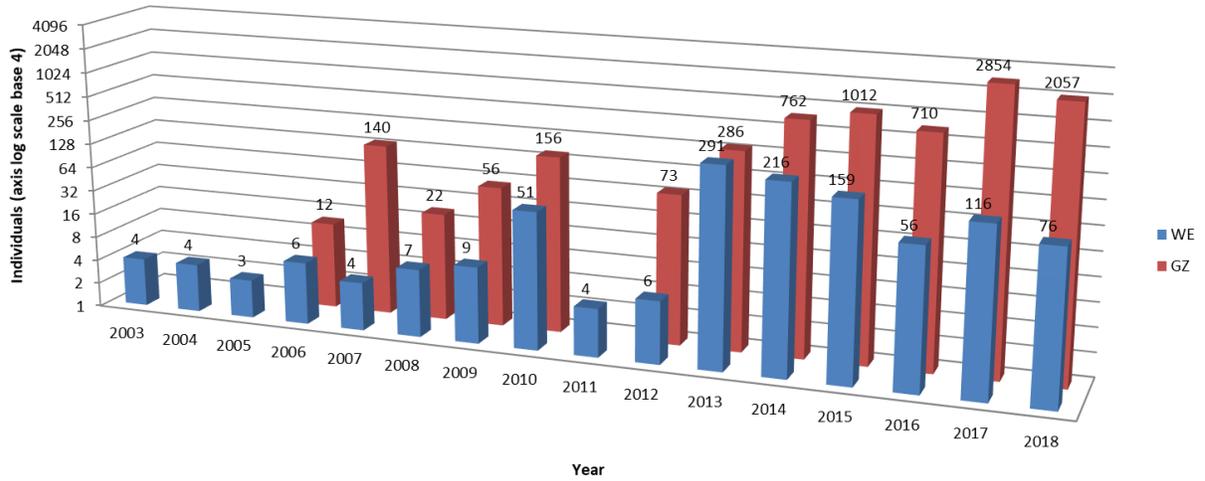


**Figure A. Green River sub-basin (green highlight) and Colorado River sub-basin (pink highlight) map with each of the associated removal reaches notated. Both sub-basins combined are referred to as the “Upper Colorado River Basin”.**

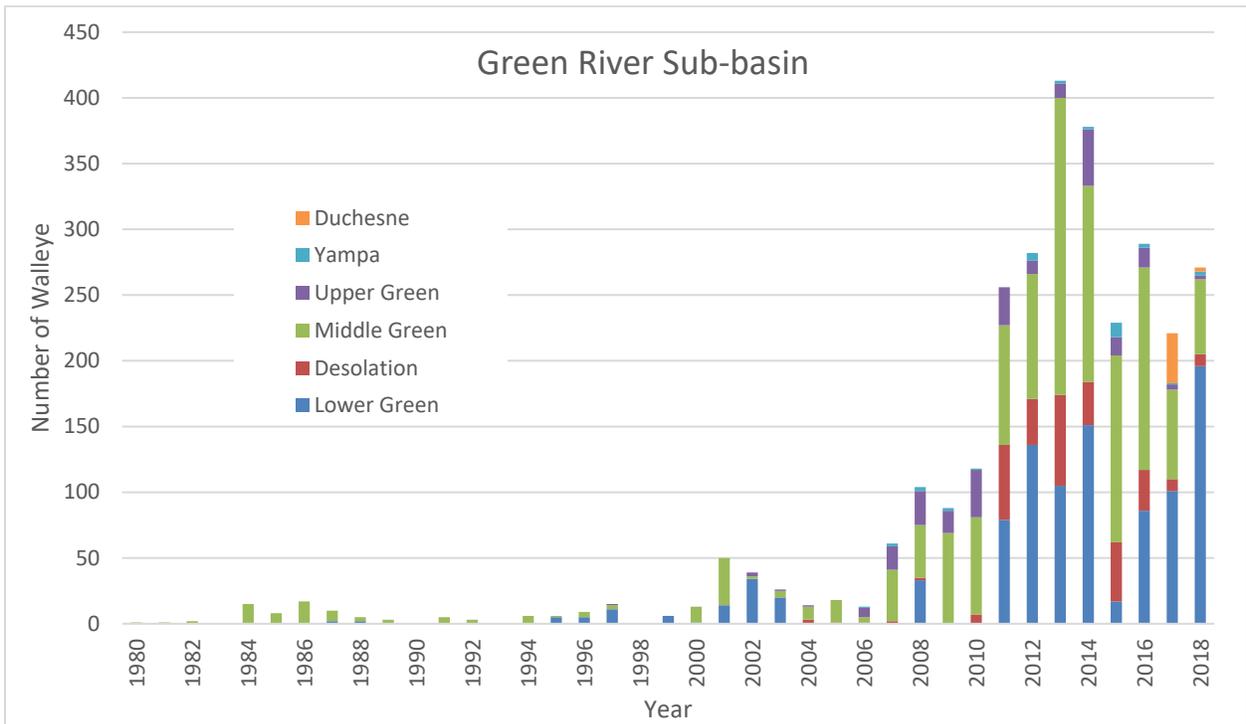
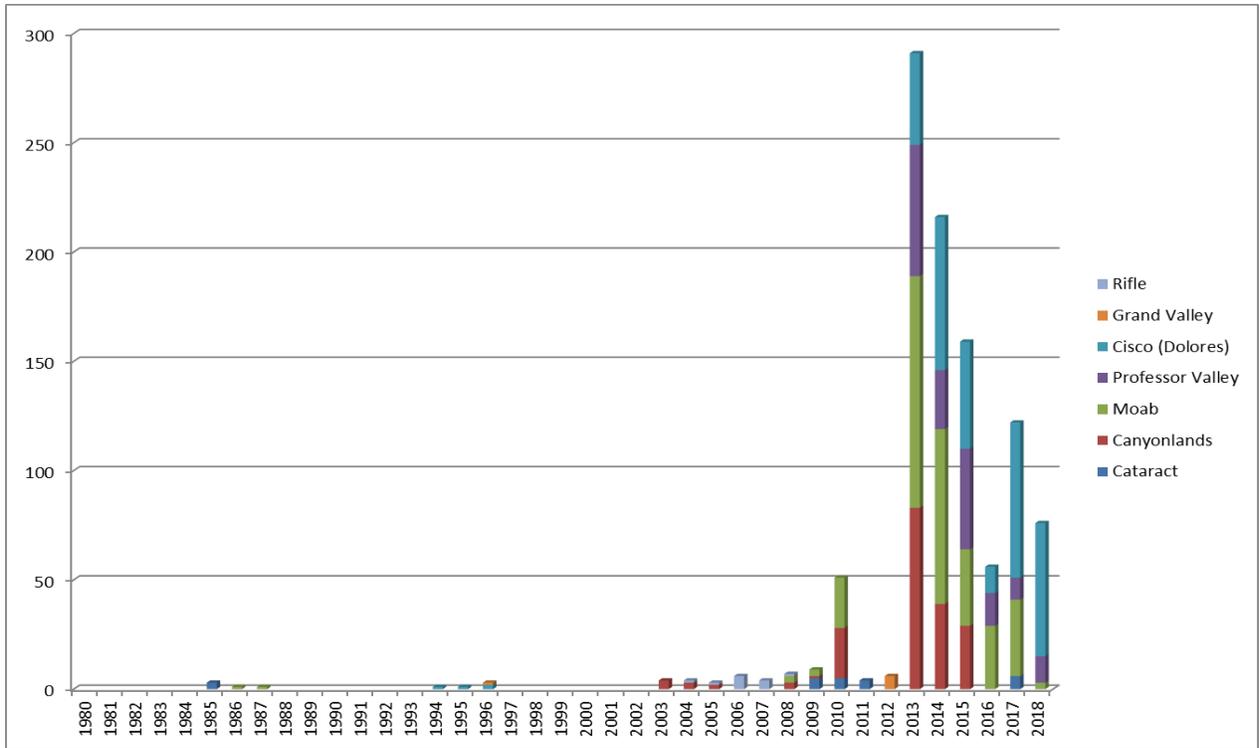


**Figure 1. Upper graph: Mean catch/station of gizzard shad from the annual gill-netting survey with SE, Lake Powell, UT. 2002-2017. Lower graph: Average catch of walleye per station from the fall gill-net survey with SE, Lake Powell, UT. 1981-2017. Provided courtesy of George Blommer, UDWR Wahweap.**

**Individual Gizzard Shad and Walleye Captures from the Colorado River  
Project Numbers 126a, 123d and 127.**



**Figure 2. Individual gizzard shad and walleye captures from the Colorado River; 2003- 2018. Note: captures are not standardized for effort.**



**Figure 3. Annual captures of walleye in the Colorado and Green River Sub-basins. Note: captures are not standardized for effort.**

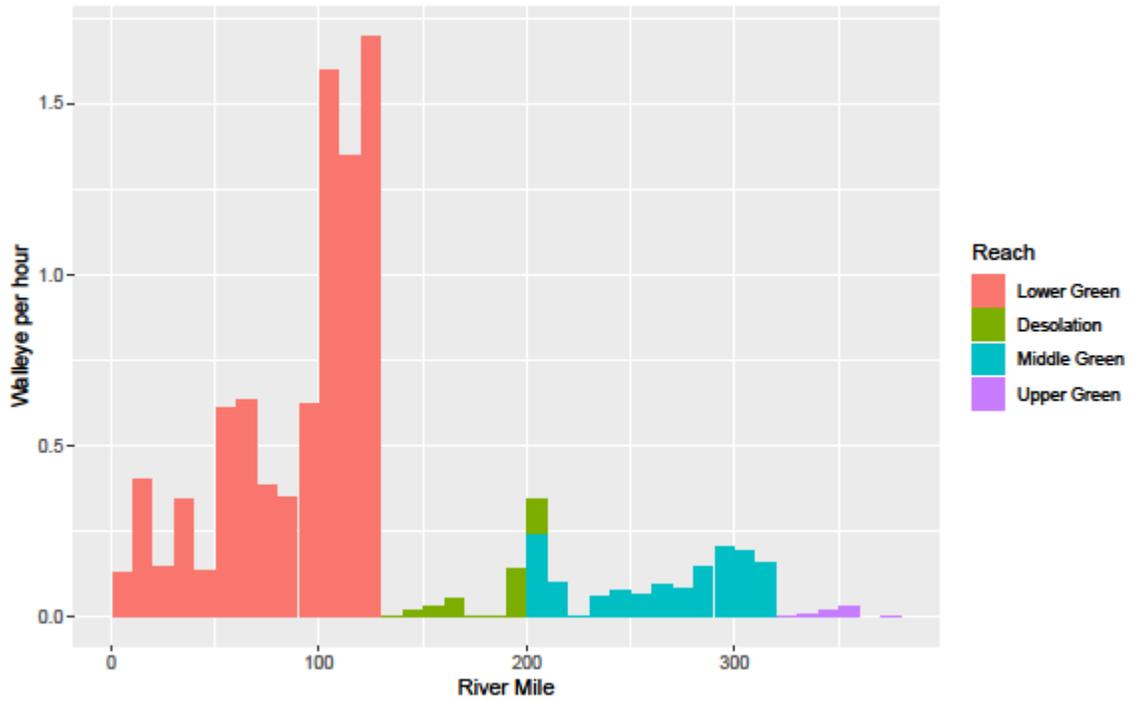


Figure 4. Catch-per-unit-effort for walleye on the Green River, 2018

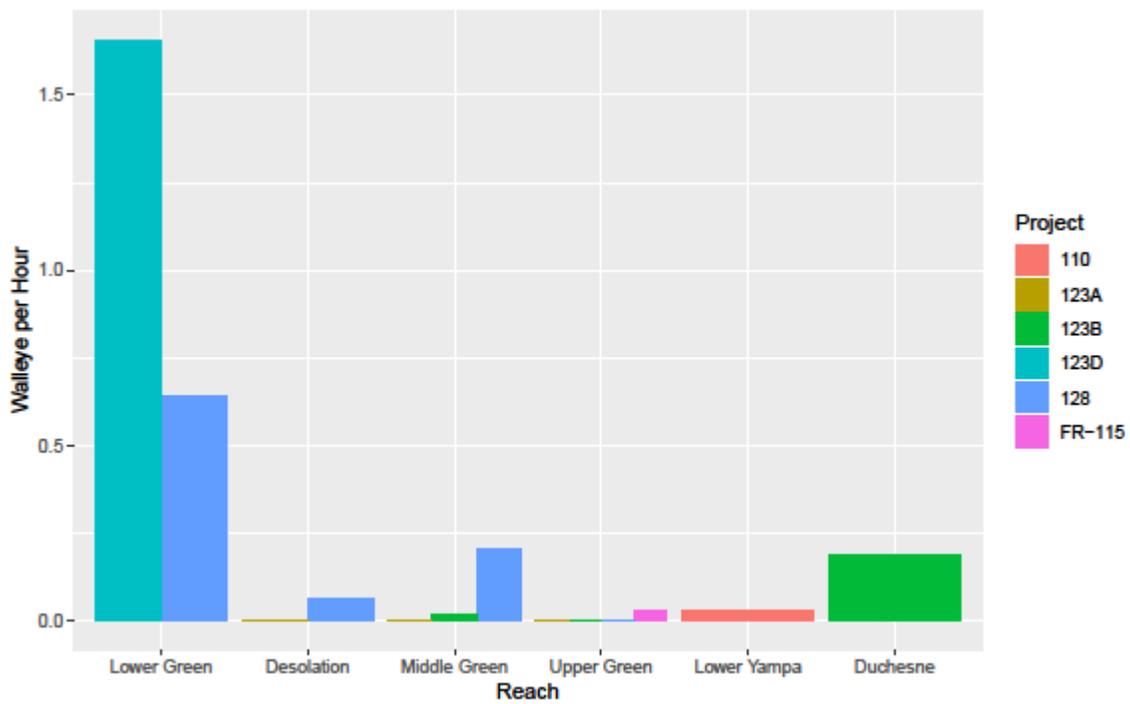


Figure 5. Catch per unit effort by project and reach in the Green River Sub-basin during 2018.

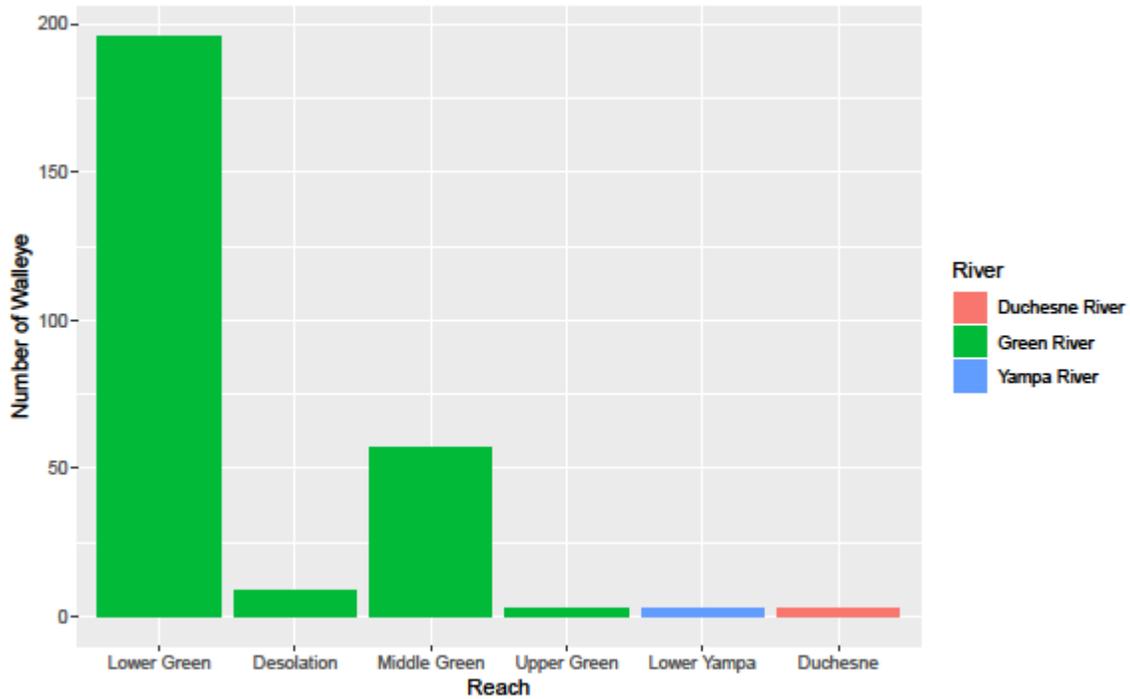


Figure 6. Number of walleye removed by reach in the Green River Sub-basin during 2018.

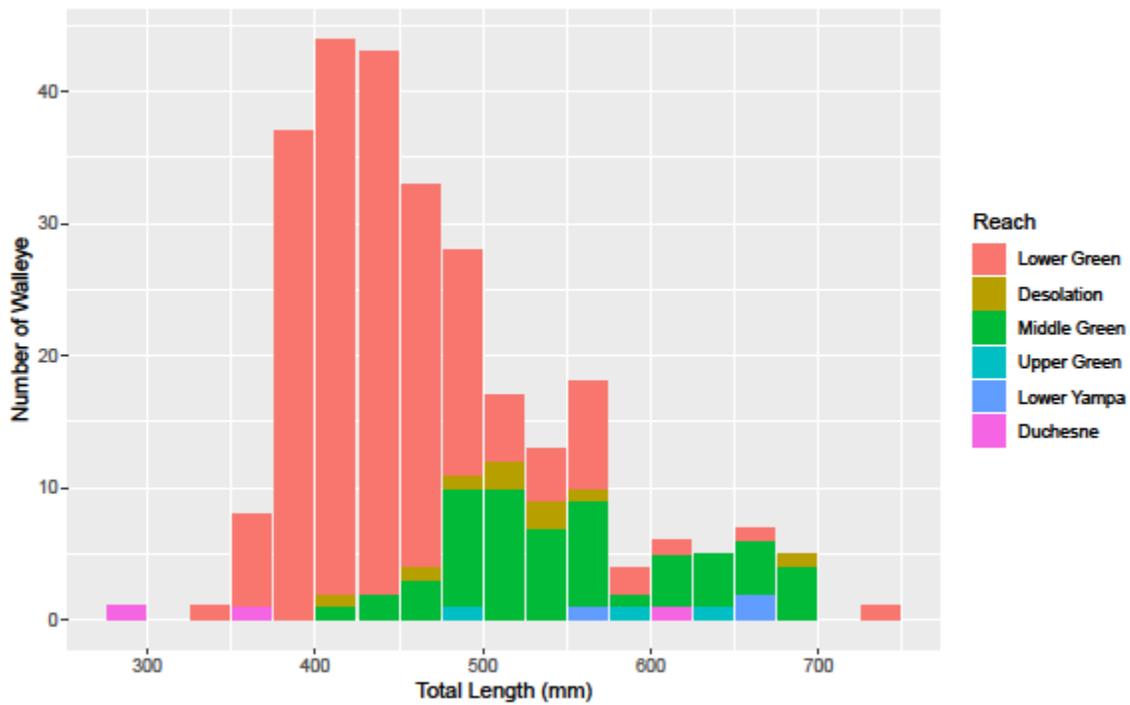


Figure 7. Length frequency histogram for walleye encountered in the Green River Sub-basin during 2018.

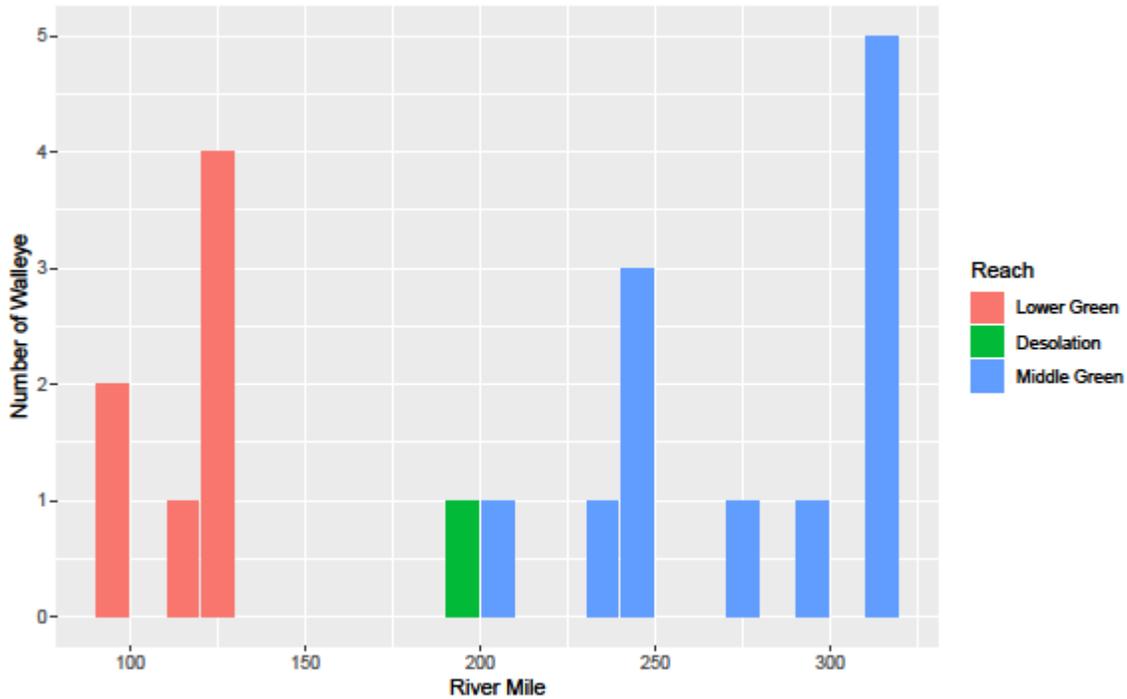


Figure 8. Encounters of ripe walleye on the Green River, 2018.

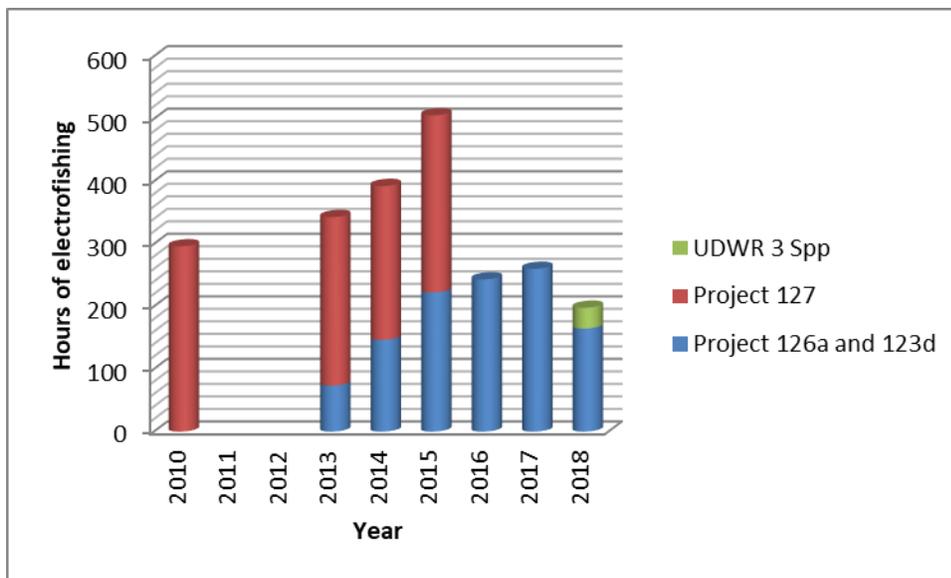
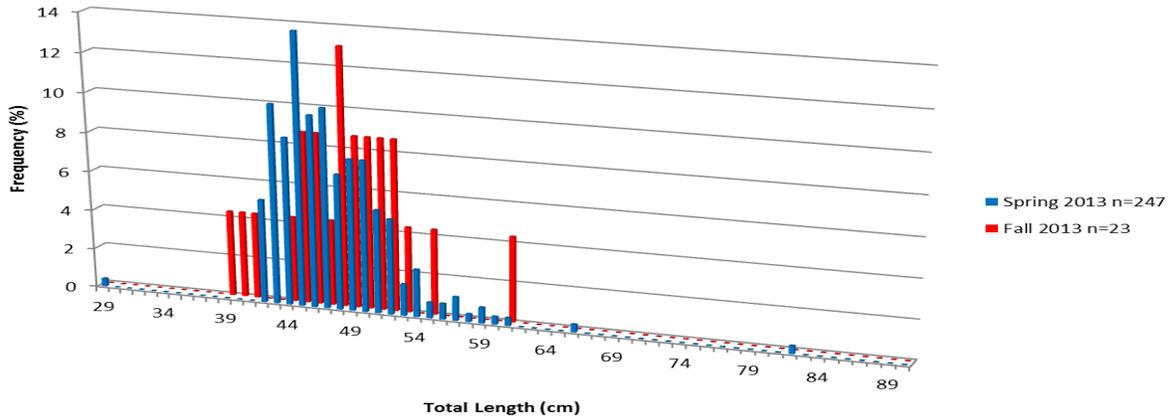
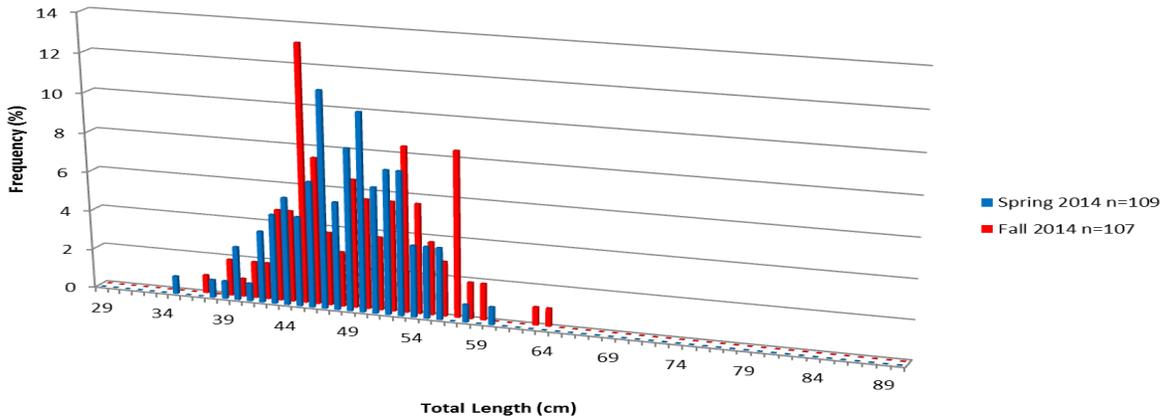


Figure 9. Total electrofishing effort expended from 2010-2018 by Colorado pikeminnow abundance estimate work (Project 127) and non-native fish removal projects (Projects 126a and 123d) in the lower 116 miles of the Colorado river Sub-basin.

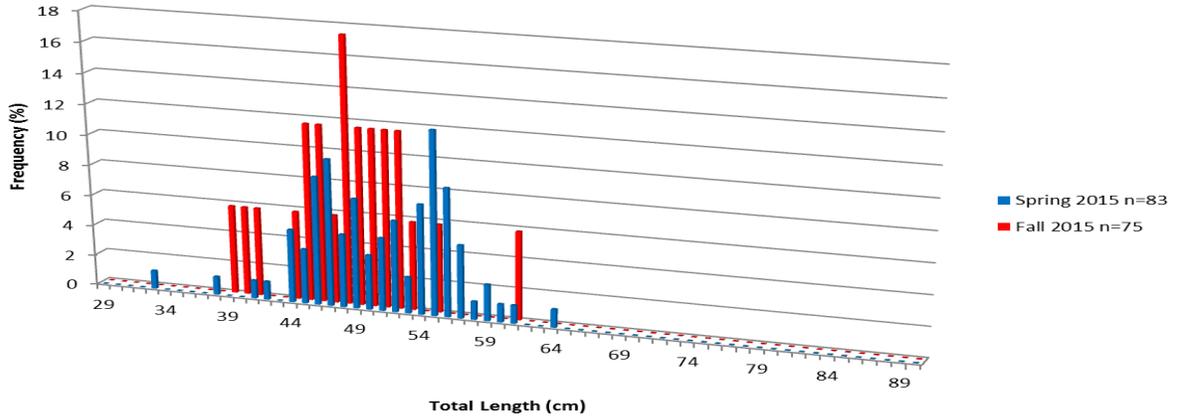
### WE Length Frequency 2013 n=270



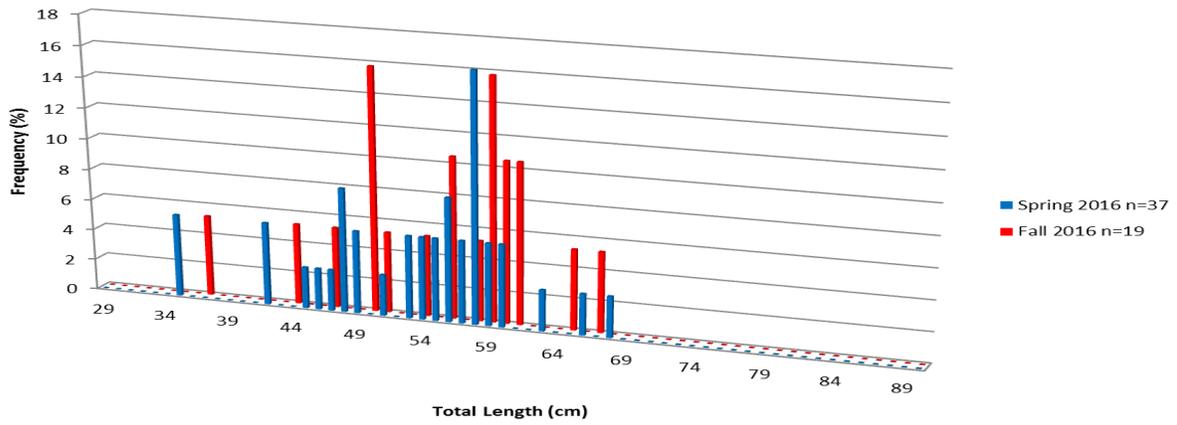
### WE Length Frequency 2014 n=216



**WE Length Frequency 2015**  
n=158



**WE Length Frequency 2016**  
n=56



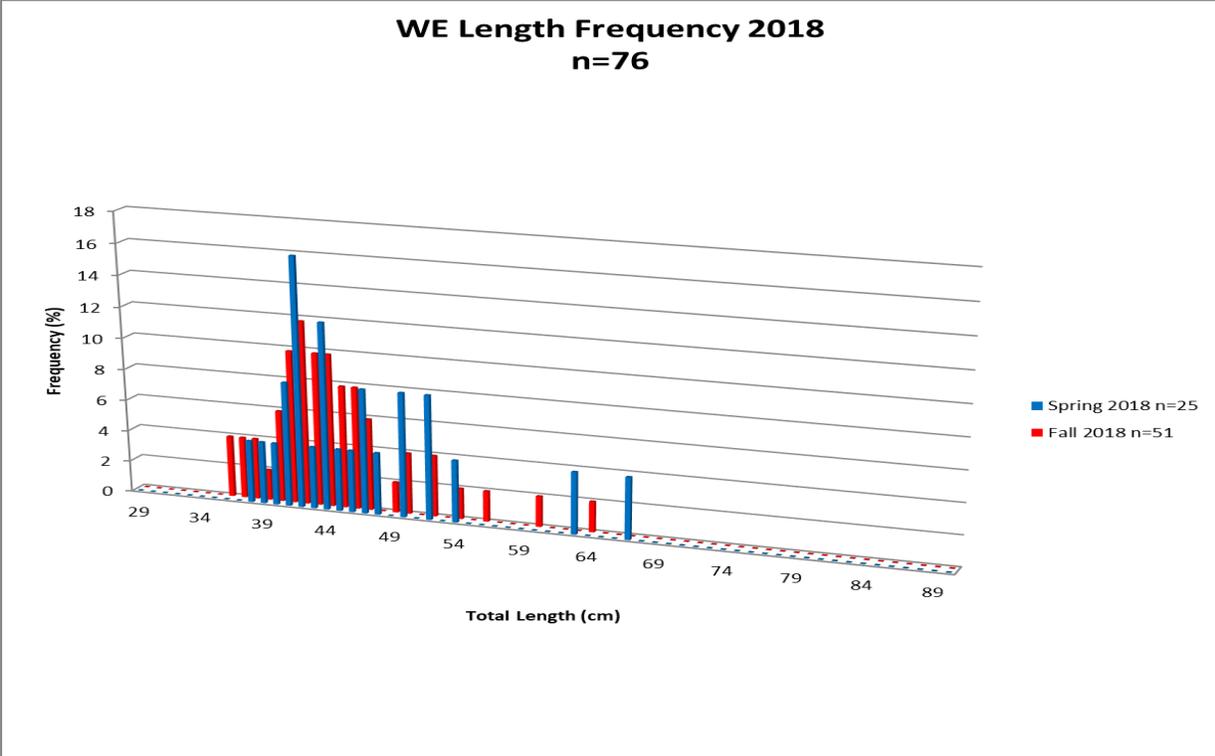
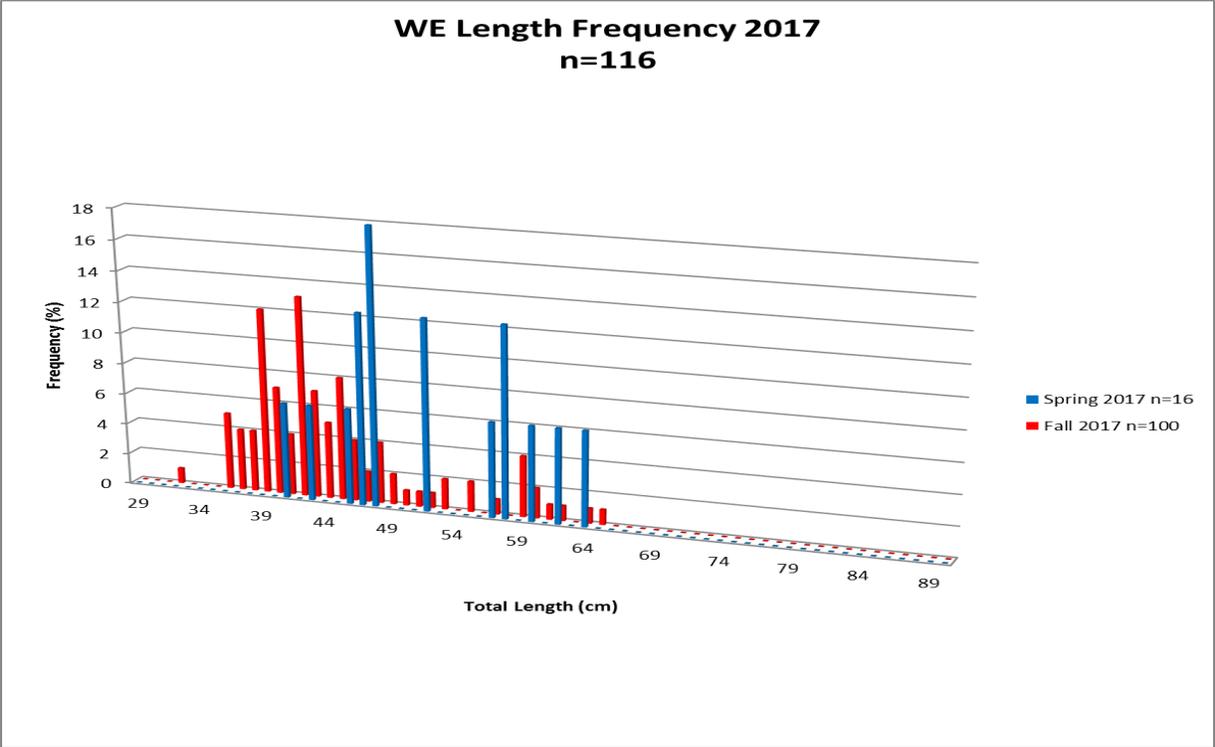


Figure 10. Length frequency histograms for walleye removed from the Colorado River from river mile 116 to the confluence of the Green River (RMI 0.0), UT 2013 through 2018.

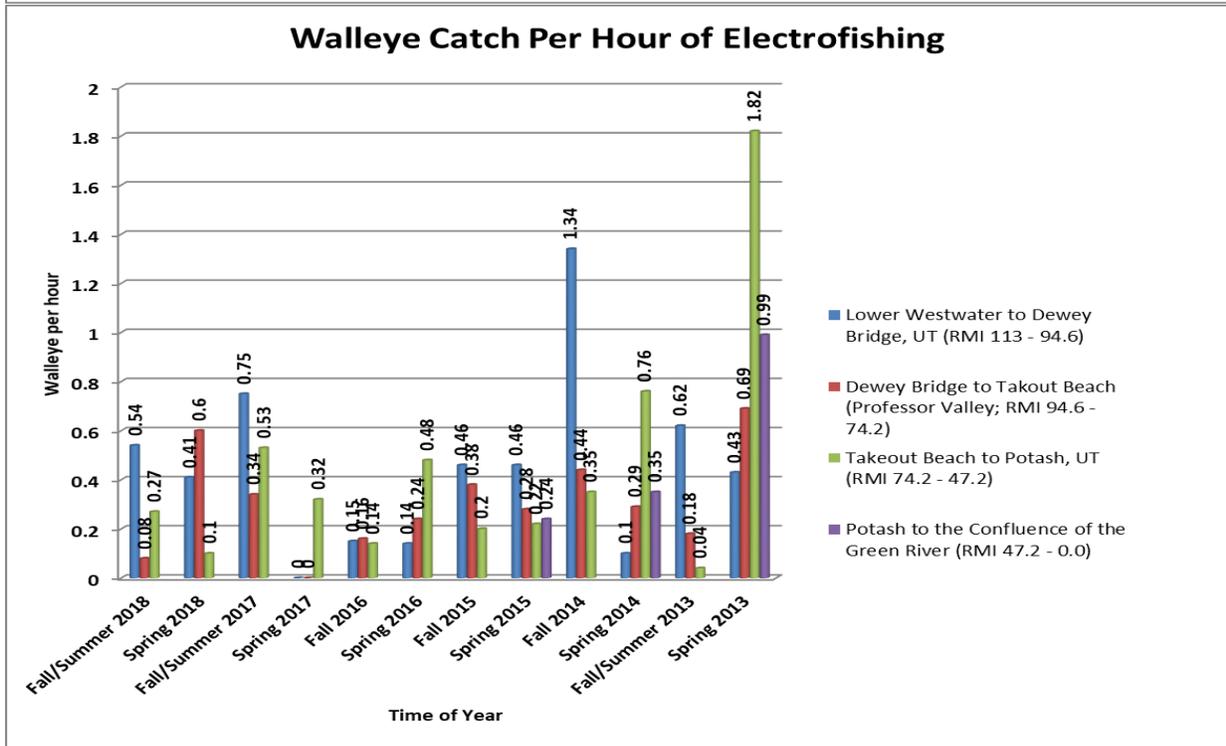
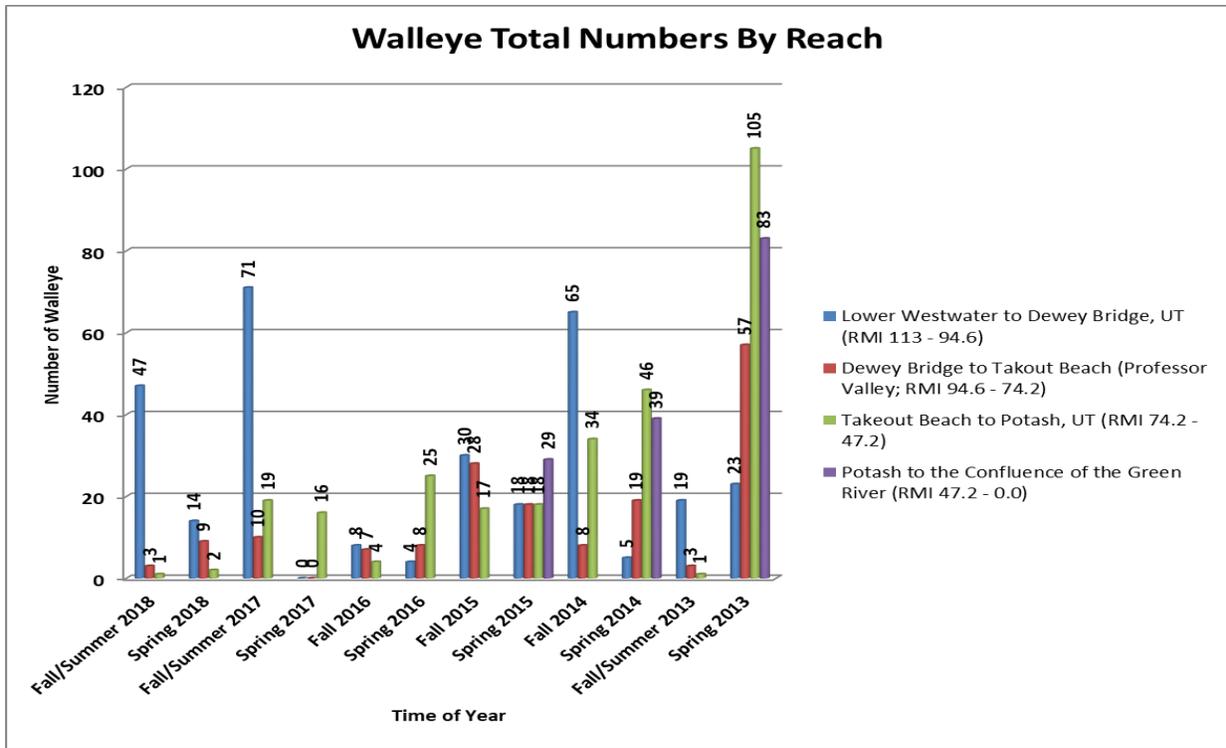
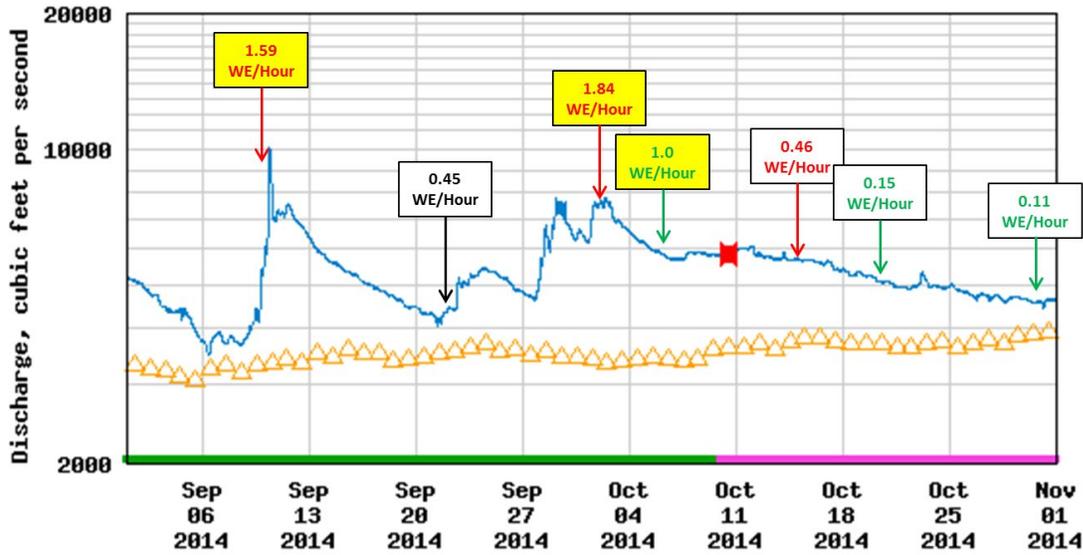


Figure 11. Walleye catch per effort and total numbers removed by season 2013-2018.



2014

USGS 09180500 COLORADO RIVER NEAR CISCO, UT

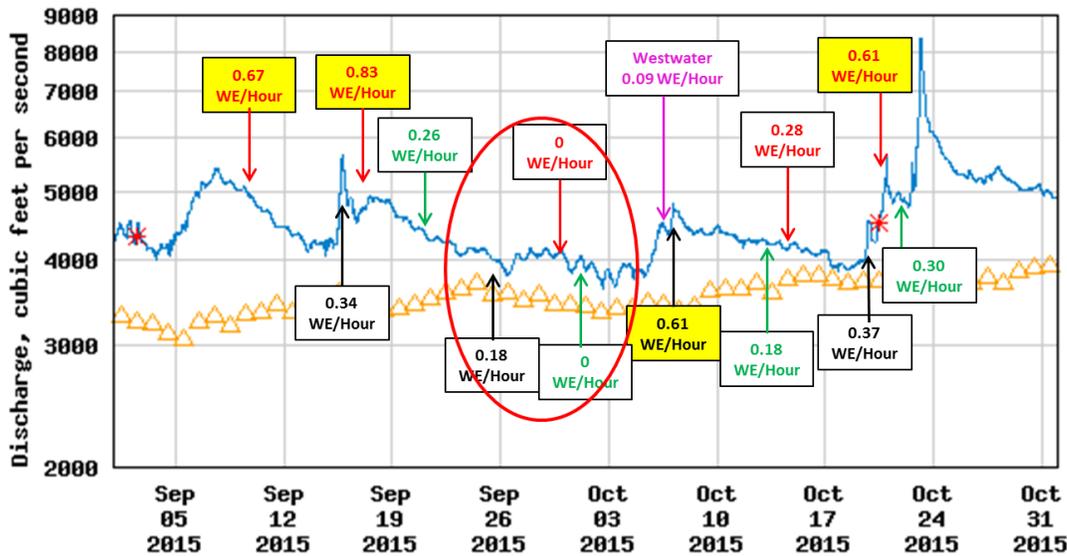


△ Median daily statistic (96 years)    — Discharge  
 — Period of approved data    \* Measured discharge  
 Red Cisco to Dewey  
 Black Dewey to Takeout  
 Green Moab



2015

USGS 09180500 COLORADO RIVER NEAR CISCO, UT



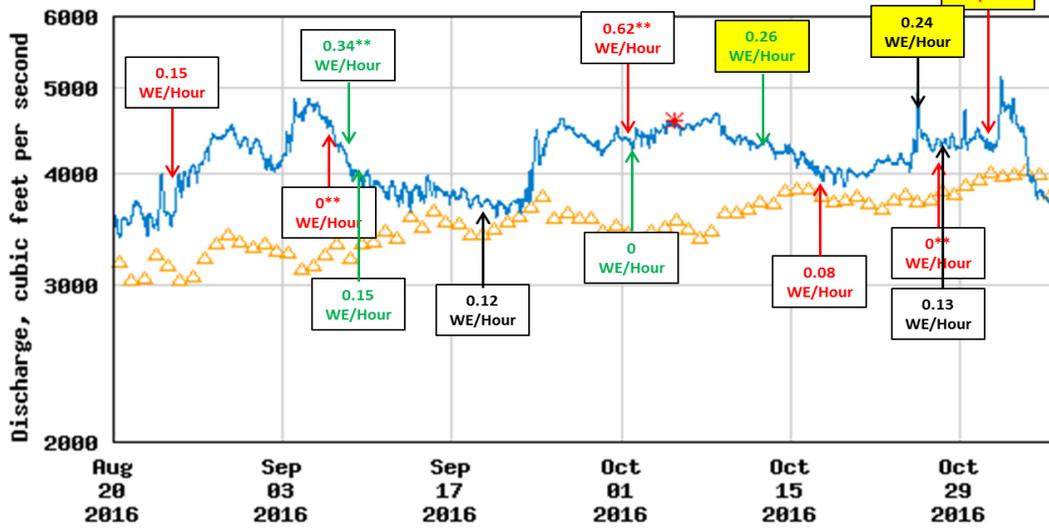
△ Median daily statistic (96 years)    — Discharge  
 \* Measured discharge  
 Red Cisco to Dewey  
 Black Dewey to Takeout  
 Green Moab

----- Provisional Data Subject to Revision -----



2016

USGS 09180500 COLORADO RIVER NEAR CISCO, UT



----- Provisional Data Subject to Revision

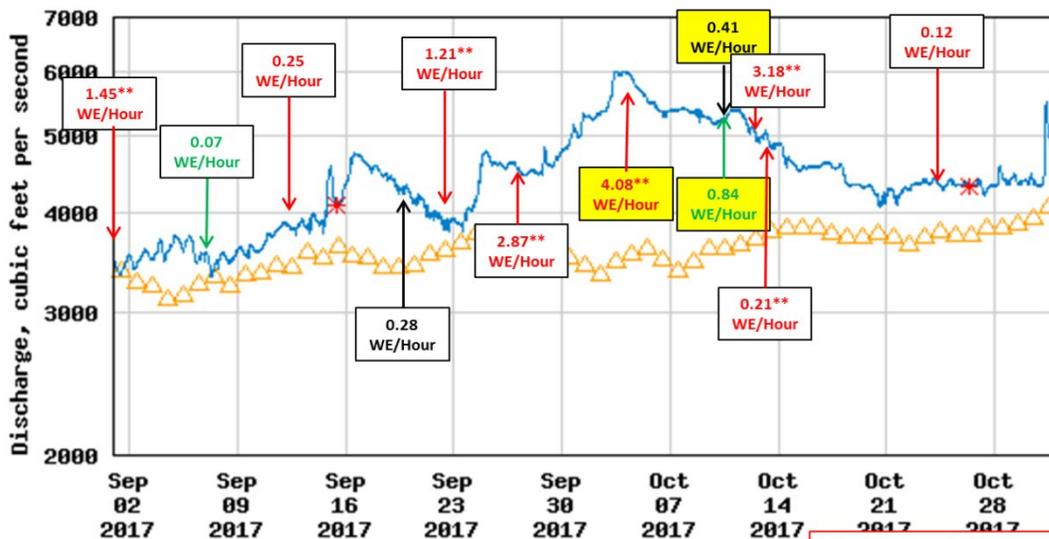
- △ Median daily statistic (97 years)
- \* Measured discharge
- Discharge

Red Westwater to Dewey  
 Black Dewey to Takeout  
 Green Moab  
 \*\* UDWR Moab shortened reaches



2017

USGS 09180500 COLORADO RIVER NEAR CISCO, UT



----- Provisional Data Subject to Revision

- △ Median daily statistic (98 years)
- \* Measured discharge
- Discharge

Red Westwater to Dewey  
 Black Dewey to Takeout  
 Green Moab  
 \*\* Shortened extra passes Bighorn Camp to Cisco

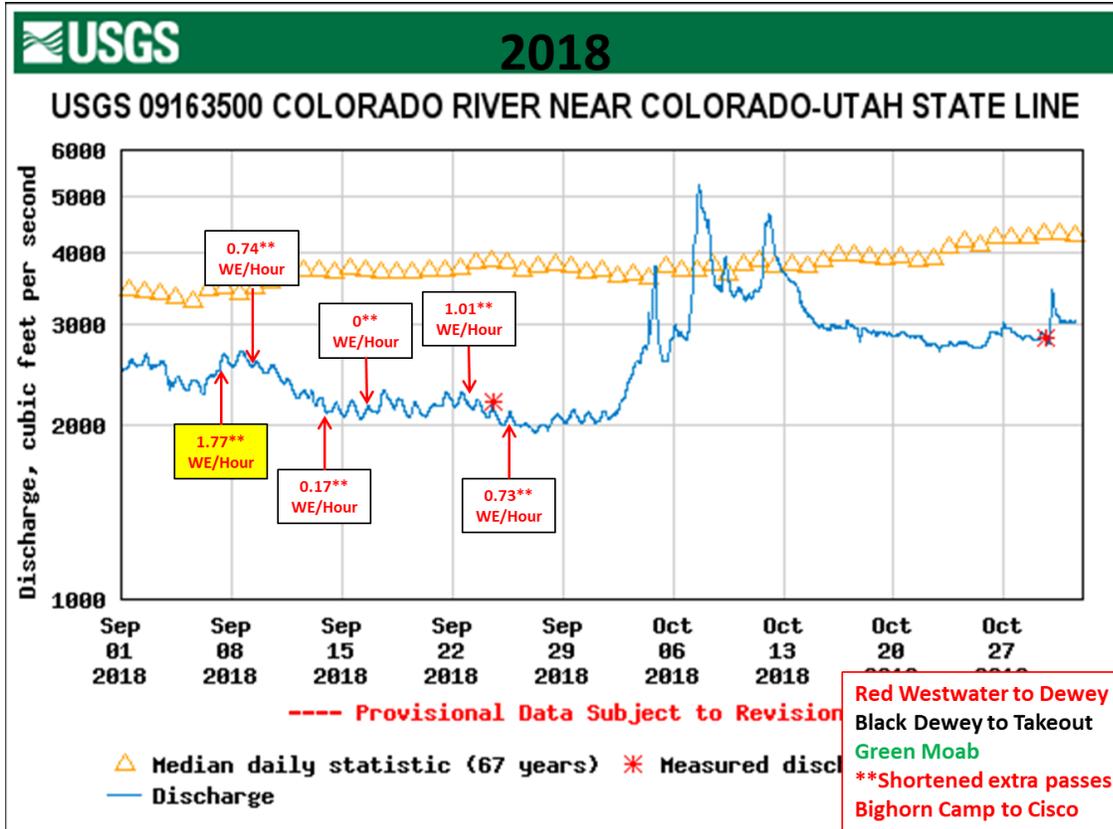


Figure 12. Fall walleye catch per effort plotted on USGS hydrograph data collected from their gauge on the Colorado River downstream of the Dolores River confluence near Dewey Bridge; 2014-2018.