

COLORADO RIVER RECOVERY PROGRAM
FY 2016 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 123a, 123b, 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

Project/Grant Period: Start date (Mo/Day/Yr): 05/01/2014
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Reporting period end date: 10/31/2016
Is this the final report? Yes _____ No X

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IV. Abstract:

Field crews removed a total of 292 walleye (*Sander vitreus*) throughout the Green River sub-basin during various field efforts in 2016. Removals occurred under projects specifically targeting walleye as well as projects targeting other species where walleye were collected as ancillary captures. Targeted walleye removal passes consistently produced higher catch rates than did other sampling efforts within reaches. Green River sub-basin-wide walleye catch rates were considerably higher during the spring and late fall than they were through the summer and early fall. The data illustrate that we are able to increase the efficacy with which we remove this predatory nonnative fish from the Green River by timing our effort properly and focusing that effort on reaches containing high value walleye habitat. However, it is also important to continue to remove this nonnative predator when encountered during other sampling efforts as well.

In 2016, field crews removed a total of 56 adult walleye throughout the upper Colorado River sub-basin, primarily under targeted walleye removal efforts. Targeted efforts to remove walleye were split fairly evenly between spring and fall and concentrated on the reach between Cottonwood Wash (RM 112.3) below Westwater Canyon to Potash, UT (RM 47.2). While spring walleye catch rates remained relatively unchanged, between 2015 and 2016, our fall catch rates declined from 1.04 fish/hr (2015) to 0.45 fish/hr (2016). Large monsoonal events (and corresponding spikes in the hydrograph) experienced in the fall of both 2014 and 2015 were not as large in magnitude in 2016. Anecdotal evidence suggests these spikes 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 2016 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Initial findings and preliminary results for 2016 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

- The contribution of Lake Powell to the fluvial walleye populations in the upper basin should 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.

Upper Colorado River Sub-basin

- Continue targeted walleye removal as a component of Projects 126a and 123a.
- 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.

Lower Green River

- Additional effort should be applied between Tusher Diversion and Green River State Park (RM 128-120) as this segment is not consistently sampled under Project 128 and currently 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

- In 2016, during a fourth Colorado Pikeminnow Population estimate pass to assist GRBFWCO, a concentration of Walleye was removed between the White River confluence and Sand Wash. Moreover, further analysis determined that approximately 50% of the Walleye removed by GRBFWCO during pikeminnow passes 1-3 were removed from this same reach. We recommend conducting Walleye-specific removal efforts in this reach during spring sampling (efforts will be more extensive in Project #128 off years). Specifically, with limited personnel and equipment available during 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
- Based on our experimental passes upstream of Split Mtn. boat ramp, we do not recommend expending additional effort targeting walleye in these reaches at this time.

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.

X. Project Status: on track and ongoing

XI. FY 2016 Budget Status

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

XII. Status of Data Submission: Data are compiled and will be submitted to the database manager by January 2017.

XIII. Signed: Christopher Michaud 11/14/2016
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: 123a

Project Title: Nonnative fish control in the Green River

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

Reporting period end date: 10/31/2016

Is this the final report? Yes _____ No X

Performance:

Walleye removal on the Green River

Task 4 was completed: Fifteen hours of electrofishing effort, targeting walleye on the lower Green River, was completed between 9 April and 31 October, 2016. All effort was focused on high value walleye habitat between Tusher diversion and Green River State Park (RM128-120). A total of eight walleye were removed from the Green River (CPUE=0.52) in 2016. Catch rates were similar between spring and fall efforts, and were highest in the 2 mile section below Tusher diversion (0.96).

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

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Project/Grant Period:

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Performance:

Task 5 was completed: Utah Division of Wildlife Resources crews completed 20.9 hours of targeted walleye sampling on the Colorado River between Big Hole and Potash boat ramp (RM 115.8-47.2) in 2016. Targeted walleye removal began on 9 September and concluded on 26 October, 2016. Three walleye were encountered over the sampling period (CPUE=0.14). Crews also removed 34 largemouth bass and 42 smallmouth bass, most of which were encountered between Big Hole and Cisco boat ramp (RM 115.6-110.5).

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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Project/Grant Period: Start date (Mo/Day/Yr): 5/1/2014
 End date: (Mo/Day/Yr): 9/30/2018
 Reporting period end date (Mo/Day/Yr): 9/30/2016
 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.

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
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Reporting period end date (Mo/Day/Yr): 9/30/2016
Is this the final report? Yes _____ No X

Performance:

GJ FWCO was tasked with completing 3 full passes of targeted walleye removal from Cisco to Potash, UT. During the spring (2016), two full passes were completed; and during the fall (2016) three full passes were completed between Cisco and Takeout Beach and one full pass was completed between Takeout Beach and Potash. A total of 53 walleye were removed. For additional details pertaining to other non-native fishes removed please see annual report for project 126a.

Appendix A:

Preliminary results of the removal of walleye from the upper Colorado River Basin, 2016.

Michaud C. & B. Shelley (UDWR), T. Francis & T Jones, (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 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 2017, 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 relatively high 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. 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 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 deeper 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. Targeted walleye removal was split between the two seasons in 2016 (spring work began 21st March and concluded 23rd June; fall work began 25th August and concluded 1st November).

Study Area

For the purpose of this study the Green River Sub-basin has been broken down into seven reaches (Table 1). 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 occurs in two relatively small sub-reaches within the main-stem Green River – a thirty mile reach near Jensen, Utah, and a thirty mile reach near Green River, Utah (Table 2).

Walleye are targeted in the upper Colorado River downstream of Westwater Canyon to the confluence with the Green River, although effort has been broken down into four reaches where walleye are currently encountered. 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

All data from all reaches were 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 slack water areas during Colorado pikeminnow sampling in the Colorado. 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 (123a, 123b and 126a), projects targeting smallmouth bass and northern pike (123a, 123b, 126a, 125, 98c, 110 and 167) and endangered fish monitoring projects (127 and 128). Detailed methodologies may be found in the annual reports for each project.

Results and Discussion

Green River Sub-basin

In 2016 walleye were encountered throughout the Green River sub-basin. A total of 292 walleye were removed from the system through 1,581 hours of electrofishing effort, producing basin wide catch rates of 0.18 walleye per hour. Sampling in this sub-basin began in early April and continued through the end of October. Walleye catch rates were higher in spring and fall than in summer (Figure 4). Further, CPUE was notably higher in two discrete sections of the middle Green River (RM 319.8-310.8 and RM 240.8-230.8) and one section of the lower Green River (RM 128-109.9) (Figure 5). Targeted walleye removal passes (under Projects 123a and 123b) produced the highest catch rates in the sub-basin (Figure 6). The success of these two projects at effectively removing walleye stems from a number of factors. First, effort is focused in early spring (123a, 123b) and late fall (123a). Second, sampling is concentrated within sub-reaches which have consistently yielded high catch rates for walleye in the past. Third, researchers maintain the flexibility to modify timing and location of sampling as well as sampling methods with the goal of maximizing walleye captures. Colorado pikeminnow abundance estimate passes (Project 128) also achieved better than average CPUE. In fact, abundance estimate passes in the middle Green River recorded the third highest catch rates, for walleye, of any effort in the Green River sub-basin. 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. In 2016, walleye were encountered in all sampled reaches of the Green River sub-basin except the middle and upper Yampa River and the White River (Figure 7).

Lower Green River

Researchers with the Utah Division of Wildlife Resources Moab Field Station (UDWR-Moab) completed 362.8 hours of electrofishing effort on the lower Green River in 2016 (Table 3). Crews removed 86 walleye through both targeted efforts and ancillary captures during Colorado pikeminnow abundance estimate passes (Figure 7). Although overall catch on the lower Green River increased from 16 walleye in 2015, CPUE remained relatively constant (0.24 vs. 0.27 walleye/hour).

Targeted walleye removal on the lower Green River (Project 123a), began on 10 April 2016 and concluded on 21 May 2016. Three removal days were completed during this interval between Tusher diversion and Green River State Park (RM 128-120) satisfying work requirements under task 4 of this year's scope of work. Two additional days of effort were completed in the fall on 6 September and 31 October 2016. This effort was transferred from task 5 (Colorado River walleye removal) due to low catch-rates in that reach. A total of eight walleye were removed over 15.3 hours of effort, catch-per-unit-effort was 0.52 walleye/hour. Catch rates were similar between spring and fall sampling (0.54 and 0.5 respectively). Highest catch rates in this reach (0.96) were recorded in the two mile interval directly below Tusher diversion (RM128-126).

All additional sampling in this reach occurred under Project 128 (Colorado pikeminnow abundance estimates). Sampling for Project 128 began on 18 April and concluded on 15 June 2016. Four passes were completed during this time interval; a total of 78 walleye were removed from the lower Green River (RM 120-0) during 347.5 hours of electrofishing yielding a catch rate of 0.22 walleye/hour (Figure 5). Catch rates were higher (0.49 walleye/hour) in the upper 23 miles of this reach than the lower 97 miles (0.16 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 217.5-128) on 21 April and finished on 9 September 2016 under projects 128, 123a and 123b. Crews completed 256.4 hours of electrofishing effort, harvesting 31 walleye and yielding a CPUE of 0.12 walleye/hour (Table 4, Figure 7). Both harvest and catch rates in Desolation and Gray Canyons were down from 2015 where 45 walleye were removed and crews achieved a CPUE of 0.39.

Middle Green River

Utah Division of Wildlife Resources Northeast Region (UDWR-Vernal) and USFWS-Vernal crews completed 551 hours of electrofishing effort in the middle Green River in 2016. Researchers removed 154 walleye from this reach between 11 April and 7 October 2016 yielding a catch rate of 0.28 walleye/hour (Table 5, Figure 7).

Nine days of targeted walleye removal, under project 123b, were completed in the middle Green River between 12 April and 8 June 2016. Seventeen walleye were removed over 21 hours of sampling yielding a CPUE of 0.8. All targeted effort was applied between Split Mountain boat ramp and Spring Hollow (RM 325.7-295.8). This sub-reach has produced substantial walleye captures in the past and is the focus of targeted walleye efforts under project 123b. An additional 31 walleye were encountered in the middle Green River during 300 hours of targeted smallmouth bass removal yielding a far lower catch rate (Table 5a).

Pikeminnow abundance estimate sampling (Project 128) began on 19 April and concluded on 2 June 2016 in the middle Green River. This project achieved the highest catch rates (CPUE = 0.45) of any non-targeted sampling endeavor in 2016 (Figure 6) and removed 104 walleye from 101.8 miles of the Green River.

Upper Green River

Sampling in the upper Green River began on 12 April and concluded on 22 September 2016. Catch rates for walleye in the upper Green River were the lowest recorded on the Green River in 2016 (0.05 walleye per hour). Researchers with USFWS-Vernal, UDWR-Moab and Vernal and Colorado State University (CSU) removed a total of 15 walleye over 317 hours of effort (Table 6, Figure 7). UDWR-Vernal expanded targeted walleye removal upstream under Project 123b into Split Mountain Canyon (RM 325.7-319.3) in 2016. Split Mountain is close to documented walleye spawning habitat in the upper few miles of middle Green River. Researchers completed two passes of targeted removal within this sub-reach and encountered only one walleye (CPUE=0.15).

Yampa River

Sampling in lower Yampa Canyon began on 21 June and concluded on 15 July 2016 under project 110. Researchers encountered only three walleye on the Yampa River in 2016 (Figure 7). All encounters were documented in the lower Yampa Canyon, within 35 miles of the Green River. Electrofishing effort (Project 110) within the lower Yampa Canyon totaled 93.5 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 during 442.1 hours of electrofishing effort on the White River. Effort from the White river was excluded from CPUE calculations for the Green River Basin.

Size Structure

Mean total length for walleye removed in 2016 was 505 mm, lengths ranged from 206 mm to 710 mm (Figure 8). The 206 mm walleye was captured in Desolation Canyon (RM 201). This 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. No obvious differences in size structure were noted between reaches.

Spawning Observations

Thirty-seven walleye, in spawning condition, were encountered in the Green River sub-basin between 13 April and 7 June 2016. The majority of these fish were male (84%). Aggregations of ripe fish were noted in the uppermost reach of the middle Green River as well as several locations downstream (Figure 9). 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). Researchers, however, encountered only one walleye under 300 mm total length in 2016 and few in previous years. Currently, it appears as though walleye are not able to successfully recruit within the Green River and most of the individuals we encounter are emigrating from reservoir populations elsewhere in the basin.

Upper Colorado River Sub-basin:

In 2016, two offices cooperated to conduct targeted walleye removal in the upper Colorado River. Because no Colorado pikeminnow population estimates (project 127) were ongoing in 2016, 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 two full walleye removal passes in the spring 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 115.24 hours of electrofishing effort. During the fall, GJ FWCO completed three full walleye removal passes in the upper two reaches and one full pass in the lower reach for a total of 107.12 hours of electrofishing effort. Beginning in 2015, UDWR Moab provided additional removal effort in the Upper Colorado River Sub-basin. Their efforts are targeted to specific walleye areas, and are thus shorter in duration and length than GJ FWCO. In 2016, UDWR Moab contributed 20.91 hours of electrofishing effort. .

In 2016, 56 adult walleye were removed with a mean total length of 539 mm and lengths ranging from 349-680 mm (Figure 11). Our 2016 walleye spring catch rate was higher (0.32 fish/hr) than our fall catch rate (0.15 fish/hr) and was similar to both our 2015 walleye fall and spring catch (spring 0.29 fish/hr, fall 0.34 fish/hr). These were a decline when compared to our 2014 walleye fall catch (0.73 fish/hr) and spring catch (0.44 fish/hr). Walleye catch rates varied amongst reaches when comparing the spring and fall (Table 8, Figure 12). 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 and 2015; thus, likely reducing the catch rate in 2016 (Figure 13).

Most walleye collected since 2014 have been dissected to determine gonadal development, sex and diet of the fish occupying the Upper 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 Upper Colorado and Green Rivers were originating in Lake Powell. We will be conducting this work the next few years on the San Juan arm of Lake Powell and therefore, continued efforts to tag walleye in the Colorado River arm will be postponed.

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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 - 217.5	101.8
	Desolation	123a, 128	UDWR, USFWS	217.5 - 128	89.5
	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
White River	White River	167, 128	CPW, UDWR, USFWS	104 - 0	104
Upper Colorado River	Lower Colorado	127,126a	UDWR, USFWS	116-0	116

Table 2: Locations of targeted walleye removal projects.

Project	River	Reach	River miles	Length (miles)
123b	Green River	Upper Green	327.5 - 319.3	8.2
		Middle Green	319.3 - 300	19.3
123a	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) Catches under Project 128 are ancillary captures, while catches under 123a are targeted captures.

Lower Green River	Effort	Walleye	CPUE
128	347.5	78	0.22
123a	15.3	8	0.52
Total	362.8	86	0.24

Table 4. Walleye captures on the Green River within Desolation and Gray Canyons (RM 217.5-128). All captures are ancillary captures under existing projects.

Desolation and Gray	Effort	Walleye	CPUE
128	201.5	28	0.14
123a	39.3	3	0.08
123b	15.5	0	0
Total	256.4	31	0.12

Table 5. Walleye captures on the middle Green River (RM 319.3-217.5). Captures under Projects 128 and 123b are ancillary captures. Captures under 123b(t) are targeted removal efforts.

Middle Green River	Effort	Walleye	CPUE
128	229.2	104	0.45
123b	300.8	33	0.11
123b(t)	21.2	17	0.80
Total	551.2	154	0.28

Table 6. Walleye captures on the upper Green River (RM 380-319.3). All captures are ancillary captures under existing projects except 123b(t), which is targeted removal.

Upper Green River	Effort	Walleye	CPUE
128	17.4	3	0.17
123a	241.2	9	0.04
123b	10.5	1	0.1
123b(t)	6.8	1	0.15
FR-115	41.4	1	0.02
Total	317.4	15	0.05

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

Lower Yampa River	Effort	Walleye	CPUE
110	93.5	3	0.03

Table 8. 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 Upper 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.

		Walleye								
River Section	Length Class (mm)		Time Period						Spring 2013 No Effort Key Punched	
			Fall 2016	Spring 2016	Fall 2015	Spring 2015	Fall 2014	Spring 2014		Fall 2013
Lower Westwater Canyon to Dewey Bridge	< 200	No. of fish	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
		E-fish C/E								
	300-374	No. of fish	1 E-fish	0	0	0	1 E-fish	0	0	0
		E-fish C/E	0.02				0.02			
	> 375	No. of fish	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	0.13	0.14	0.46	0.46	1.32	0.1	0.62	NA
Dewey Bridge to Takeout Beach (Professor Valley)	< 200	No. of fish	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
		E-fish C/E								
	300-374	No. of fish	0	0	3 E-fish	0	0	0		0
		E-fish C/E			0.04					
	> 375	No. of fish	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	0.16	0.24	0.34	0.28	0.44	0.29	0.18	NA
Takeout Beach to Potash, UT	< 200	No. of fish	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
		E-fish C/E								
	300-374	No. of fish	0	2 E-fish	2 E-fish	0	0	1 E-fish	0	0
		E-fish C/E		0.04	0.02			0.02		
	> 375	No. of 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	0.14	0.44	0.18	0.22	0.35	0.74	0.04	NA
Potash, UT to the confluence of the Green River	< 200	No. of fish	No sample	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		No sample	0	No sample	1
		E-fish C/E								
	300-374	No. of fish	No sample	No sample	No sample	1 E-fish	No sample	0	No sample	2
		E-fish C/E				0.01				
	> 375	No. of fish	No sample	No sample	No sample	(28 total) 26 E-fish	No sample	(39 total) 31 E-fish	No sample	84
		E-fish C/E				0.23		0.35		

Table 9. Walleye dissection results from the Colorado River 2014-2016.

Year	2014	2015	2016
# WE removed	216	158	56
# WE dissected	70	156	53
# gender identified	70	104	39
% Male	53	38	28
% Female	47	62	72
# WE empty stomachs	28	102	34
# WE unidentifiable fish remains in stomach	34	24	6
# WE with NNF in stomachs	6	21	3
# WE with T&E fish in stomachs	2	4	3
# WE with other native fishes in stomachs	0	4	7
# WE with mammals or crustaceans in stomach	0	1	0
% positively identified stomach contents native	25	28	77
% positively identified stomach contents non-native	75	72	23

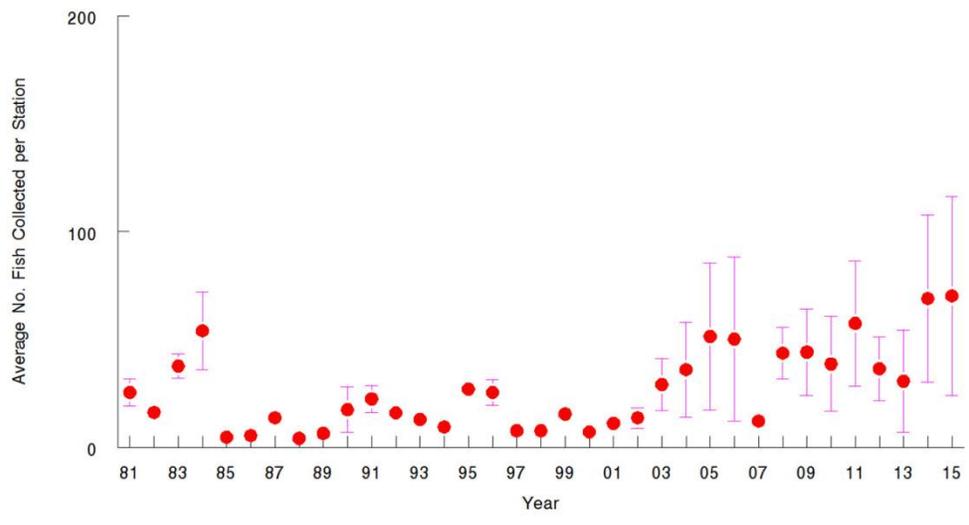
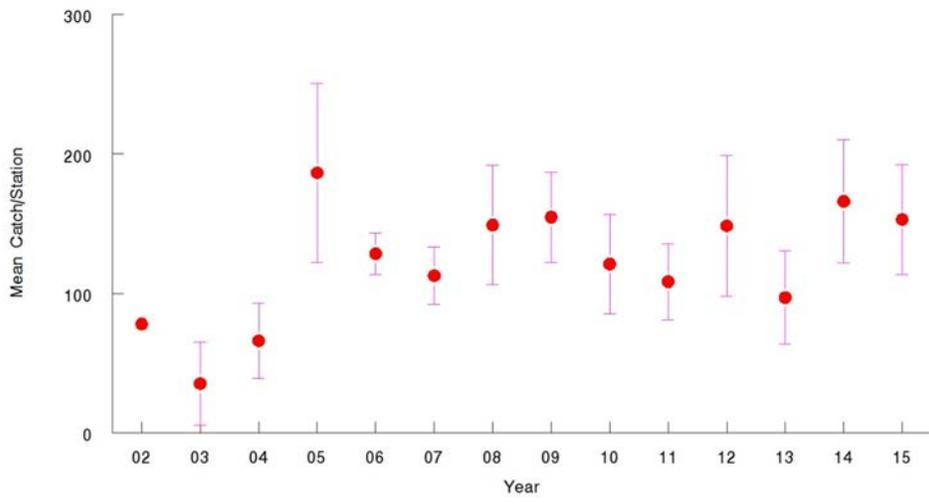


Figure 1. Upper graph: Mean catch/station of gizzard shad from the annual gill-netting survey with SE, Lake Powell, UT. 2002-2015. Lower graph: Average catch of walleye per station from the fall gill-net survey with SE, Lake Powell, UT. 1981-2015. Provided courtesy of George Blommer, UDWR Wahweap.

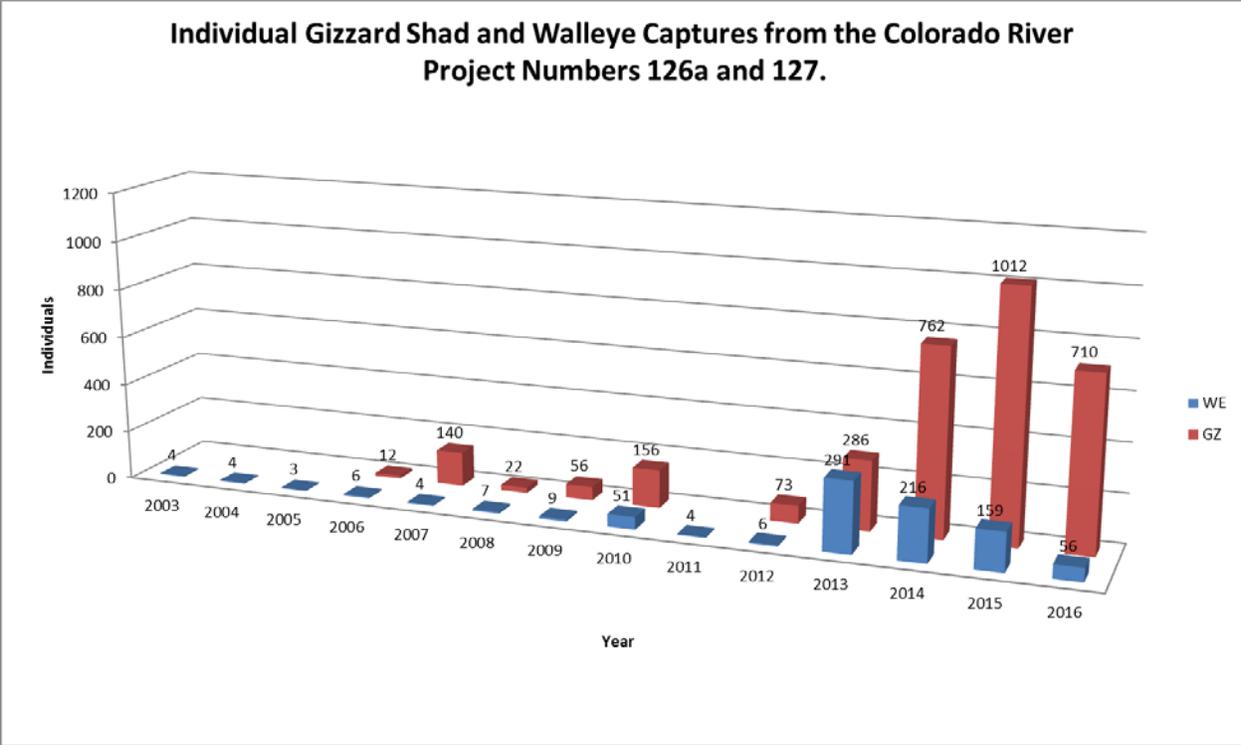


Figure 2. Individual gizzard shad and walleye captures from the Upper Colorado River; 2003-2016.

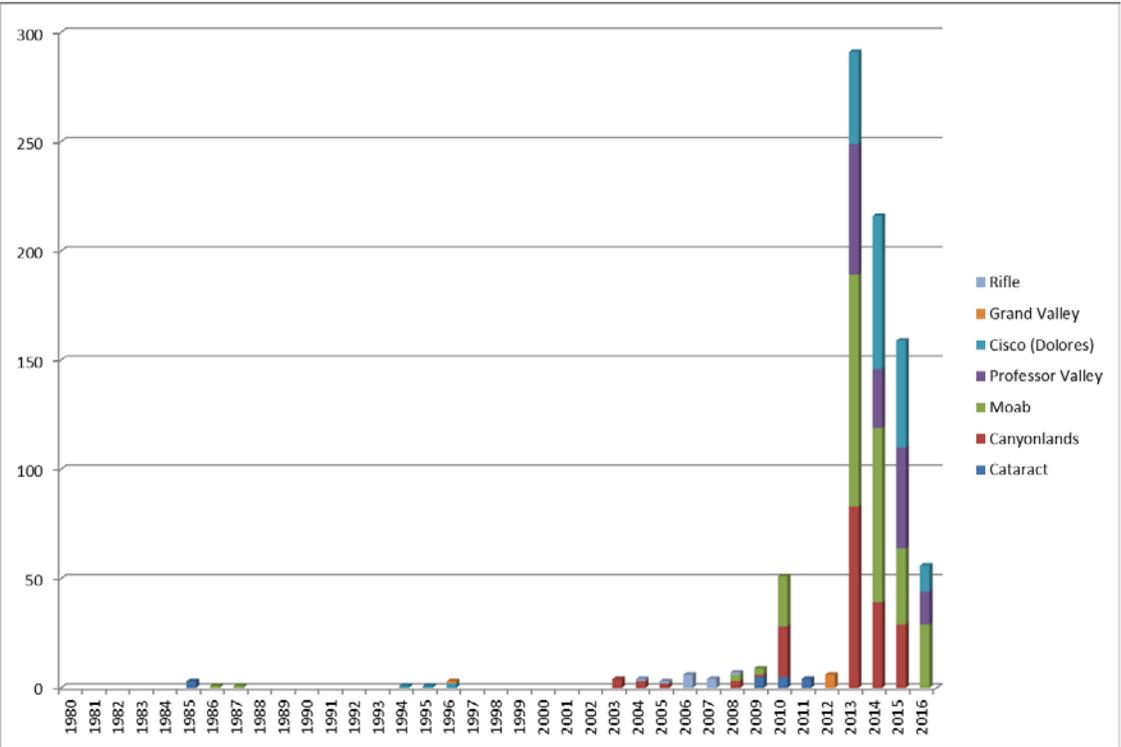


Figure 3. Annual captures of walleye in the Upper Colorado River Sub-basin. Note: captures are not standardized for effort.

Green River

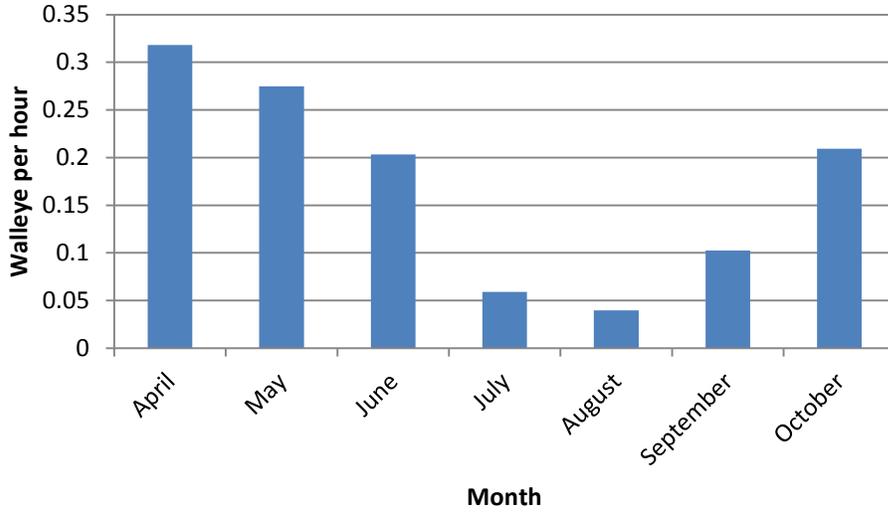


Figure 4. Catch per unit effort by month for walleye encountered on the Green River (all projects).

Green River

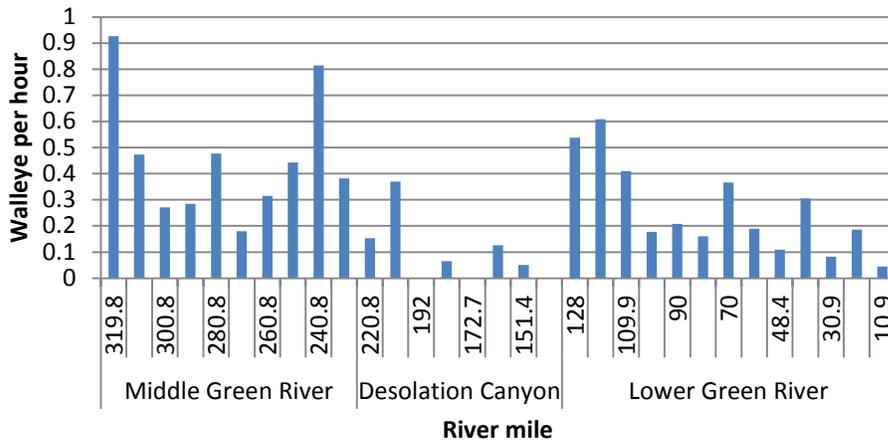


Figure 5. Catch per unit effort for walleye on the Green River between 9 April and 8 June 2016.

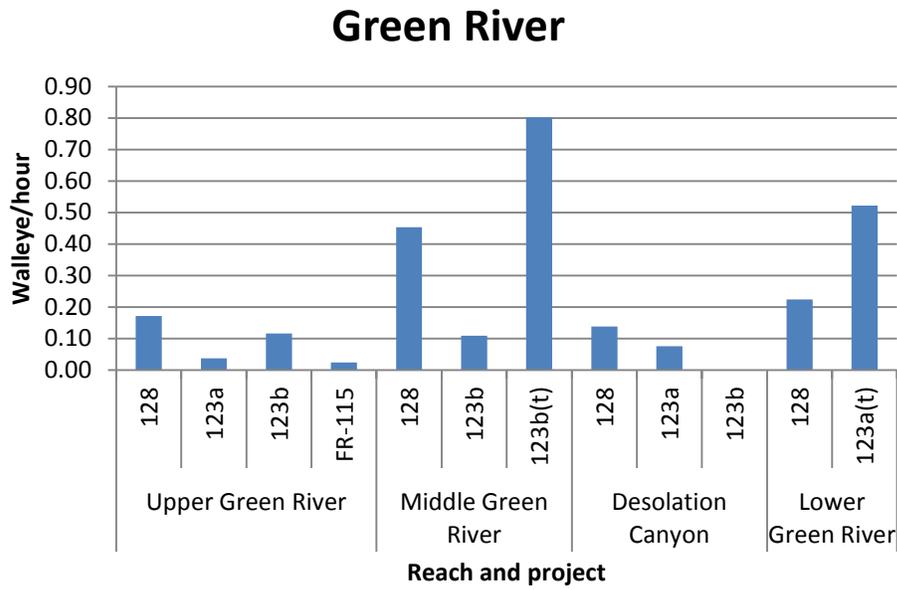


Figure 6. Catch per unit effort by project and reach. (t) denotes targeted walleye effort.

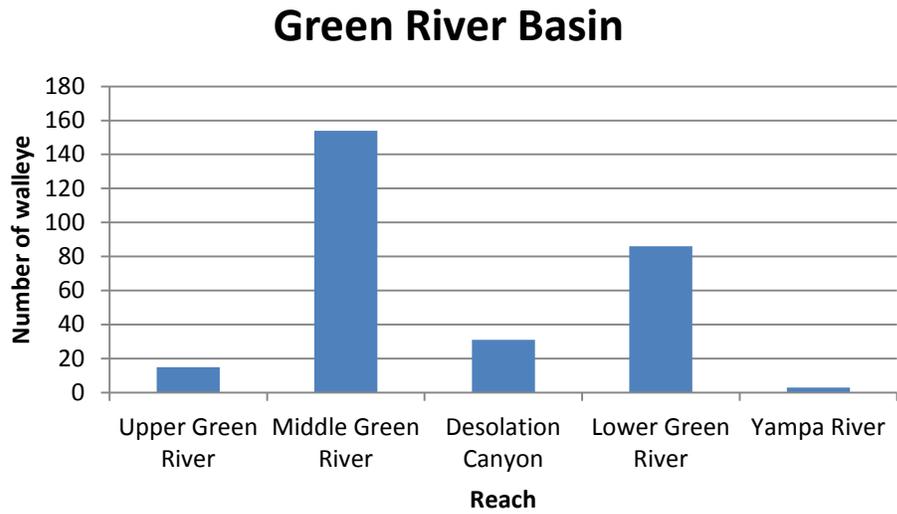


Figure 7. Number of walleye removed by reach in 2016. Field crews removed a total of 292 walleye.

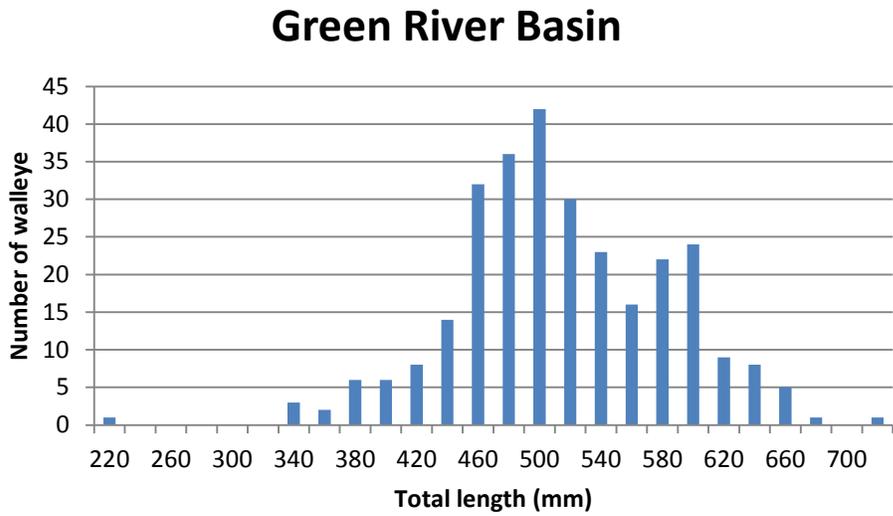


Figure 8. Length histogram for walleye encountered in the Green River Basin.

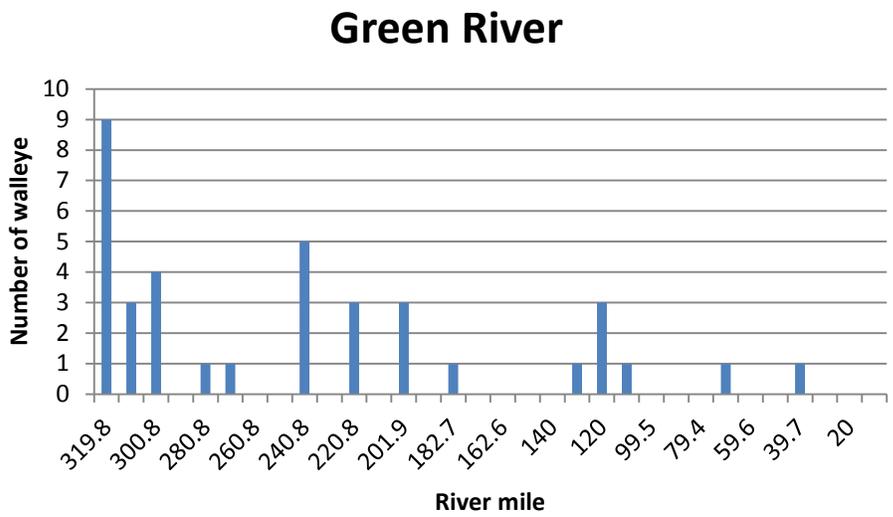


Figure 9. Locations of walleye encountered in spawning condition.

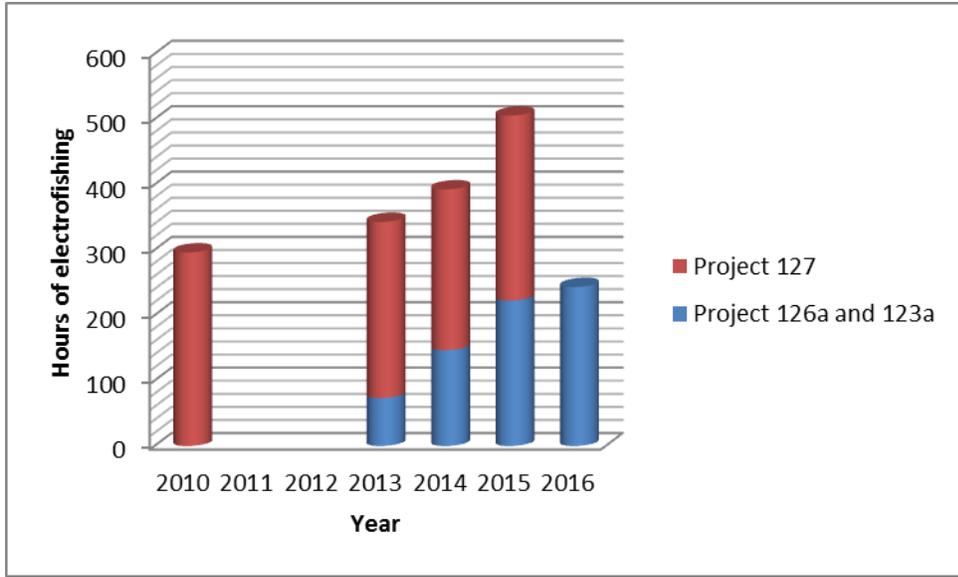
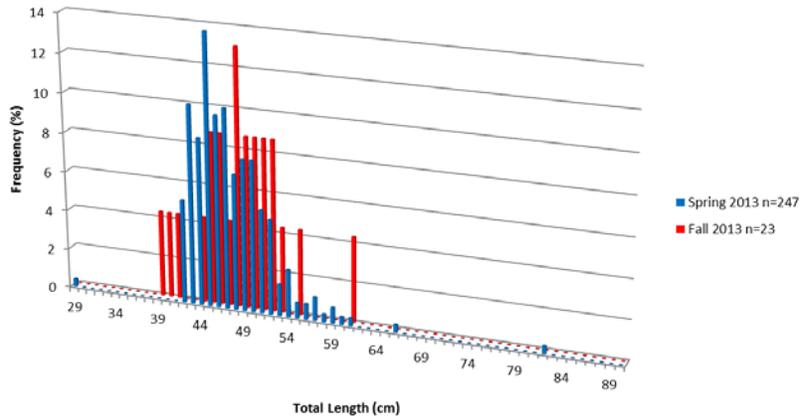
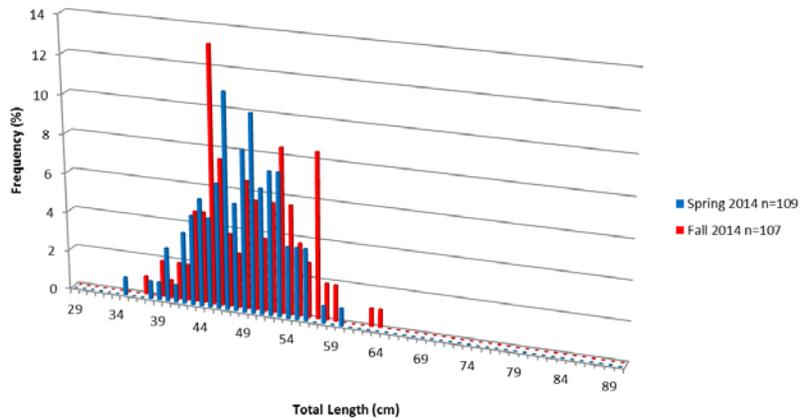


Figure 10. Total electrofishing effort expended from 2010-2016 by Colorado pikeminnow abundance estimate work (Project 127) and non-native fish removal projects (Projects 126a and 123a) in the lower 116 miles of the Upper Colorado river Sub-basin.

WE Length Frequency 2013
n=270



WE Length Frequency 2014
n=216



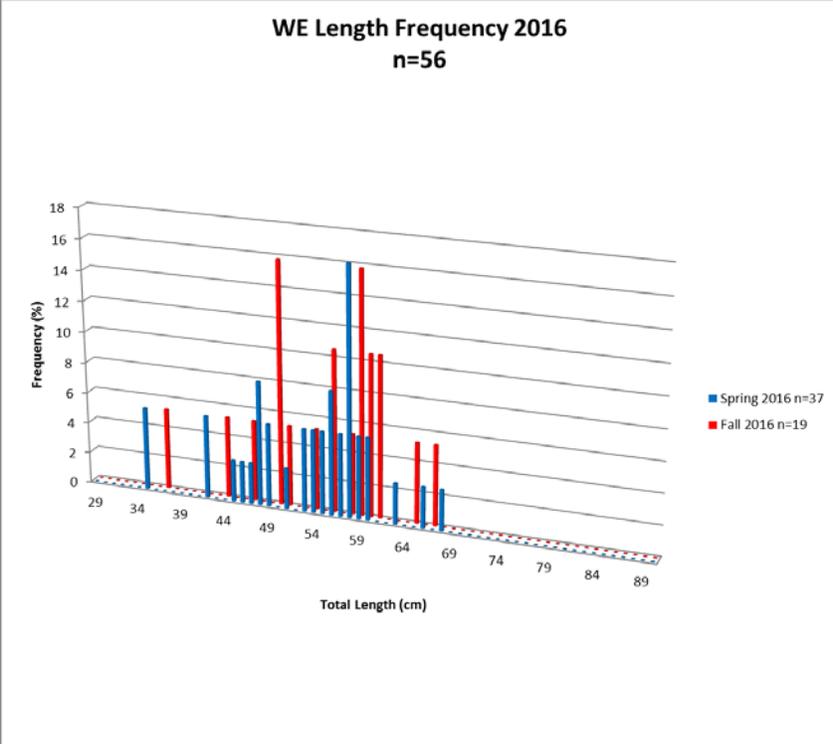
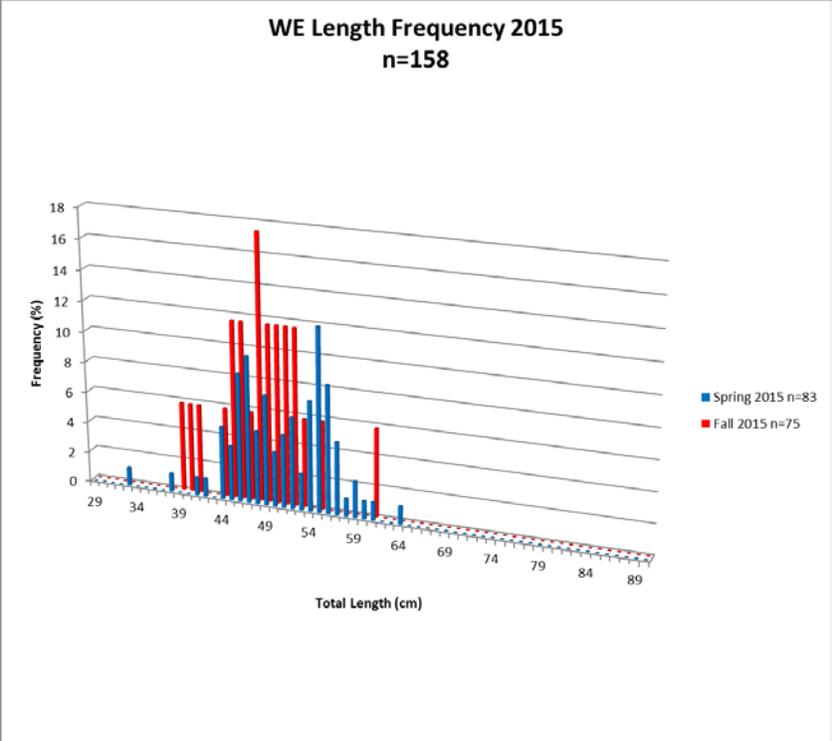


Figure 11. Length frequency histograms for walleye removed from the Colorado River from river mile 116 to the confluence of the Green River (RMI 0.0), UT 2013 through 2016.

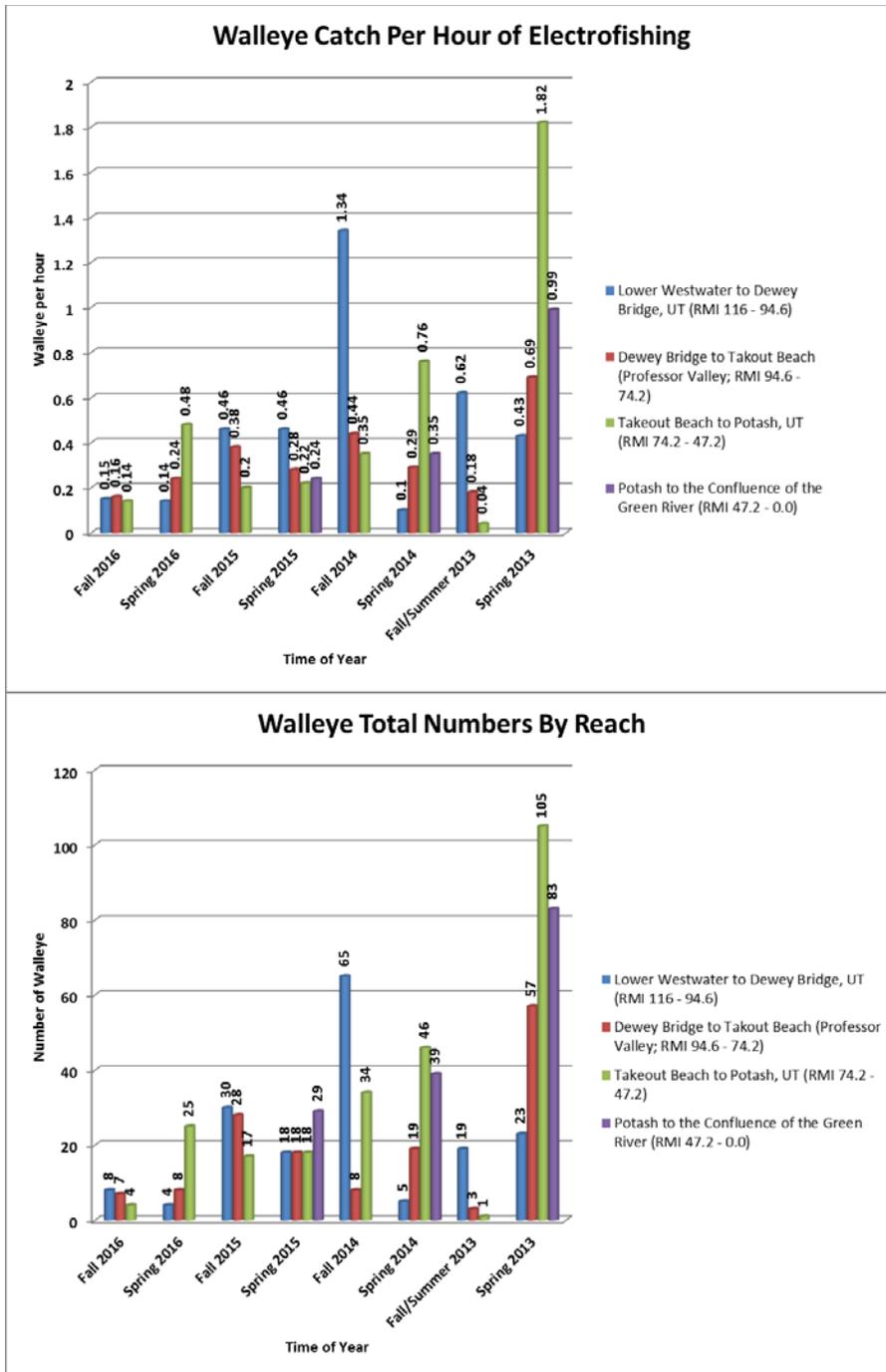
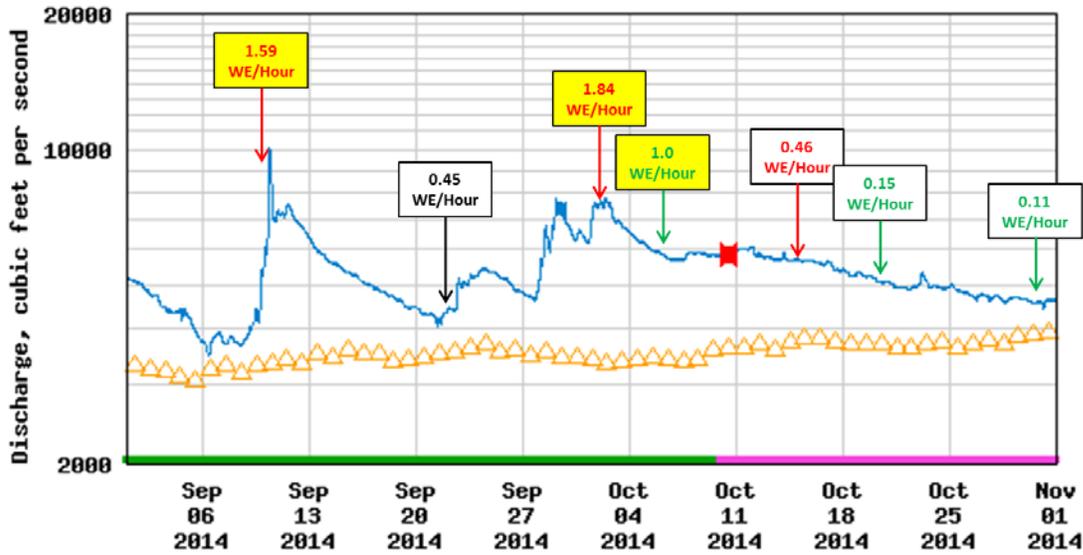


Figure 12. Walleye catch per effort and total numbers removed by season 2013-2016.



2014

USGS 09180500 COLORADO RIVER NEAR CISCO, UT



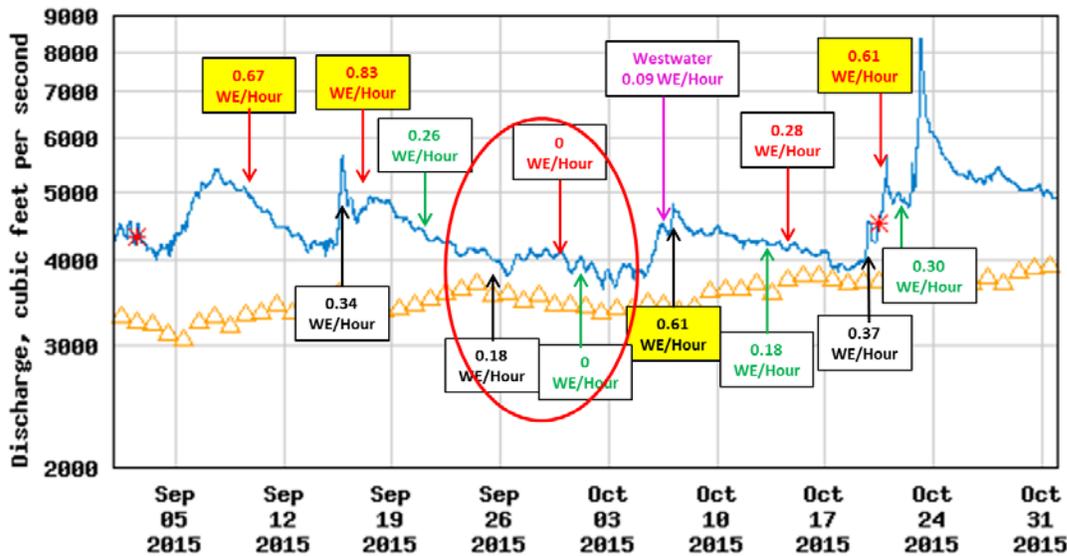
△ Median daily statistic (96 years) — Period of approved data
 — Discharge * Measured discharge
 — Period of approved data

Red Cisco to Dewey
 Black Dewey to Takeout
 Green Moab



2015

USGS 09180500 COLORADO RIVER NEAR CISCO, UT



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

△ Median daily statistic (96 years) * Measured discharge
 — Discharge

Red Cisco to Dewey
 Black Dewey to Takeout
 Green Moab

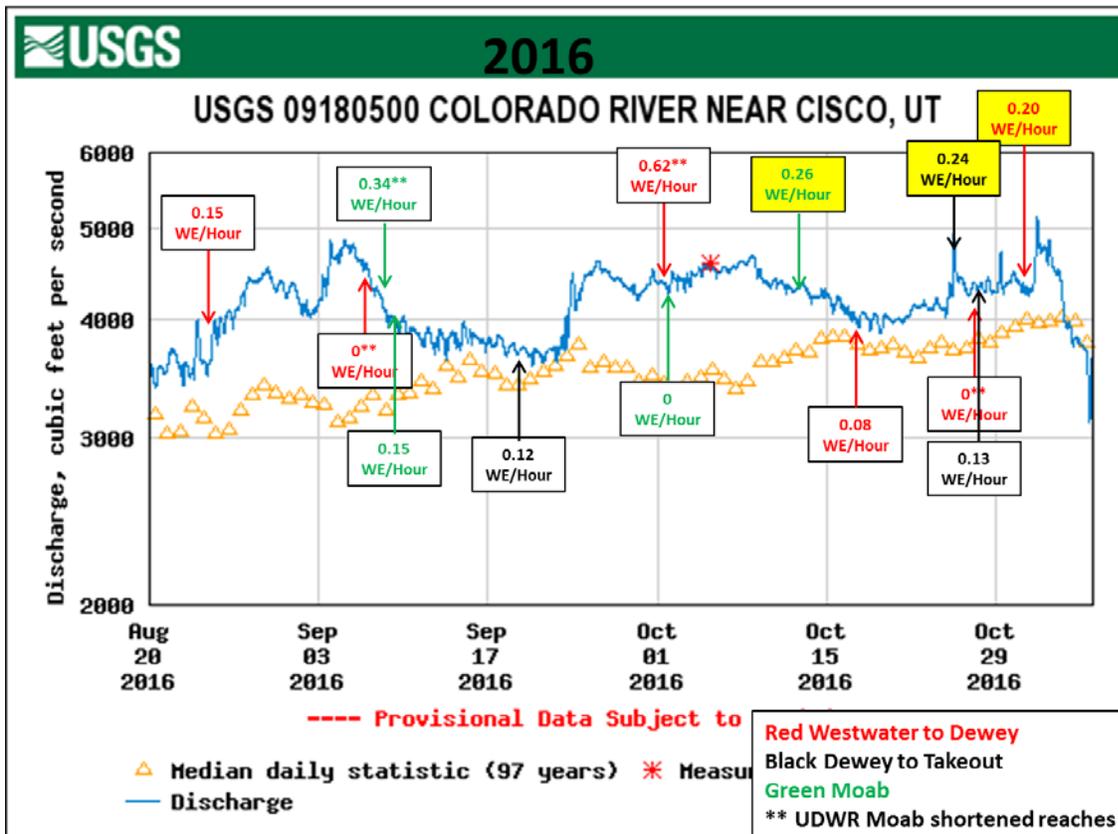


Figure 13. Fall walleye catch per effort plotted on USGS hydrograph data collected from their gauge on the Colorado River downstream of the Dolores River confluence near Dewey Bridge; 2014-2016.