COLORADO RIVER RECOVERY PROGRAM
FY 2016 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER:C-20

I. Project Title: **O&M of Highline Lake Fish Barrier Net**

II. Bureau of Reclamation Agreement Number(s): R12AP40001

Project/Grant Period: Start date (12/28/2011):
End date: (9/30/2016):
Reporting period end date: 11/3/16
Is this the final report? Yes ____ No __X-expected to be ongoing __

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IV. Abstract:

A spillway barrier net designed to control escapement of nonnative, warm water fishes from Highline Lake (Highline Lake State Park, Colorado) was installed in August 1999. The net is from Dyneema and is approximately 363 feet wide, 19 feet deep, and 1,400 pounds, with mesh openings no larger than a quarter inch. The net is designed to flex with the surge of the current and changing water depth to prevent fish from escaping over or under it. The net was replaced for the second time on March 14, 2014, and is currently in good shape and performing as designed.

V. Study Schedule:

Initial Year: 1999
Final Year: Ongoing

VI. Relationship to RIPRAP:

This study reports on the maintenance and periodic replacement of the Highline Lake spillway net, instances of reservoir outlet gate operations, and sampling of the outlet stream below the lake to determine net performance.

Colorado River Action Plan: Mainstem:
The Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin (USFWS 1996) included specific reference to the need to screen the spillway at Highline Lake to control escapement of nonnative, warm-water fish species. This requirement prescribed that "Public and private waters that have a direct connection to rivers in the Upper Colorado River Basin (e.g., Elkhead Reservoir, Highline Lake and many ponds) will be equipped or managed with an anti-escapement device or practice acceptable to the Service (USFWS) and the State fish and wildlife agency." In addition, the Procedures, section IV.6, stated "The Upper Colorado River Basin Endangered Fish Recovery Program will pursue funding for equipping public reservoirs with anti-escapement devices" (USFWS 1996).

Funding from the UCRP became available in 1998 for installation of a fish screen at Highline Lake and the net was installed on 18 August 1999. The net reached the end of its life span after seven years of continuous operation and was replaced for the first time in March, 2006. The net was replaced for the second time in March, 2014. The replacement net was received in 2011 but installation was delayed due to lake conditions, and a major dredging project that occurred in the fall of 2013. Outlet testing in 2013 resulted in uncontrolled releases due to a stuck outlet gate, which was temporarily resolved by the use of a mobile external outlet plug. CPW purchased penstock sock nets to be used to prevent fish escapement in future annual outlet testing. Net installation was completed in early 2014 prior to refilling the reservoir.

General Recovery Program Support Action Plan:

III. Reduce negative impacts of nonnative fishes and sport fish management activities.
III.A.2. Identify and implement viable control measures.
III.A.2.c. Implement and evaluate the effectiveness of viable active control measures.
III.B. Reduce negative impacts to endangered fish from sport fish management activities.
III.C. Ensure public involvement occurs as appropriate.
VI.C. Plan and implement information and education and public involvement activities for all significant Recovery Program actions (e.g. presentations, public meetings, public involvement training, etc.)

Colorado River Action Plan: Mainstem
III.B.1.a. Operate and maintain Highline Lake net.

VII. Accomplishment of FY 2016 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

A. FY 2016 Tasks and Deliverables

Task 1. Maintain Protective Buoy Line.
Schedule: March - October, 2016
Deliverable: **Task Completed**

Task 2. Net Cleaning and Repair Operations (in water).
Schedule: April - October, 2016
Deliverable: **Task Completed**

Task 3. Weekly Visual Survey.
Schedule: March - October, 2016
Deliverable: **Task Completed**

Task 4. Underwater Survey.
Schedule: April – October, 2016
Deliverable: **Task Completed**

Task 5. Fish sampling downstream of Highline Reservoir in outlet stream.
Schedule: Fall 2016
Deliverable: **Task Completed.** Annual report included.

B. Discussion of Initial Findings and Shortcomings: **N/A**

Study Area

The study area for this project is Highline Lake including the outlet downstream (Mack Wash) to the Colorado River.

Results and Discussion

Task 1. Maintain Protective Buoy Line: The buoy line was inspected on a weekly schedule with the Park's Patrol Boat during the summer season. No issues or problems were identified. The connecting cable, shackles, U bolts are in good working order.

Task 2. Net Cleaning and Repair Operations (in water): We performed 4 net cleanings in 2016: April 10, June 14, August 11, and October 13. The first cleaning this year took place a month earlier than last year since the net was beginning to show some algae growth. This growth can create additional weight and cause the net to sink down below the water surface level. This weight could render the net ineffective during the initial filling and surge of inlet water into the reservoir. The remaining cleanings took place about 2 months apart to stay on top of the algae growth. The net was cleaned manually all 4 times by divers from United Underwater Contractors. As the net ages, there will be a continual increase in algal buildup. We will continue with 4 net cleanings in 2017.

The highlights of the April 10 report were: 1) Cleaning was done on the net and it is showing spots of heavy algae growth and most of it cleaned off well. The net is still in good condition. 2) The net, thimbles, shackles, manta bolts and cable were completely inspected and all were in good condition. 3.) Suspenders installed two years ago are breaking and some repairs were made. 4) There were numerous hooks found on the net and they were removed.

The highlights of the June 14 report were: 1) The net, lead line, thimbles, shackles, manta

bolts and cable were completely inspected. All of the hardware is in good working condition. 2) All anchoring cables are attached to the 4 manta bolts and the safety wire is in place and holding the shackles secure. 3) The net continues to show spots of heavy algae growth but these areas are cleaning off well. 4) The ¼" poly line which is being used to spread apron was replaced with new ¼" poly line. 5) Many hooks continue to be found on the net and as many as possible were removed.

The highlights of the August 11 report were: 1) The net, lead line, thimbles, shackles, manta bolts and cable were completely inspected. All of the hardware is in good working condition. 2) All anchoring cables are attached to the 4 manta bolts and the safety wire is in place and holding the shackles secure. 3) The net continues to show spots of heavy algae growth but these areas are cleaning off well. 4) The ¼" poly line suspenders repaired on the last dive are holding up well and are keeping the net upright for a better water flow through the net. 5) There were very few hooks in the net for this cleaning.

The highlights of the October 13 report were: 1) The net had heavy algae growth and divers were able clean off thick loose layers of dying algae. 2) The lead line, thimbles, shackles, manta bolts and cable were inspected and in good condition. 3) All anchoring cables are attached to the 4 manta bolts and the safety wire is in place and holding the shackles secure. 4) There were not many hooks in the net.

Task 3. Weekly Visual Survey: The net top line and floats along with the skirt were visually checked on a weekly basis with the Park Patrol Boat. On weekends, the Patrol Boat would be deployed for several hours and when time permitted, we would examine the net from the water surface. Due to issues with the PVC wearing on the old net, the skirt was tied with ¼" poly line from the skirt to the safety line which kept the skirt stretched out. The ¼" poly line held up through the season and the park purchased additional poly line to replace next spring.

Task 4. Underwater Survey: The net was inspected during each net cleaning by United Underwater Contractors, the same divers that have been checking the net for the last several years. They prepared a report for each of their inspections which are available at the park or on request.

VIII. Additional Noteworthy Observations:

Gizzard shad were first discovered in Highline Lake during standard annual sampling in October, 2015, and continue to be very abundant. Possible sources include the Government Highline Canal, illegal introductions and/or illegal use of live fish as bait. No gizzard shad were collected in Mack Wash downstream of Highline Lake in 2015 or 2016, suggesting the net has been effective in preventing escapement from Highline Lake.

The ¼" poly line suspenders installed in 2014 were replaced, and should be replaced annually. Replacement ¼" poly line was purchased for 2017.

IX. Recommendations:

- Due to the hard buildup of algae beginning on the net, and with past experience, we will continue with 4 net cleanings in 2017. Cleanings will take place approximately the same time as in 2016 so we have a clean net when the inlet is opened up. Two cleanings will occur during the summer, followed by a final cleaning before inlet water is shut off.
- Park staff will continue to monitor the net and debris being washed into the reservoir in the spring, and will inform divers when the cleaning of the net will need to take place.

X. Project Status: This project is on-track and on-going.

XI. FY 2016 Budget Status:

A. Funds Provided: --
B. Funds Expended: No USBOR funds were expended in this fiscal year. $4,000 was expended by CPW for four net cleanings in FY 2016 (CPW covers annual O&M up to $10,000)
C. Difference: --
D. Percent of the FY 2016 work completed, and projected costs to complete: 100%; $4,000
E. Recovery Program funds spent for publication charges: $0.00

XII. Status of Data Submission (Where applicable): N/A

XIII. Signed: Alan C. Martinez 11/6/2016
Principal Investigator Date

APPENDIX: Mack Wash and Highline Lake Fish Sampling Report

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Background

Mack Wash originates from Highline Lake and flows approximately five miles downstream to the confluence with Salt Creek. Salt Creek flows slightly more than two miles before the confluence with the Colorado River. The 100-year floodplain of Salt Creek and the Colorado River at this confluence are considered critical habitat for federal and state listed fish species, as well as other native, non-listed fishes.

Fish can escape into Mack Wash from Highline Lake by moving over the spillway net and/or through the bottom release on the dam when no anti-escapement device is in place. Colorado Parks and Wildlife (CPW) biologists were concerned about fish escapement from Highline Lake into Mack Wash that may have occurred during canal surges and unintended lake bottom releases. Irrigation water is delivered to water users downstream of Highline Lake typically from the beginning of April through the end of October. Thus, fish surveys in both Mack Wash downstream of Highline Lake as well as Highline Lake downstream of the spillway net could not commence until water was no longer delivered downstream.

CPW biologists completed annual fish surveys at two sites in Mack Wash downstream of Highline Lake in the month of November from 2011-2016. Additionally, CPW biologists completed fish surveys within Highline Lake downstream of the spillway net and upstream of the spillway in March of 2012, March of 2013, and March of 2016. In March of 2014, the spillway net was replaced with a new net, and no sampling was completed in Highline Lake downstream of the spillway net and upstream of the spillway. Sampling for this same area was scheduled for the spring of 2015, but water delivery from Highline Lake downstream into Mack Wash began earlier than anticipated, preventing CPW crews from sampling.

This summary focuses on the data gathered in 2016; summaries of the 2011 through 2015 data for both Mack Wash and Highline Lake are available in the 2015 Annual Report for this Project C-20 Highline Lake screening O and M. A map of the Mack Wash fish survey sites follow, along with 2016 fish survey results from both Mack Wash and Highline Lake.

Mack Wash

CPW biologists bank electrofished two sites on Mack Wash downstream of Highline Lake on November 15, 2016 and November 16, 2016. Site #1 was located immediately downstream of the Highline Lake spillway and Site #2 was located on private property approximately three miles downstream of Site #1. The objectives of the fish surveys were to determine fish species composition and relative abundance downstream of the Highline Lake spillway net. Specifically, we were interested in identifying potential escapement of non-native fishes from Highline Lake downstream of the spillway net. Non-native, non-salmonid fishes collected were lethally removed.

Mack Wash Fish Survey Sites

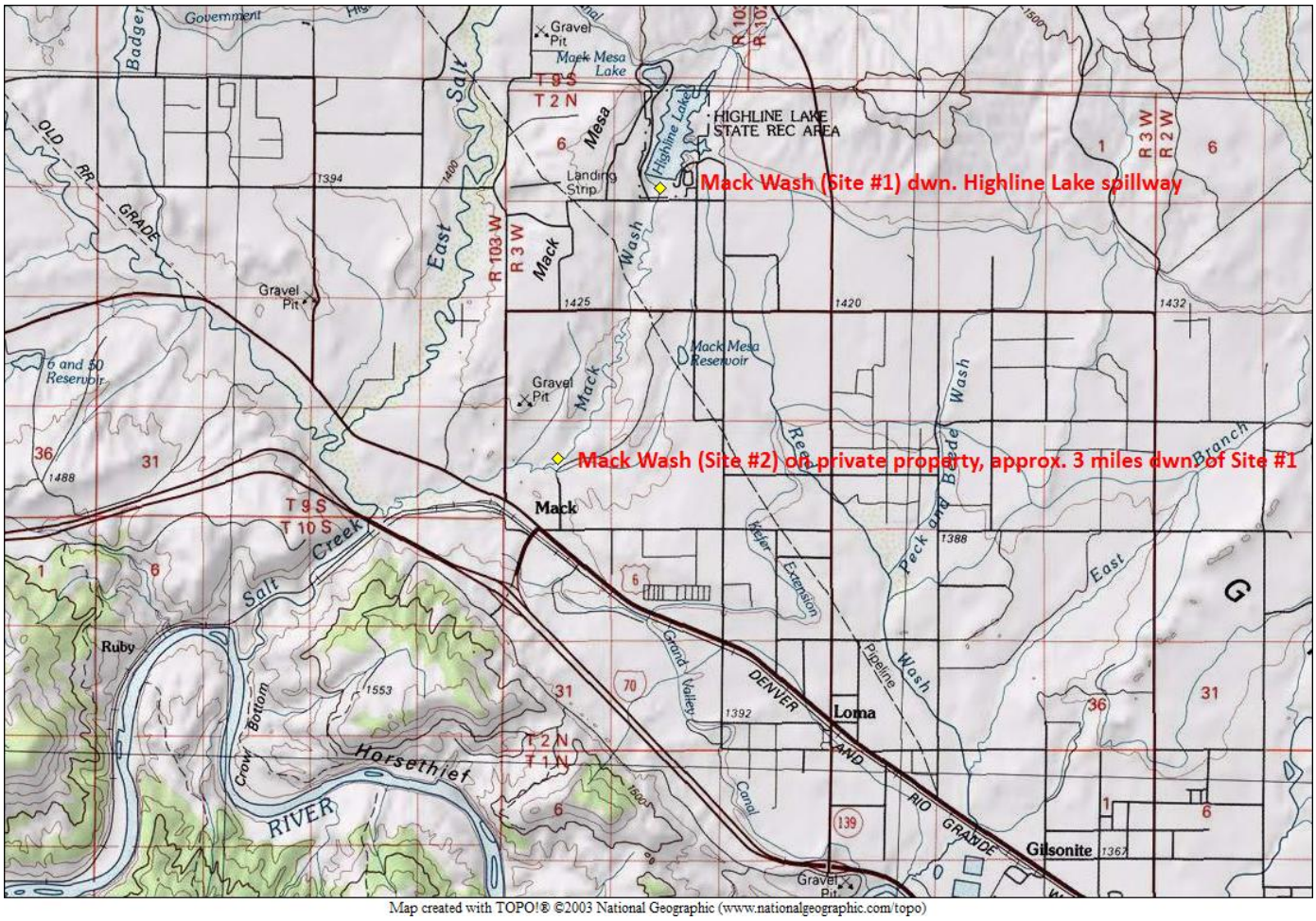


Figure 1. Map of sampling locations on Mack Wash which were surveyed in November of 2016 using a single pass with a bank electrofishing unit.

Mack Wash Fish Survey Results

Table 1. Total number of fish collected; total length size range in millimeters; catch per unit effort (# fish/hour) by species at Site #1 (immediately downstream of Highline Lake spillway; station length 0.12 mile) and Site #2 (Private property approximately 3 miles downstream of Site #1; station length 0.15 mile) in Mack Wash in 2016.

Fish Species Collected	Site #1	Site #2
Bluehead Sucker	0	29; 49-262; 39.2
Common Carp	5; 449-521; 7.0	0
Fathead Minnow	0	1; 5; 1.4
Flannelmouth Sucker	0	72; 48-112; 97.3
Green Sunfish	16; 72-170; 22.5	2; 105-122; 2.7
Largemouth Bass	9; 75-100; 12.7	0
Red Shiner	0	48; 21-85; 114.9
Speckled Dace	0	18; 34-65; 25.3
White Sucker / Hybrid	1; 185; 1.4	22; 32-125; 29.7
Yellow Perch	0	0
Total Number of Fish Collected	31	192

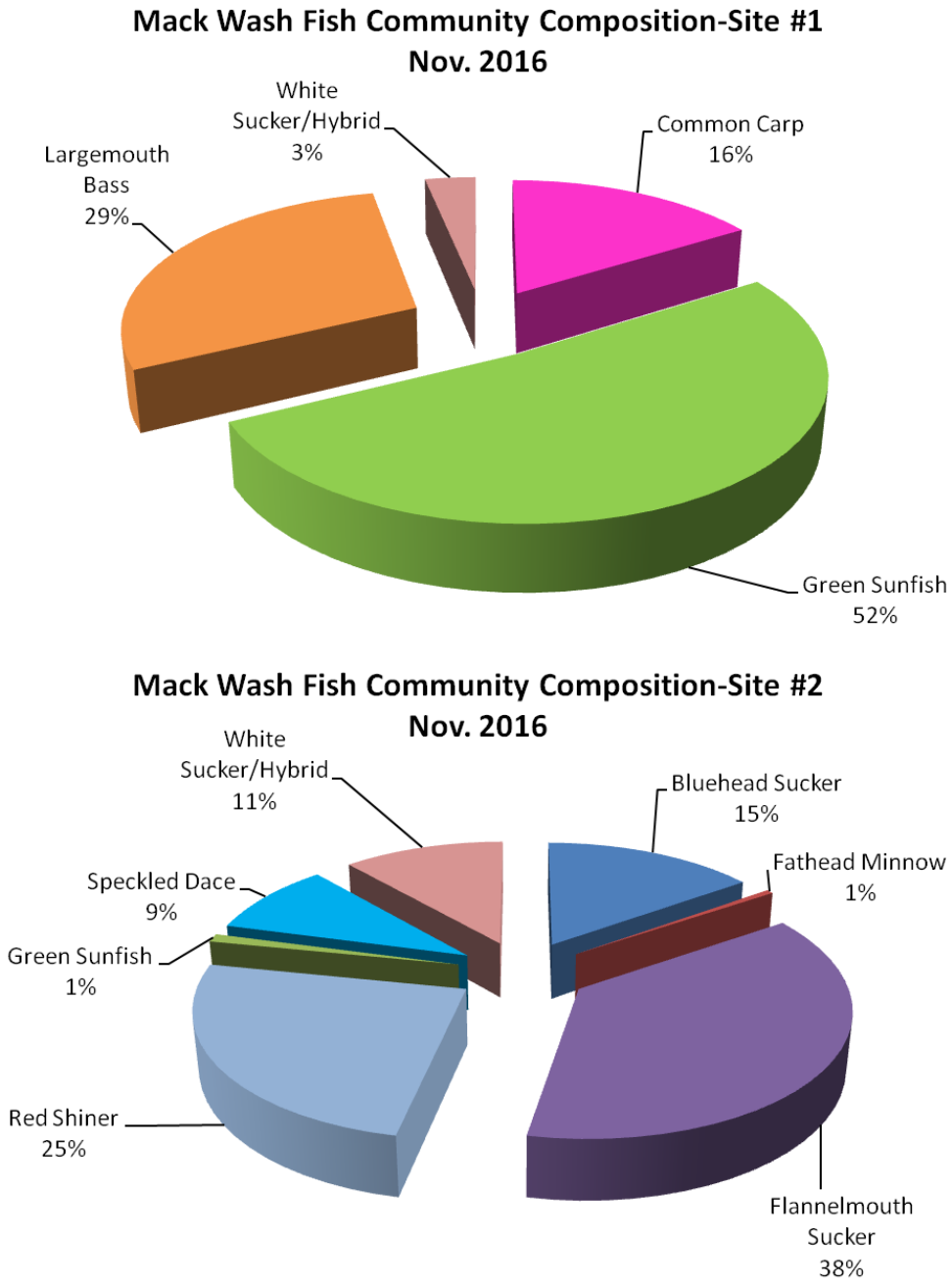
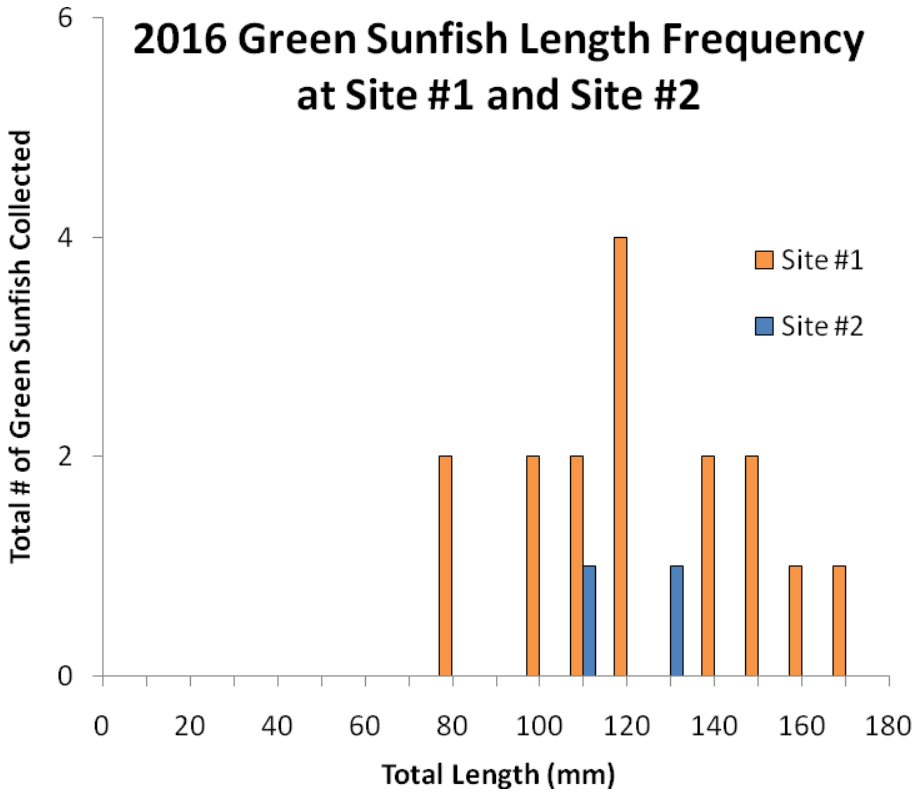


Figure 2. Species composition of fish surveyed in Mack Wash at Site #1 and Site #2 in November of 2016.


2016 Green Sunfish Length Frequency at Site #1 and Site #2
Total # of Green Sunfish Collected
Total Length (mm)
Site #1
Site #2
0
2
4
6
0
20
40
60
80
100
120
140
160
180

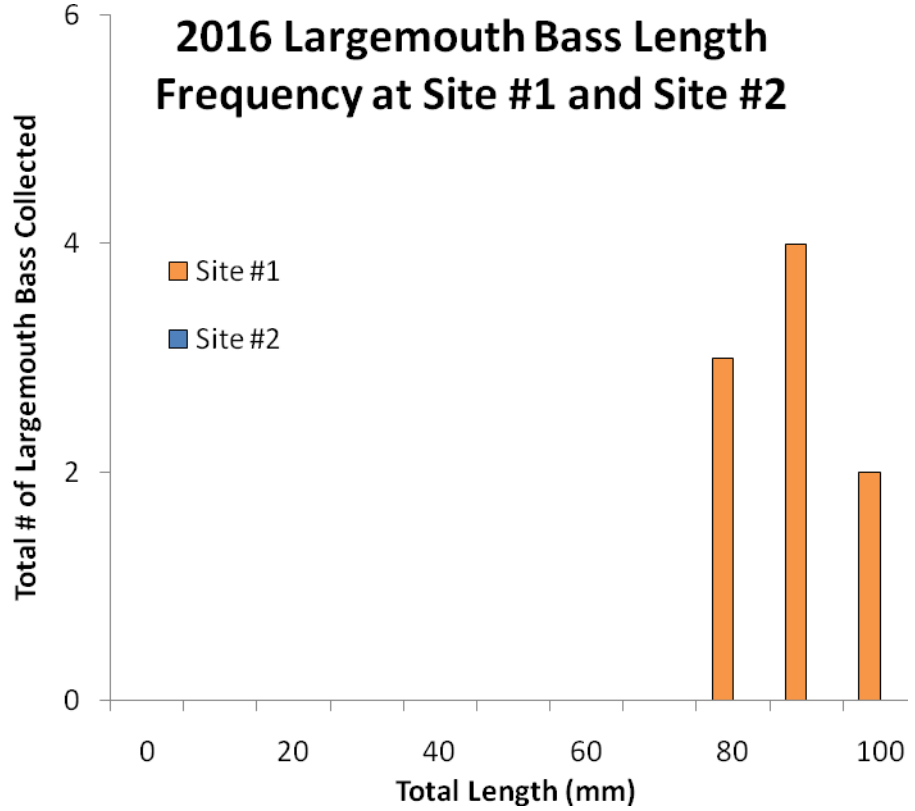

2016 Largemouth Bass Length Frequency at Site #1 and Site #2
Total # of Largemouth Bass Collected
Total Length (mm)
Site #1
Site #2
0
2
4
6
0
20
40
60
80
100

Figure 3. Length frequency histogram of green sunfish and largemouth bass surveyed in Mack Wash at Site #1 and Site #2 in November of 2016.

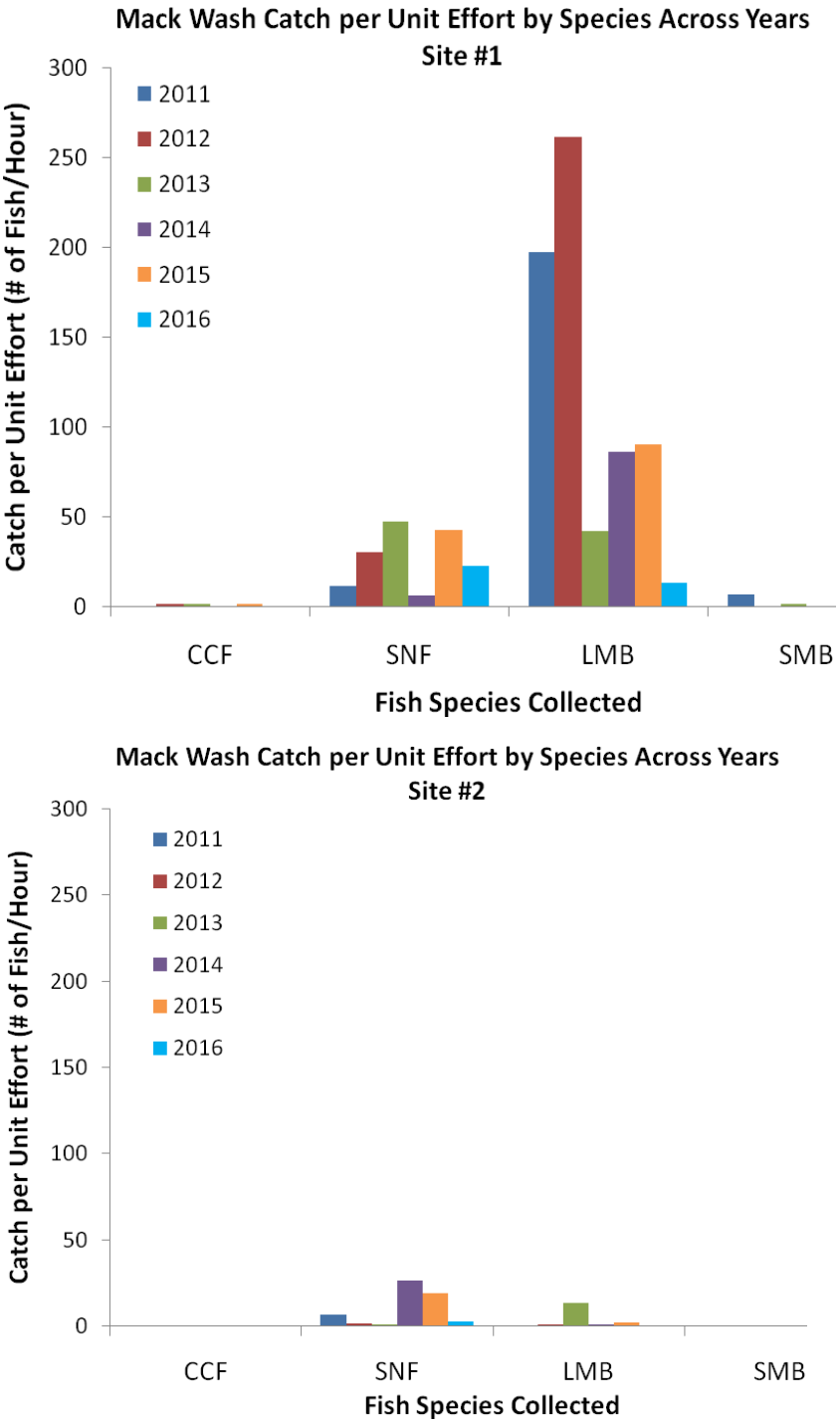


Figure 4. Historical (2011-2016) catch per unit effort of channel catifsh (CCF), green sunfish (SNF), largemouth bass (LMB), and smallmouth bass (SMB) in Mack Wash at Site #1 and Site #2.

Highline Lake

CPW biologists surveyed Highline Lake between the spillway net and the spillway using a combination of boat-electrofishing and experimental gill nets in the spring of 2016. The objective of the fish survey was to determine fish species composition and relative abundance within the lake downstream of the spillway net. Surveying was completed prior to water being delivered downstream to water users. Fish collected were released back into Highline Lake upstream of the spillway net with the exception of smallmouth bass which were lethally removed.

Highline Lake Fish Survey Results

Table 2. Summary of sample (species composition, number of fish collected, length range, and catch per unit effort) of fish gathered between the spillway net and the spillway in Highline Lake in March of 2012, 2013, and 2016.

Collection Method	Fish Species Collected	Total # Fish Collected	Total Length Size Range in Millimeters	Catch per Unit Effort (# fish/hour)
		2012 (300 fish collected)		
Electrofishing	Bluegill	47	57-188	74.6
	Common Carp	1	483	1.6
	Green Sunfish	223	42-157	354.0
	Largemouth Bass	24	56-296	38.1
	Red Shiner	3	58-71	4.8
	Smallmouth Bass	1	77	1.6
Gill Nets	Rainbow Trout	1	284	0.02
		2013 (163 Fish Collected)		
Electrofishing	Bluegill	23	47-170	30.7
	Common Carp	1	502	1.3
	Green Sunfish	126	40-190	168.0
	Largemouth Bass	13	67-123	17.3
		2016 (205 Fish Collected)		
Electrofishing	Black Crappie	1	119-119	1.2
	Bluegill	55	63-144	66
	Common Carp	5	443-510	6
	Largemouth Bass	34	57-281	40.8
	Rainbow Trout	1	259-259	1.2
	Smallmouth Bass	1	127-127	1.2
	Green Sunfish	108	53-166	129.6

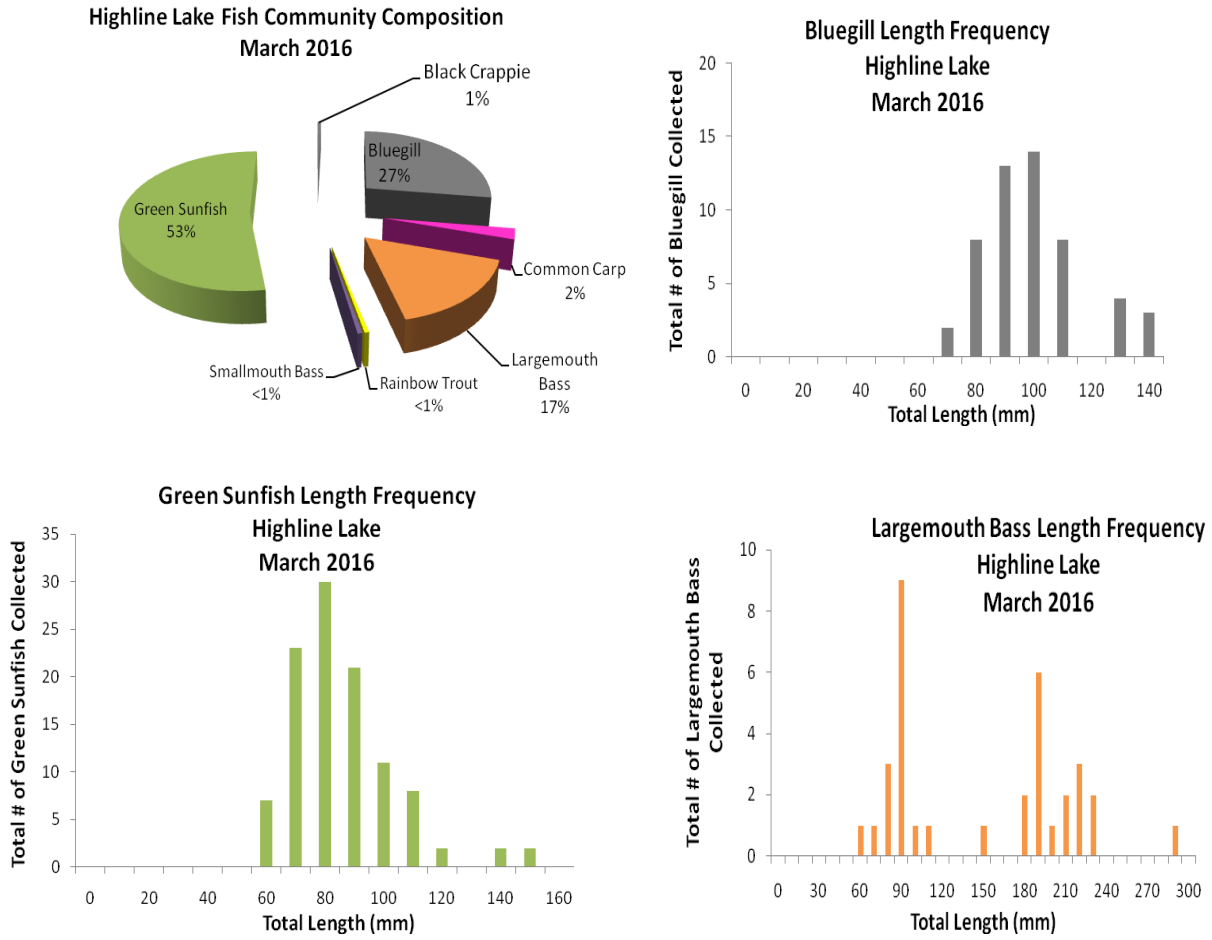


Figure 5. Species composition and length frequency histograms of bluegill, green sunfish, and largemouth bass surveyed in Highline Lake between the spillway net and spillway in 2016.

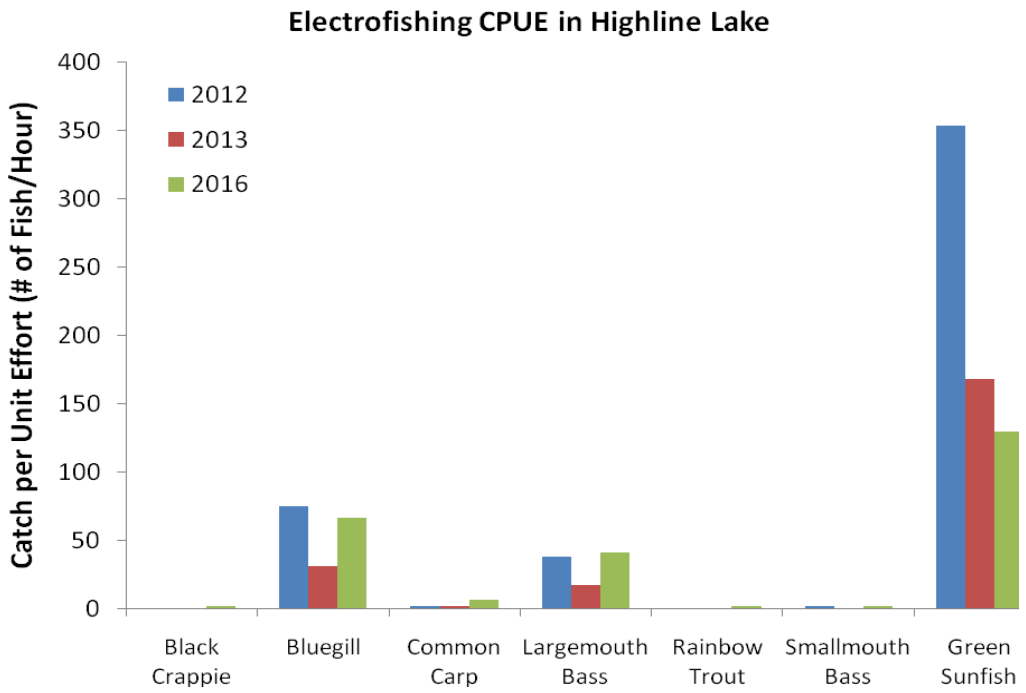


Figure 6. Historical electrofishing catch per unit effort (in number of fish captured per hour) of black crappie, bluegill, common carp, largemouth bass, rainbow trout, smallmouth bass, and green sunfish in Highline Lake between the spillway net and the spillway.

Conclusions and Discussion

The spillway net at Highline Lake was compromised during canal surges across 2011, 2012 and 2013, and during an extended bottom release in 2013 in preparation for lake dredging across 2013-2014. The spillway net was replaced in March of 2014 after dredging of the lake was completed. These events along with annual degradation of the spillway net likely influenced the results of CPW fish surveys within Highline Lake and Mack Wash, downstream of the spillway net. Catch rates for green sunfish and largemouth bass in Mack Wash were very low in 2016 relative to previous years' sampling events. This suggests that the spillway net is effectively reducing the number of non-native fish escaping from Highline Lake into Mack Wash relative to other years when bottom releases had recently occurred or when the net had recently been compromised. This improved function of the net is further supported by the fact that an established population of gizzard shad which were first found in Highline Lake in 2015 have not been documented between the spillway net and the spillway or in Mack Wash. A more detailed analysis of the 2011-2015 data can be found in the 2015 report.
CPW staff have taken several actions to reduce the chance of fish esacaping from Highline Lake. These actions include:

1) continuing coordination and communication efforts with operators of the Government Highline canal system to ensure operation of the spillway net is not hindered as a result of water delivery practices;

2) cleaning the spillway net more frequently and with a shorter time frame between cleanings to reduce strain and wear and tear of the net. The exisiting spillway net was replaced in March of 2014 after dredging activities within Highline Lake were completed;

3) re-adjustment of the poly-line from the skirt to safety cable appears to be holding the spillway net in better position, and keeping the skirt from washing over the net

4) operating the outlet structure/bottom release only when dissolved oxygen concentrations are minimal, and fish are less likley to be present in the water column near the outlet structure

5) design and installation of a fish capture net on the downstream side of the outlet structure/bottom release to capture fish that have escaped from Highline Lake during operation of the outlet structure/bottom release

CPW biologists will continue to complete annual fish surveys in Highline Lake between the spillway net and spillway in the spring prior to irrigation season, as well as at the two sites in Mack Wash downstream of the Highline Lake spillway net in the fall, post-irrigation season.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R12AP40001

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: C-20

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Project/Grant Period: Start date (12/28/2011):
End date: (9/30/2016):
Reporting period end date: 11/3/2016
Is this the final report? Yes ___ ___ No __X-expected to be ongoing __

Performance: All tasks were accomplished and tailrace fish sampling results are included in this report. The outlet gates were not operated in 2016.