

I. Project Title: **Highline Lake screening O&M**

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: 11/11/13  
Is this the final report? Yes \_\_\_\_\_ No X

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IV. Abstract:  
In August 1999, a spillway barrier net designed to control escapement of nonnative, warmwater fishes that might enter the Colorado River from Highline Reservoir (Highline Lake State Park, Colorado) was installed. Research has shown that nonnative fishes eat young, native fish and compete for food and habitat in the river. In addition to keeping the nonnative and native fishes apart, installation of the fish barrier net brings the reservoir into compliance with the nonnative fish stocking requirements established by the states of Colorado, Utah, and Wyoming, and the U.S. Fish and Wildlife Service.

The fish barrier net is made of Dynema, a high molecular weight polyethylene material, which is extremely strong and durable. The net is approximately 363 feet wide and 19 feet deep, weighs 1,400 pounds, and has mesh openings no larger than a quarter inch. The net stretches across an area of the reservoir that empties into a concrete spillway that flows into Mack Wash and Salt Creek before reaching the Colorado River. 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.

On March 21, 2006 the original spillway barrier net was removed and on March 22, 2006 a replacement spillway net was installed. In April 2011 we received a second replacement net but were unable to install because the lake was surging with water. As a result, we planned on a fall installation. However, we are now waiting to install in the spring of 2014 to time installation after a major dredging operation. By waiting until after the dredging, we will not impact the new net.

V. Study Schedule: 1999 – 2016 (end of current reporting period; study expected to continue beyond 2016)

VI. Relationship to RIPRAP: Colorado River Action Plan: Mainstem

The initial Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin (USFWS 1996), under which this project was initiated, included specific reference to the need to screen the spillway at Highline Reservoir to control escapement of nonnative, warmwater species (see Appendix A). 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 Reservoir 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, state that "The [Upper Colorado River Basin Endangered Fish Recovery Program ('UCRP')] 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.

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.

VI C. Ensure public involvement occurs as appropriate.

Colorado River Action Plan: Main stem

III.B.1.a. Operate and maintain Highline Reservoir net.

VII. Accomplishment of FY 2013 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

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 continue to do 3 cleanings of the net each year because it successfully lightens the load on the net. Cleaning of the net took place April 14, 2013, May 31, 2013 and August 20, 2013. The first cleaning this year took place a week later than it should have. The surge of water this spring started to partially submerge the net under water and the divers were immediately notified to come clean the net which they did. The second and third cleanings were moved earlier than

years past to keep from getting the heavy buildup. The divers were prepared for a fourth cleaning but due to the fact we will be drawing the lake level down and changing out the net the decision was made not to do a fourth cleaning. The net was cleaned manually all 3 times by divers from United Underwater Contractors.

Task 3. Weekly visual survey—The net top line and floats along with the skirt and the PVC pipe sections that we use to deploy the skirts were visually checked on a weekly basis with the Park Patrol Boat – on weekends the Patrol Boat would be on-the-water for several hours and when time permitted we would examine the net from the water surface. Due to issues with the skirt washing over the top of the net where spreaders come up missing we had the divers tie ¼” poly line from the skirt to the safety line which kept the skirt stretched out the entire summer.

Task 4. Underwater Survey—the net was inspected 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. The reports are available at the park.

The highlights of the report submitted on April 14, 2013 were: 1) Cleaning was scheduled because the net was partially submerged by the high flow of water and large amount of debris being washed into the lake. The net was thick with moss and algae growth. In addition, mineral growth is becoming nearly impossible to remove. 2) All hardware was inspected. Anchoring cables are attached to the 4 manta bolts and the safety wire is in place and holding the shackles secure. 3) The net, thimbles, shackles, manta bolts and cable were completely inspected and all were in good condition. Due to heavy mineral buildup, the decision was made to move second cleaning up to end of May and polly line will be tied from skirt to the safety line.

The highlights of the report submitted on May 31, 2013 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) All of the spreader bars are in place. The earlier cleaning seemed to keep a lot less strain and wear and tear off the net. The safety cable installed last year is in great condition. The ¼” poly line was connected from the skirt to the safety cable in 5 locations.

The highlights of the report submitted on August 20, 2013 were: 1) The net was successfully cleaned because the shorter time frame from the second to 3<sup>rd</sup> cleaning. The ¼” poly line is intact and appeared to be holding the skirt forward like it should be. This system with the line attached to the safety cable appears to be holding the net in better position and should be considered when installing the new net. 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.

#### VIII. Additional noteworthy observations:

On August 26, 2013 dissolved oxygen numbers were taken to see if it was possible to exercise the outlet structure without sending fish downstream. The numbers were well within the appropriate levels to exercise the outlet gate. On August 27, 2013 a Colorado Parks and Wildlife engineer opened the outlet gate to test it. There were issues encountered and he was unable to close the outlet gate. There was a large effort made with contractors, divers and numerous engineers to close the gate; and the outlet gate was finally closed on September 5, 2013. Dissolved oxygen counts were taken daily. On August 31, 2013 we found that the oxygen stratification had diminished enough that fish were no longer excluded from greater depths by low oxygen levels; there was therefore a risk of escapement through the gate. By the time the head gate was closed, the lake level dropped nearly 7 feet. During the episode, we were able to remove a large number of catfish from Mack Wash but it is unknown how many made it downstream.

In anticipation of the dredging, CPW had commissioned construction of a capture net, which the park was able to install on the culvert below the outlet structure after the head gate was closed. The park was able to test it 3 times to make sure we wouldn't lose additional fish once we opened the outlet structure to begin lowering the lake level in November. On November 3, 2013 the park opened up the outlet structure to begin lowering the lake for the dredging operation and we have found that capture net is working perfectly and don't believe there is any fish escapement going on from this operation. In future years we intend to install the capture net prior to annual routine exercising of the outlet structure.

As in previous years, CPW surveyed Mack Wash in mid-November, after the end of the irrigation season when flows become suitable for in-stream sampling. Because of heightened interest in the Mack Wash survey due to the uncontrolled release from Highline described above, a report on that sampling is provided below in Appendix A. Results from 2011 and 2012 sampling of Mack Wash are also provided for comparison. Additionally, Highline Reservoir was sampled in 2012 and 2013, and a summary report on that sampling is also included in Appendix A.

#### IX. Recommendations:

The net is going to be replaced as soon as the dredging work is completed at Highline Lake. United Underwater Contractors looked at the net with the lake drained 20' at the end of November and decided to replace it in March before the canal is turned on and Highline Lake is filled. In addition to replacing the current net the remains of the first net will be removed as well. With the success of the 1/4" poly line keeping the skirt from washing over the top of the net we will have this system set up with the new net

installation. Due to the large amount of algae and moss that have been accumulating on the net we will monitor the net to see if 4 cleanings are necessary. The first year after installation should not require 4 cleanings but park staff will monitor the net and debris being washed into the lake 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 2013 Budget Status
  - A. Funds Provided: \$0.00
  - B. Funds Expended: \$3,000 expended by CPW on three cleanings (CPW covers annual O&M up to \$10,000)
  - C. Difference:
  - D. Percent of the FY 2013 work completed, and projected costs to complete: 100%
  - E. Recovery Program funds spent for publication charges: \$0.00
- XII. Status of Data Submission (Where applicable): N/A
- XIII. Signed: Alan C. Martinez 11/14/2013  
Principal Investigator Date

**Literature Cited:**

USFWS. 2009. Procedures for stocking nonnative fish species in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Denver, Colorado. 15 pp.

## **APPENDIX A: Sampling of Mack Wash 2011-2013 and Highline Reservoir 2012-2013**

### 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 four, federal and state listed fish species, as well as other native, non-listed fishes.

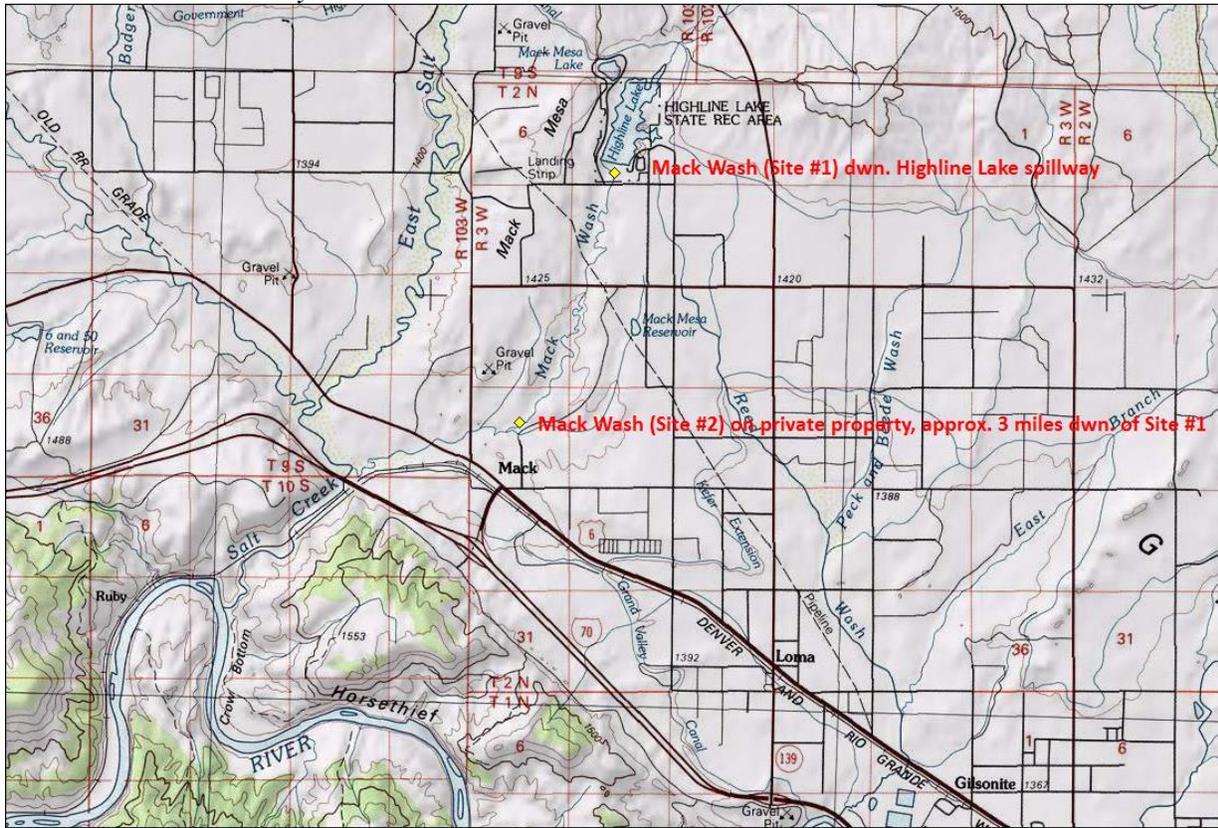
Fish can escape into Mack Wash from Highline Lake by moving over the spillway net and/or through the bottom release on the dam when no anti-escapement device is in place. Colorado Parks and Wildlife (CPW) biologists were concerned about fish escapement from Highline Lake into Mack Wash that may have 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, creating conditions not suitable for fish sampling. 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 fish surveys at two sites in Mack Wash downstream of Highline Lake in November of 2011, November of 2012, and November of 2013. Additionally, CPW biologists also completed fish surveys within Highline Lake downstream of the spillway net and upstream of the spillway in March of 2012 and March of 2013. A map of the Mack Wash fish survey sites follow, along with 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. 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. All non-native, non-salmonid fishes collected were lethally removed.

*Mack Wash Fish Survey Sites*



Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

Mack Wash Fish Survey Results

**Site #1-Just downstream of Highline Lake spillway**

Total length of site surveyed in November 2011 = 0.11 mile

Total length of site surveyed in November 2012 = 0.14 mile

Total length of site surveyed in November 2013 = 0.14 mile

**Total # of Fish Collected; Total Length Size Range in Millimeters; Catch per Unit Effort (# fish/hour)  
by Species and Year for Site #1  
2011-2013**

<b>Fish Species</b>	<b><u>2011</u></b>	<b><u>2012</u></b>	<b><u>2013</u></b>
<b><u>Collected</u></b>			
Black Bullhead	1; 157; 1.6	0	1; 210; 1.3
Black Crappie	0	0	1; 69; 1.3
Channel Catfish	0	1; 522; 1.0	1; 293; 1.3
Common Carp	1; 193; 1.6	6; 466-625; 6.0	0
Green Sunfish	7; 84-192; 10.9	30; 74-195; 30.0	36; 37-179; 47.1
Largemouth Bass	126; 68-253; 196.9	261; 56-342; 261.0	32; 72-144; 41.8
Rainbow Trout	5; 305-358; 7.8	1; 309; 1.0	0
Smallmouth Bass	4; 107-207; 6.3	0	1; 92; 1.3
White Sucker/Hybrid	18; 202-380; 28.1	22; 173-268; 22.0	1; 369; 1.3
<b><u>Total Number of Fish Collected</u></b>	<b>162</b>	<b>321</b>	<b>73</b>

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**Site #2-Private property approximately 3 miles downstream of Site #1**

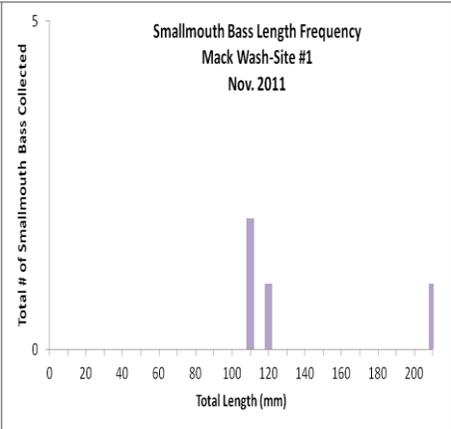
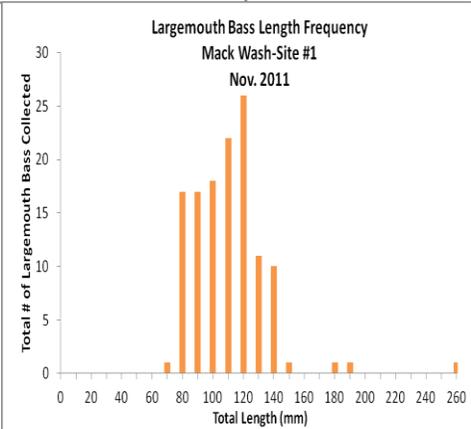
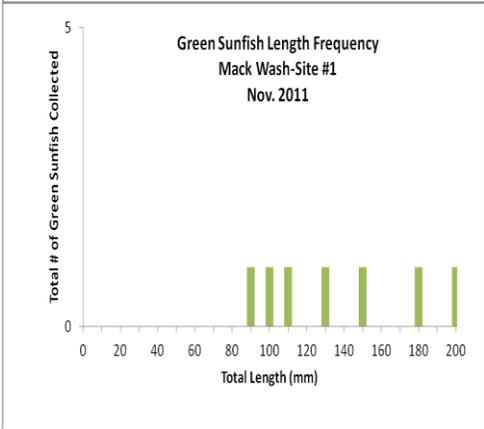
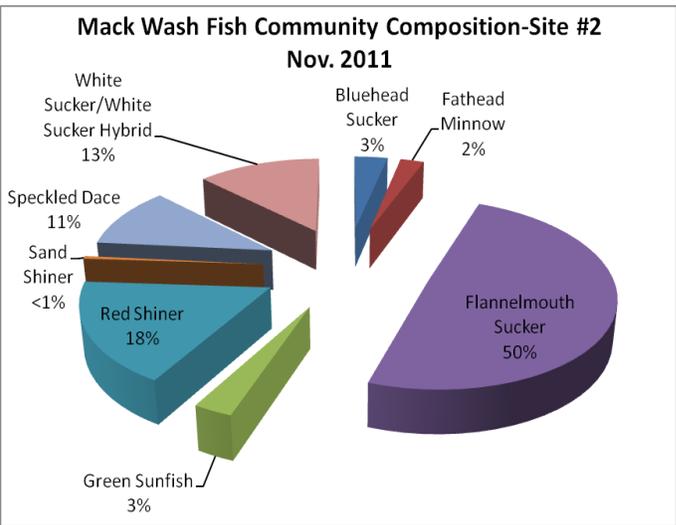
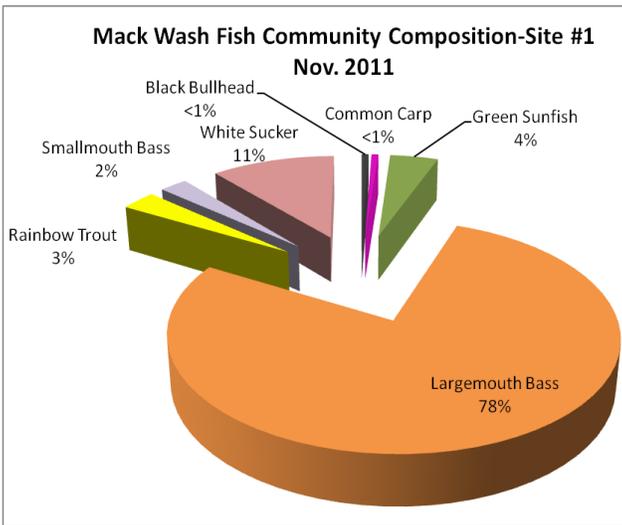
Total length of site surveyed = 0.16 mile

Total length of site surveyed = 0.18 mile

Total length of site surveyed = 0.19 mile

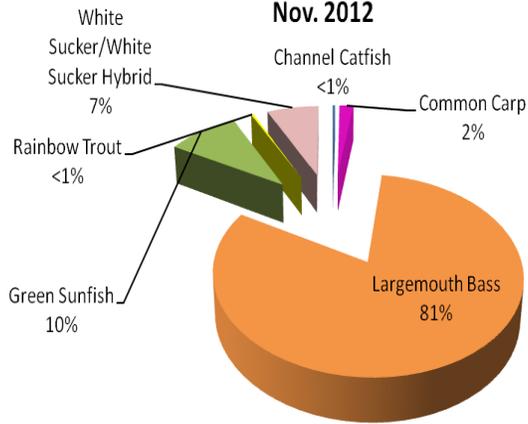
**Total # of Fish Collected; Total Length Size Range in Millimeters; Catch per Unit Effort (# fish/hour)  
by Species and Year for Site #2  
2011-2013**

<b>Fish Species</b>	<b><u>2011</u></b>	<b><u>2012</u></b>	<b><u>2013</u></b>
<b><u>Collected</u></b>			
Bluehead Sucker	7; 63-95; 7.9	30; 56-216; 24.0	23; 72-195; 19.3
Fathead Minnow	5; 53-70; 5.7	15; 47-90; 12.0	6; 47-83; 5.0
Flannelmouth Sucker	101; 62-198; 114.8	104; 52-505; 83.2	45; 78-195; 37.8
Green Sunfish	6; 54-128; 6.8	2; 95-135; 1.6	1; 83; 0.8
Largemouth Bass	0	1; 129; 0.8	16; 67-176; 13.4
Red Shiner	36; 28-89; 40.9	84; 29-89; 67.2	453; 24-86; 380.7
Roundtail Chub	0	1; 84; 0.8	1; 74; 0.8
Sand Shiner	1; 44; 1.1	0	0
Speckled Dace	22; 58-88; 25.0	23; 53-99; 18.4	46; 44-91; 38.7
White Sucker/Hybrid	26; 59-259; 29.5	24; 42-230; 19.2	19; 67-214; 16.0
<b><u>Total Number of Fish Collected</u></b>	<b>204</b>	<b>284</b>	<b>610</b>



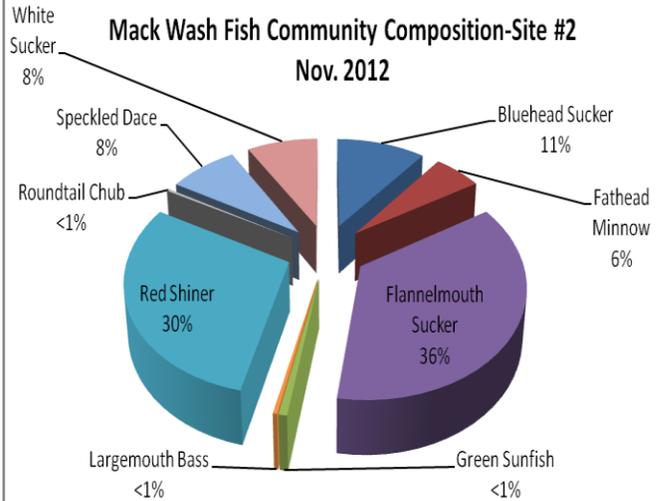
**Mack Wash Fish Community Composition-Site #1**

**Nov. 2012**

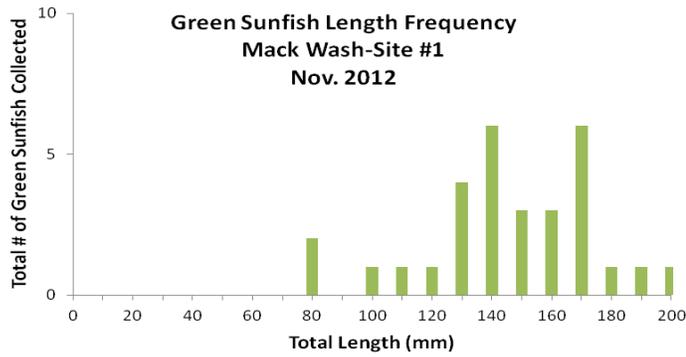


**Mack Wash Fish Community Composition-Site #2**

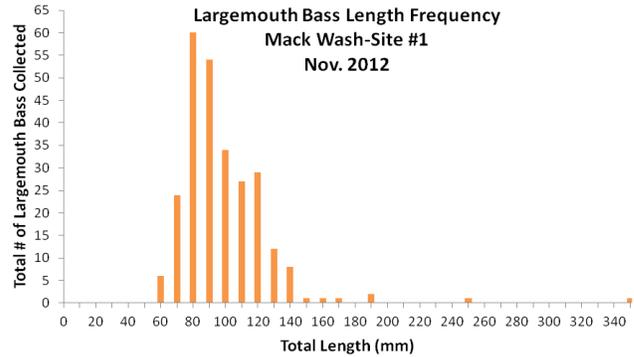
**Nov. 2012**



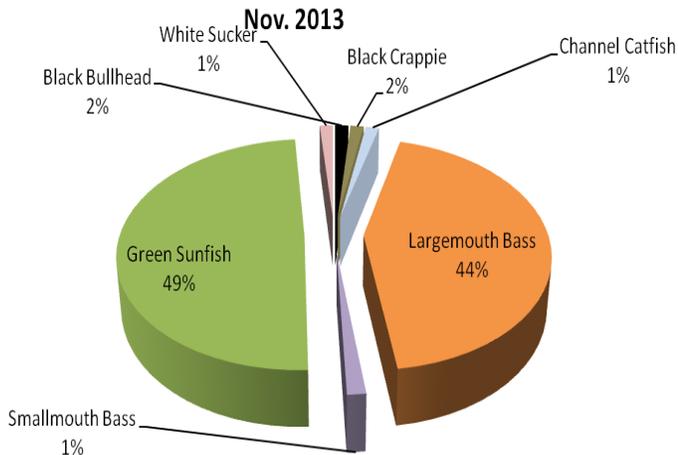
**Green Sunfish Length Frequency  
Mack Wash-Site #1  
Nov. 2012**



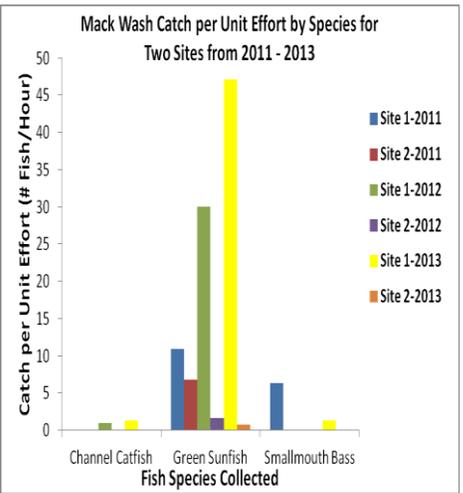
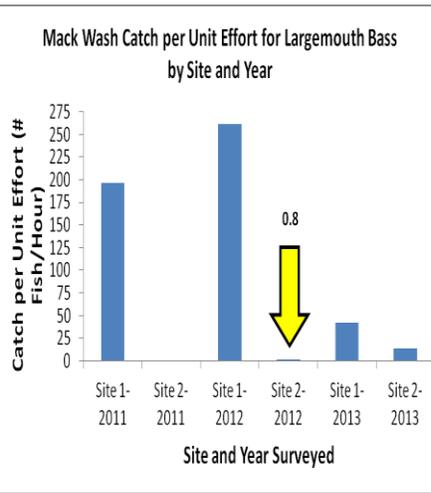
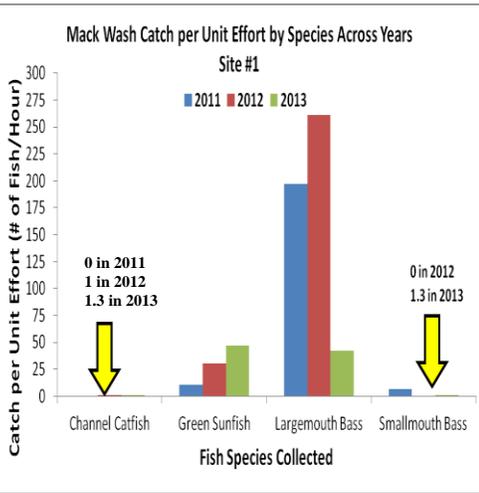
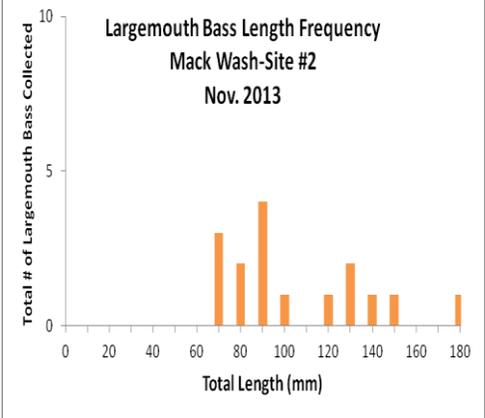
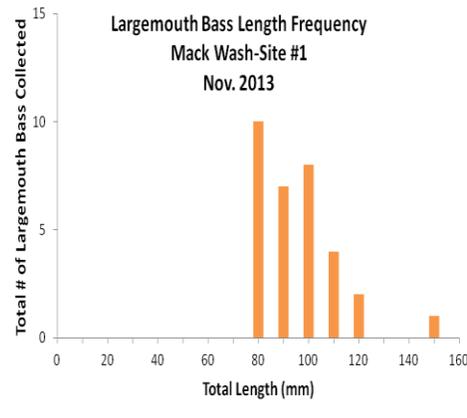
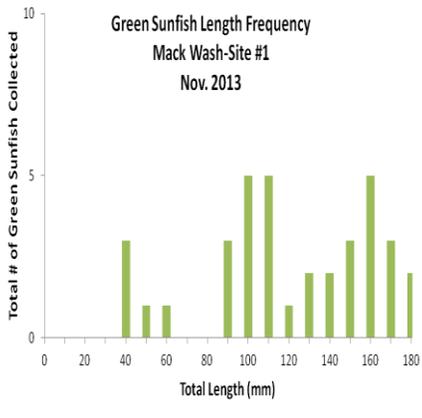
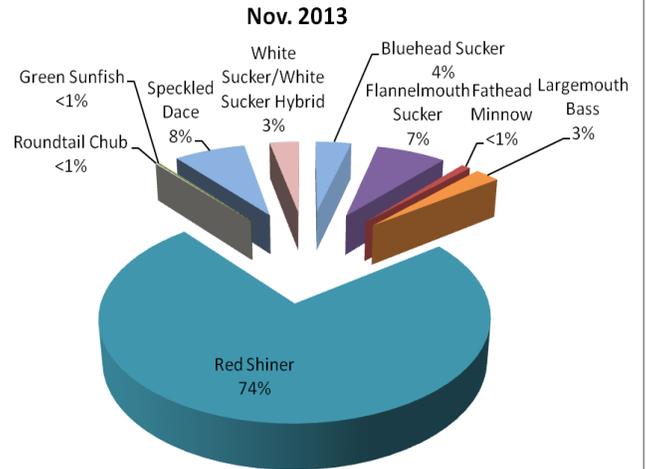
**Largemouth Bass Length Frequency  
Mack Wash-Site #1  
Nov. 2012**



### Mack Wash Fish Community Composition-Site #1



### Mack Wash Fish Community Composition-Site #2



## Highline Lake

CPW biologists boat-electrofished Highline Lake on the evenings of March 20, 2012 and March 25, 2013 between the spillway net and the spillway. In addition, three experimental gill nets were also set the evening of March 20, 2012 in the same area and pulled the following morning. The objectives of the fish surveys were 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 one smallmouth bass which was lethally removed.

### *Highline Lake Fish Survey Results*

#### **2012**

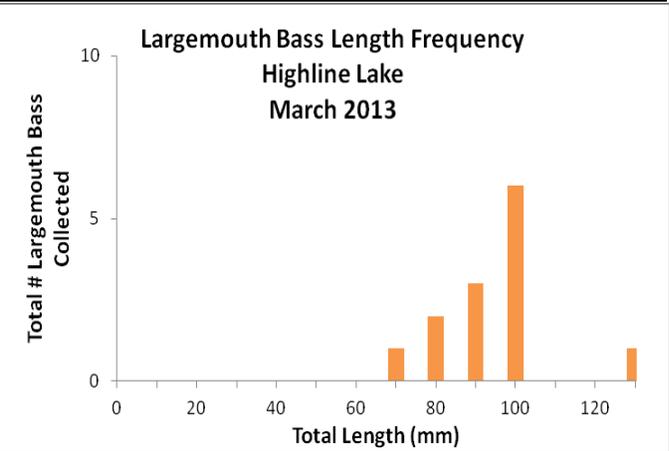
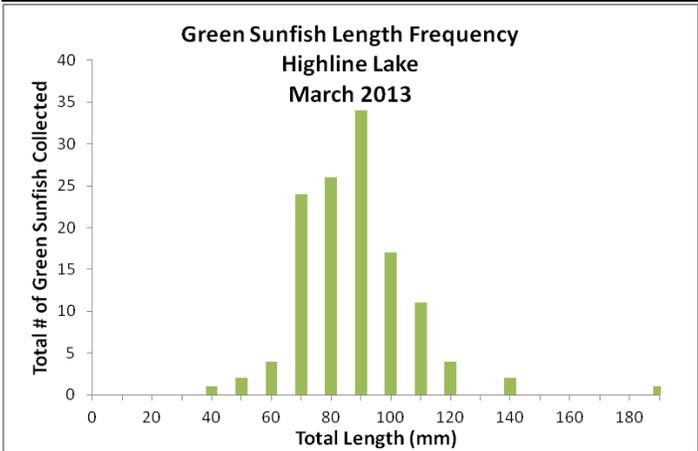
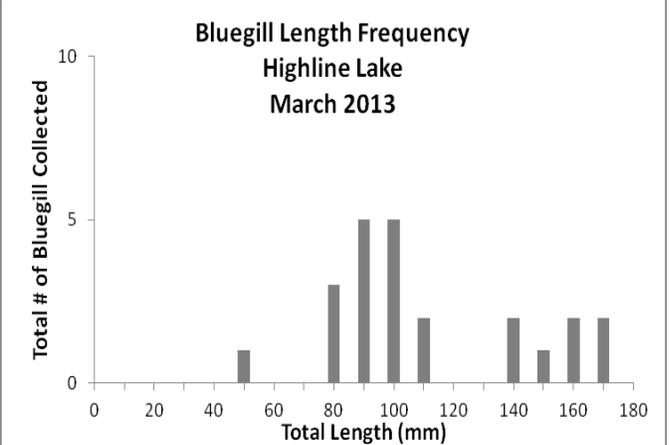
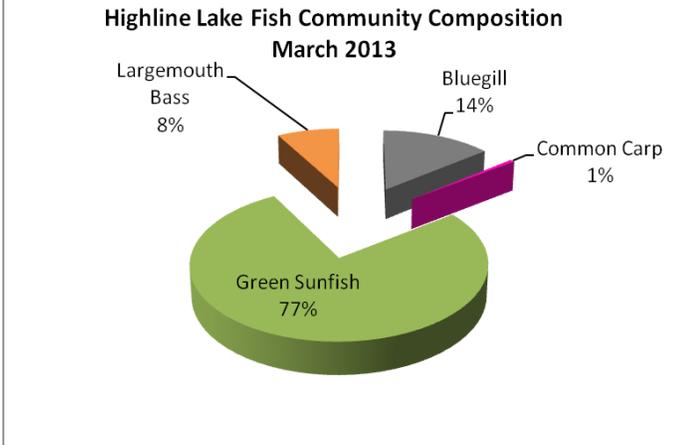
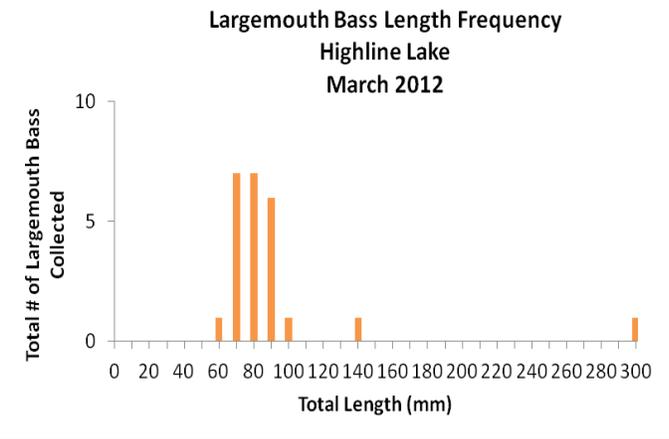
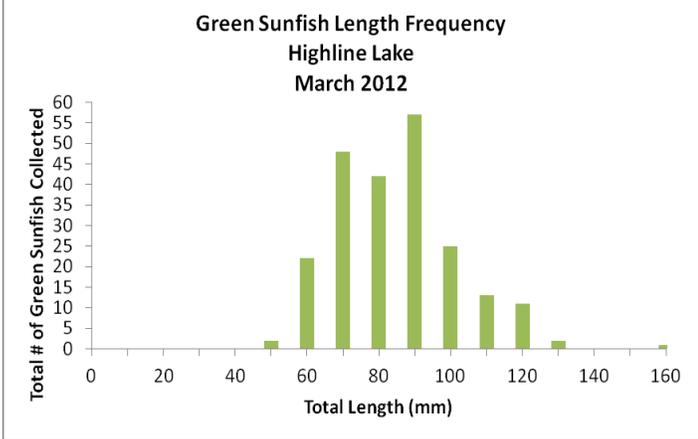
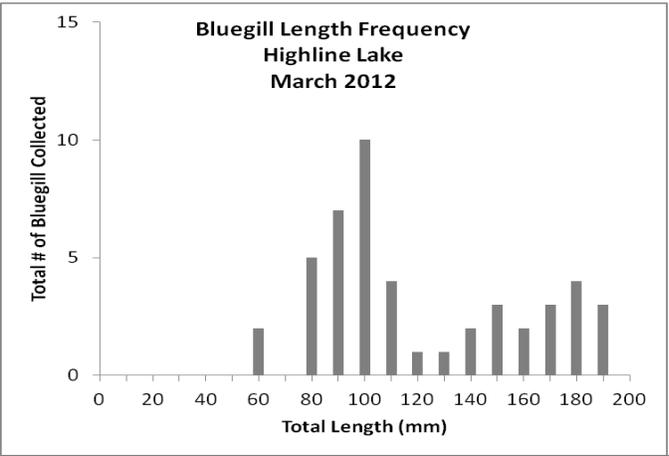
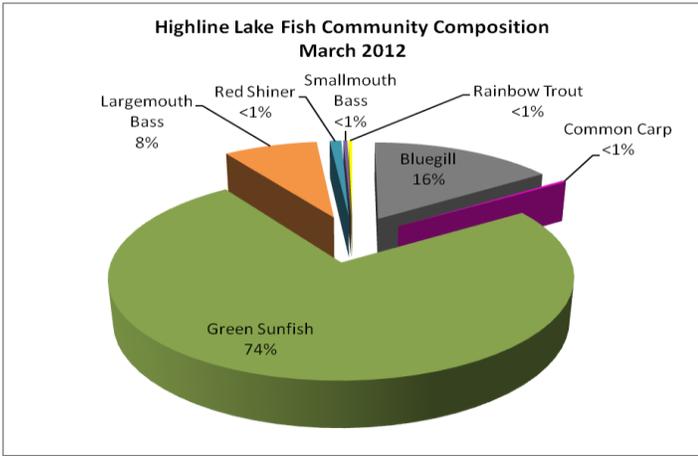
Collection Method	Fish Species Collected	Total # Fish Collected	Total Length Size Range in Millimeters (mm)	Catch per Unit Effort (# fish/hour)
Electrofishing	Bluegill	47	57-188	74.6
	Common Carp	1	483	1.6
	Green Sunfish	223	42-157	354.0
	Largemouth Bass	24	56-296	38.1
	Red Shiner	3	58-71	4.8
	Smallmouth Bass	1	77	1.6
Gill Nets	Rainbow Trout	1	284	0.02

**Total Number of Fish Collected = 300**

#### **2013**

Collection Method	Fish Species Collected	Total # Fish Collected	Total Length Size Range in Millimeters (mm)	Catch per Unit Effort (# fish/hour)
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

**Total Number of Fish Collected = 163**



## *Conclusions and Discussion*

The spillway net at Highline Lake was compromised during canal surges across the past three years, and during an extended bottom release in 2013. 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. The majority of ictalurids and centrarchids collected within Mack Wash, which likely originated from Highline Lake, were captured within the plunge pool at the base of the spillway downstream of Highline Lake across all years. Fish appear to be confined to this plunge pool in the fall when water is not being released from Highline Lake and delivered downstream. Catch effort increased from 2012 to 2013 for ictalurids (two adult fish), black crappie (one juvenile fish), green sunfish, and smallmouth bass (one juvenile fish) and decreased for largemouth bass captured in Mack Wash immediately downstream of the spillway. Densities and catch rates for ictalurids and centrarchids remain the highest in Mack Wash immediately downstream of the spillway. Largemouth bass density and catch rate increased from 2012 to 2013 in Mack Wash at Site #2, approximately three miles downstream of Highline Lake. In addition, the 2013 catch rate for red shiners at Site #2 was more than five times the 2012 catch rate. Catch rates for all fish species collected between the Highline Lake spillway net and spilway declined from 2012 to 2013.

CPW staff have taken several actions to reduce the chance of fish escaping from Highline Lake. These actions include:

- 1) continuing coordination and communication efforts with operators of the Government Highline canal system to insure 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 existing spillway net is scheduled to be replaced once dredging activities within Highline Lake are completed in the fall of 2013/spring of 2014;
- 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 likely 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.