Year 3 **6-2-2011**

Post Restoration Monitoring Summary
Rock Creek Project (Marys River Basin)

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Project Sponsors include:
The City of Corvallis
Oregon Watershed Enhancement Board (OWEB)
Marys River Watershed Council
Oregon Department of Fish and Wildlife (ODFW) Fish Passage Program
United States Forest Service (USFS)

Introduction

This is the third post project summary designed to quantify the response of native cutthroat in the Rock Cr subbasin of the Marys River following an intensive restoration project conducted in 2008 that centered on providing unimpeded access for both juvenile and adult cutthroat to approximately 8 miles of previously inaccessible habitats. These headwater habitats exhibited the potential for providing additional capacity for spawning, rearing and thermal refugia. By necessity, the entire hydrologic unit described as Rock Creek and its tributaries has been analyzed as a single functional unit that extends below and above the boundaries of the City of Corvallis ownership where all of the project activities occurred. This was imperative because the distribution of cutthroat is dynamic and always responding to the basin scale influences of temperature and the variable locations of key spawning and rearing habitats.

The post project monitoring consisted of a 20 percent snorkel inventory of the distribution and abundance of cutthroat conducted on May 23-25, 2011. The intent of the survey timing was to match the timing of the baseline inventory (May 19-21, 2006) and the year 1 post project inventory (May 19-21, 2009). Due to late spring rains and the resultant poor visibility for the snorkel methodology, the 2010 survey was delayed by 23 days. The primary objective of this review is to compare the pre and post abundances and distributions of cutthroat as a method for assessing the efficacy of the multiple fish passage improvements conducted by the partnership.

Methodology

Protocols involved the Rapid Bio-Assessment (RBA) methodology developed by Bio-Surveys, LLC for snorkel inventory. This is a random sampling strategy that is designed to gather a 20 percent sample of all pool habitats within the current distribution of cutthroat for the Rock Cr subbasin. The method collects pool metrics and classifies variations in habitat complexity.

The survey was initiated at the mouth of Rock Cr (confluence of Greasy Cr) and continued up the mainstem of Rock and it's tributaries until increases in gradient diminished the potential of the aquatic habitat for providing significant cutthroat production. The survey included 11.2 miles of contiguous stream habitat.

The start and finish points of each inventoried stream segment were also maintained for consistency.

Pre project conditions

Basin scale aquatic issues effecting cutthroat trout distribution and abundance

Extremely high water quality (cold summer temperatures) was identified in the headwaters of the Rock Creek subbasin. All headwater streams originate from high coastal elevations and flow through largely intact Late Successional Reserves (LSR) on USFS property. Canyons are narrow, steep, heavily canopied and exhibit limited solar exposure on the aquatic habitats of Rock Creek tributaries. Wood densities are high, resulting in deep accumulations of transient bedload material (sand, gravel and cobble). These deep bedloads of migratory substrate store and buffer summer flows from the impacts of direct sunlight and air.

Each of the major headwater tributaries (North Fork, South Fork, Middle Fork and Griffith Creek) eventually transitions onto the City of Corvallis ownership, which is positioned lower in the watershed. The natural geomorphology of the City's ownership is described by wider floodplains and flatter channel gradients. These two natural features predispose the stream corridor to increased impacts from air and solar exposure. Lower stream gradients (<2%) lengthen the window of solar exposure which is exacerbated by the east / west aspect of significant portions of the Rock Creek mainstem. Add the decrease in stored bed load from low instream wood densities on City property and the stream begins to exhibit exposed bedrock functioning as summer heat sinks. Pool turnover rates (the time water is retained in a single pool) are slower with reduced gradient, resulting in prolonged exposure to warming bedrock and sunlight.

Because increases in mainstem water temperatures are known to trigger upstream temperature dependant migrations during late spring and summer and because of the known abundance of high quality spawning gravel in the upper reaches of Rock Cr and its tributaries, the provision of access to these habitats was identified as a high priority aquatic restoration prescription in the City of Corvallis Forest Stewardship Plan. The perceived high priority fish passage issues were identified and prioritized as follows:

1) Water intake diversion dam on SF Rock without a functional fish ladder
2) MF Rock culvert w/ 3ft vertical perch
3) Water intake diversion dam on Griffith Cr. without a functional fish ladder

4) 4 ft natural bedrock intrusion at RM 1.5 (Rock Cr mainstem) with right angle water delivery into jump pool.
5) Griffith Cr culvert w/ 0.5ft perch with juvenile velocity issues.
6) Stillson Cr culvert w/ 2ft vertical perch
7) Trib D culvert w/ 1ft vertical perch

Project Activities

1) Design and construct a fish ladder with 6 inch lifts to meet current NMFS fish passage criteria for passing both adult and juvenile age classes of cutthroat.

2) Design and install a 14 ft wide culvert with an internal simulated stream channel.

3) Design and construct a fish ladder with 6 inch lifts to meet current NMFS fish passage criteria for passing both adult and juvenile age classes of cutthroat.

4) Design and construct an instream log structure to divert current side channel flow into historic channel that provides direct delivery of the thalweg into the existing jump pool below.

5) Design and install a 14 ft wide culvert with an internal simulated stream channel.

6) Design and install a 14 ft wide culvert with an internal simulated stream channel.

7) Design and install an 11 ft wide culvert with an internal simulated stream channel.

Monitoring Results

The results of both the pre and the three post project snorkel inventories have been summarized below.
(Table 1)

Stream	**Total 1+ and older Cutthroat**			
	Spring 2006 (Pre)	**Spring** 2009	**Spring** 2010	**Spring** 2011
Griffith (below dam)	60	120	190	115
Griffith (above dam)	170	330	255	370
MF Rock	135	115	130	195
Stillson	20	45	15	25
Trib D	25	30	5	10
Rock (below dam)	720	385	1035	925
Rock (above dam)	275	370	530	390
Total	**1,405**	**1,395**	**2,160**	**2,030**

Note: Some values do not match previously reported values because data has been excluded from the NF Rock (inaccessible to migratory fish) and the dam pool above the SF Rock diversion dam to normalize the comparison between years.

Table 1 suggests that no significant change in the basin scale abundance of cutthroat was observed between the pre and first year post project inventory (2009). This implies that the positive shift in distribution observed above the dam in 2009 (28% of all cutthroat above dam in pre project shifting to 49% in 2009) was not an artifact of density dependant pressures on the existing population. The absence of an increase in the total population strengthens our assessment that the observed upstream shift in distribution was not the result of the variable dynamics of a larger population. There continued to be a higher percentage of the total mainstem Rock Cr cutthroat above the dam in post project years 2 and 3.

Overall cutthroat abundance for the basin has increased from the pre project year in both years 2 and 3 of the post project inventories (54% and 44% respectively). One of the hypotheses entering into this suite of restoration prescriptions was that the provision of improved access to high quality spawning habitats above each of the diversion dams would result in a basin scale increase in population size beginning in 2010. This increase has occurred and expectations are that the magnitude of this increase should improve as structures mature and begin to trap and sort additional high quality spawning gravels.

The spring of 2011 in Rock Cr was unique with unusually high flows sustained over an extended temporal range. In addition, these flows remained cold from a snow pack on Mary's Peak that extended into June. These exceptional environmental variables may have impacted (delayed) the run timing for cutthroat spawning migrations in 2011.

Some of the more dramatic changes observed over time have occurred in distribution patterns. There were large decreases in the abundance of cutthroat rearing in the mainstem of Rock Cr and a complimentary large increase of cutthroat in the headwater stream segment above the SF Rock water intake structure (compare figures 1,2,3,4). The shift in distribution from the mainstem of Rock Cr to the stream segment above the SF Rock diversion dam is a clear indicator of successful upstream passage through the newly constructed fish ladder. Regardless of the biological driver of this migration (spawning or elevated mainstem temperatures) a higher percentage of all the cutthroat in the mainstem of Rock Cr were present above the retrofitted fish ladder in all post project years when compared to the pre project year (2006). In mainstem Rock Cr for the pre project year, 28% of all cutthroat were documented above the dam. In the following 3 post project years the percent of the total cutthroat above the dam was 49%, 34% and 30% respectively.

In Griffith Cr for the pre project year, 74% of all cutthroat were observed above the dam. Because there were multiple barriers to migration access in Griffith Cr (perched culvert and no fish ladder on diversion dam), the comparison of pre and post abundances above the dam are inappropriate. This comparison misses the positive impacts of culvert removal to the stream segment above the culvert and below the dam. There was however a significant increase in the total abundance of cutthroat in

Griffith Cr in all post project years when compared to the pre project inventory (96%, 93% and 111% respectively).

In 2006 (pre project), there was a large concentration of older age class cutthroat (28 individuals) observed at RM 1.5 attempting to jump a 4ft vertical bedrock falls. Only 1 cutthroat was observed in the pool below this falls in the 1st post project year (2009), 4 cutthroat were observed in the pool below these falls on the 2nd post project year (2010) and 1 cutthroat was observed at the same location for the 3rd post project year (2011). The log structure placed above this falls to realign the thalweg appears to have been very effective in providing unencumbered passage.

Additional habitat complexity was provided to the mainstem of Rock Cr by placing 23 log structure complexes by helicopter. As a result of these structures it was observed during the first pre project inventory that approximately 71% of the cutthroat in the treated reach of the mainstem on May 20 were disproportionately accumulating at log structure sites. The structure sites comprised approximately 33% of the available pool habitats. Additional habitat complexity in the form of improved floodplain interaction, channel braiding from bedload aggradation and the accumulation of transient canopy litter are expected to also improve over time as these sites mature. The results of the second year post project were very different and suggested that there was no disproportionate habitat use occurring with 31% of the cutthroat rearing in the structure reach in pools with complex helicopter log structures. This is very similar to the 33% distribution of complex structure habitat. This suggests that higher spring flows were likely still providing linkage to edge oriented or floodplain habitats. The results for 2011 again indicated a higher abundance of cutthroat in habitats associated with log structure placements. Structure pools comprised 33 % of all of the habitat quantified in the treated reach and these habitats contained 57% of all the cutthroat observed.

In 2010 we observed a distinct decrease in the densities of cutthroat above the Griffith Cr dam when compared to the higher densities just below the dam (figure 7). We suggested that continued monitoring would be important for determining if a reoccurring passage problem existed at this site that may be delaying or frustrating effective passage. The 2011 inventory did not observe this same density differential (Figure 8) associated with pool habitats directly above and below the water diversion dam. This suggests that the impediment to passage did not exist in 2011. In 2010 we recommended the installation of a 2" lift on the Griffith Cr dam boards in an attempt to increase the attraction flow to the ladder. These recommendations were not implemented by the City of Corvallis. Because there was no modification to the elevation of the Griffith Cr intake pool it is likely that the improved passage observed at the water intake facility in 2011 was the result of sustained high spring flows. This conclusion suggests that passage issues may continue to exist at the site for upstream spring and summer migrants during both normal and low spring flow regimes.

Two of the other culvert replacements (Stillson Cr and Trib D) also exhibited increases in fish abundance above the repaired crossings in the first post project inventory in 2009. The increase in Stillson was 125% of pre project abundance and the increase in Trib D was 20%. These two tributaries provide cold water refugia from the mainstem and it is conceivable that increases in abundance could be more significant later during pinch period low flows in the mainstem. The actual numbers of cutthroat that these increases represent are minor from a basin scale perspective. Trib D however, has exhibited a decrease in abundance when compared to the pre project year in both 2010 and 2011. Stillson exhibited a decrease in 2010 and a slight increase in 2011.

Only one of the passage project sites (MF Rock) had failed to exhibit an increase in the abundance of cutthroat above the repaired crossing in the first two post project years (2009, 2010). The 2011 inventory finally observed a 44% increase in abundance from the pre project inventory.

Conclusion

These are the combined results of three consecutive years of post project monitoring. Obvious and significant alterations in cutthroat abundance and distribution were observed that suggest that the improvements in fish passage infrastructure conducted by the consortium of partners has been mostly effective in providing access to high quality headwater habitats.

An exception continues to exist (that was identified in the 2010 final report) at the Griffith Cr fish ladder. Although Cutthroat densities directly below and above the ladder indicate that unencumbered passage was occurring during the spring of 2011, we believe that this was likely the result of unusually high spring flows, sustained over an extended period. These high flows provided the additional attraction to the ladder that was observed missing in 2010. It is likely that without following through with the recommendations delivered in the 2010 final report (2” lift on the intake dam pool elevation), that low attraction flows to the ladder during spring and summer will continue to frustrate, delay and possibly deny access to headwater spawning reaches for both resident and fluvial cutthroat.

It is expected that future fish abundance and distribution monitoring will be conducted in Rock Cr as part of a long term recovery plan for the Greasy Cr subbasin by the Mary’s River Watershed Council. These surveys will be focused on detecting a response in cutthroat to additional restoration actions that might occur in the basin to address the known temperature limitations that exist during summer flow regimes. Future inventories will likely continue to describe increases in basin scale cutthroat abundance. These increases will continue to be linked to the provision of unimpeded access to the high quality spawning habitat and summer thermal refugia in the headwaters provided by this suite of passage improvements.

FIGURE 1

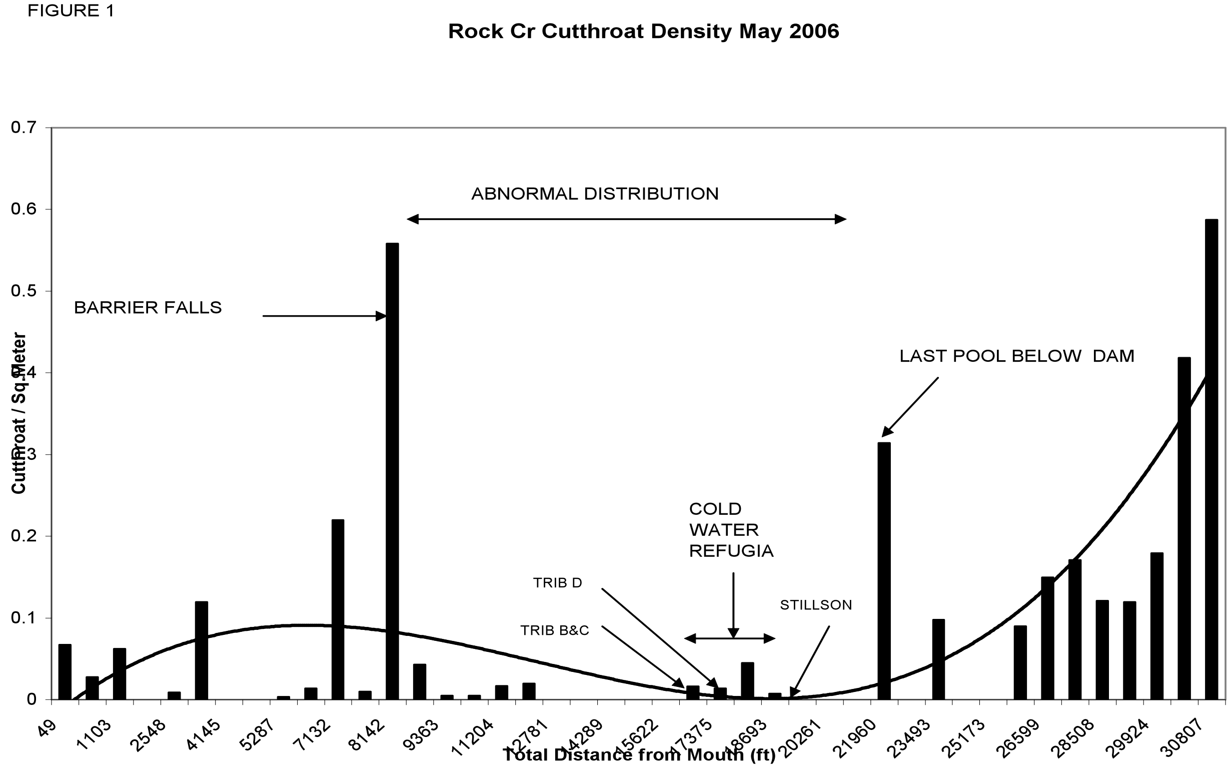

FIGURE 2

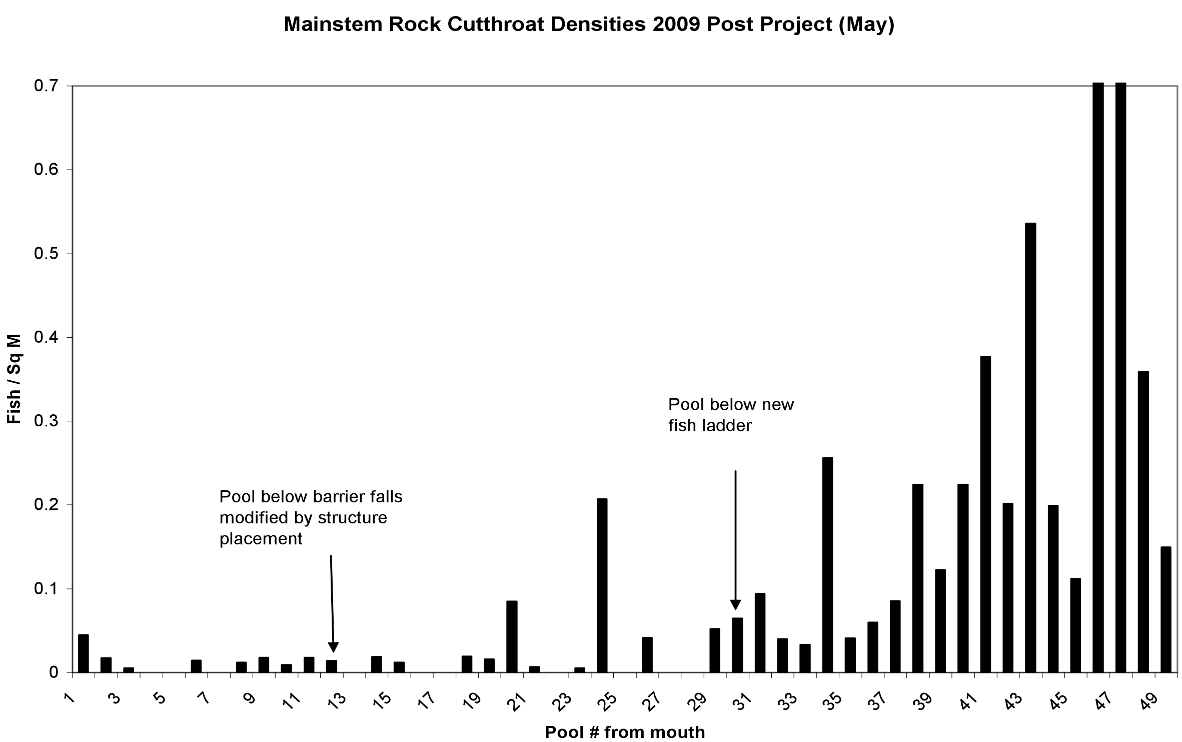

FIGURE 3

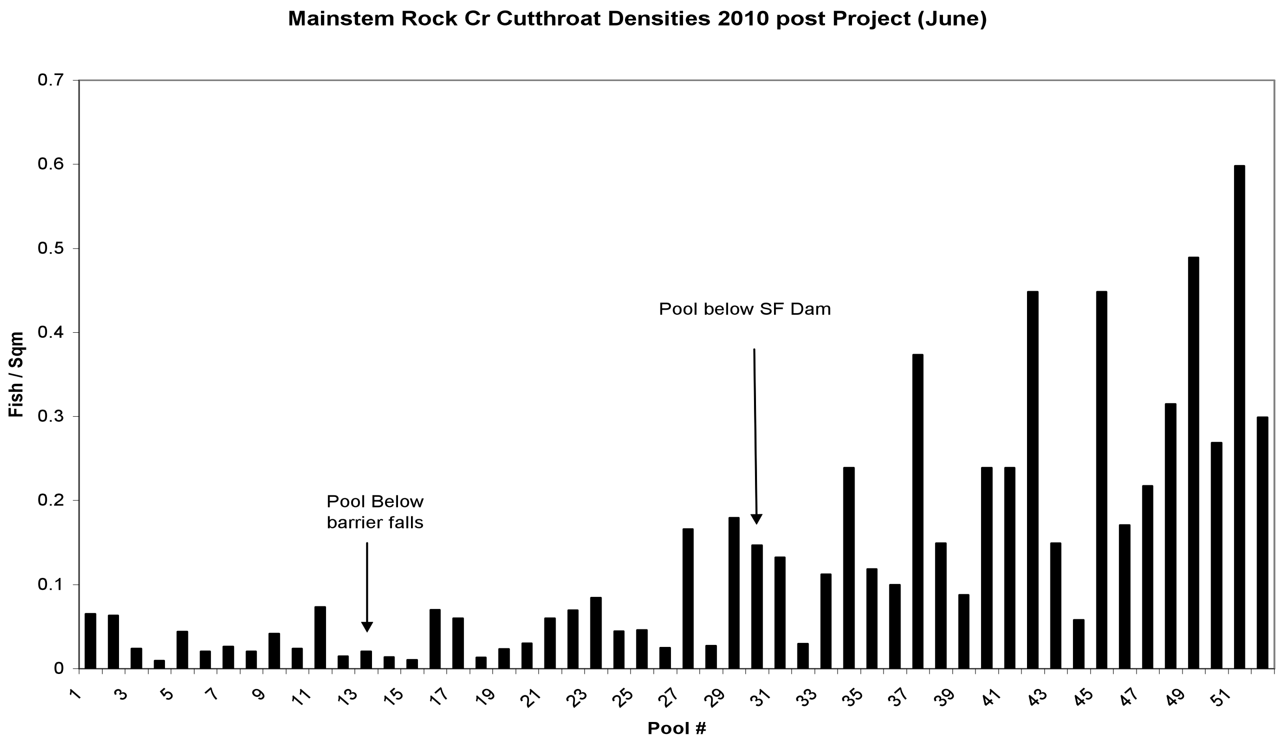

Figure 4

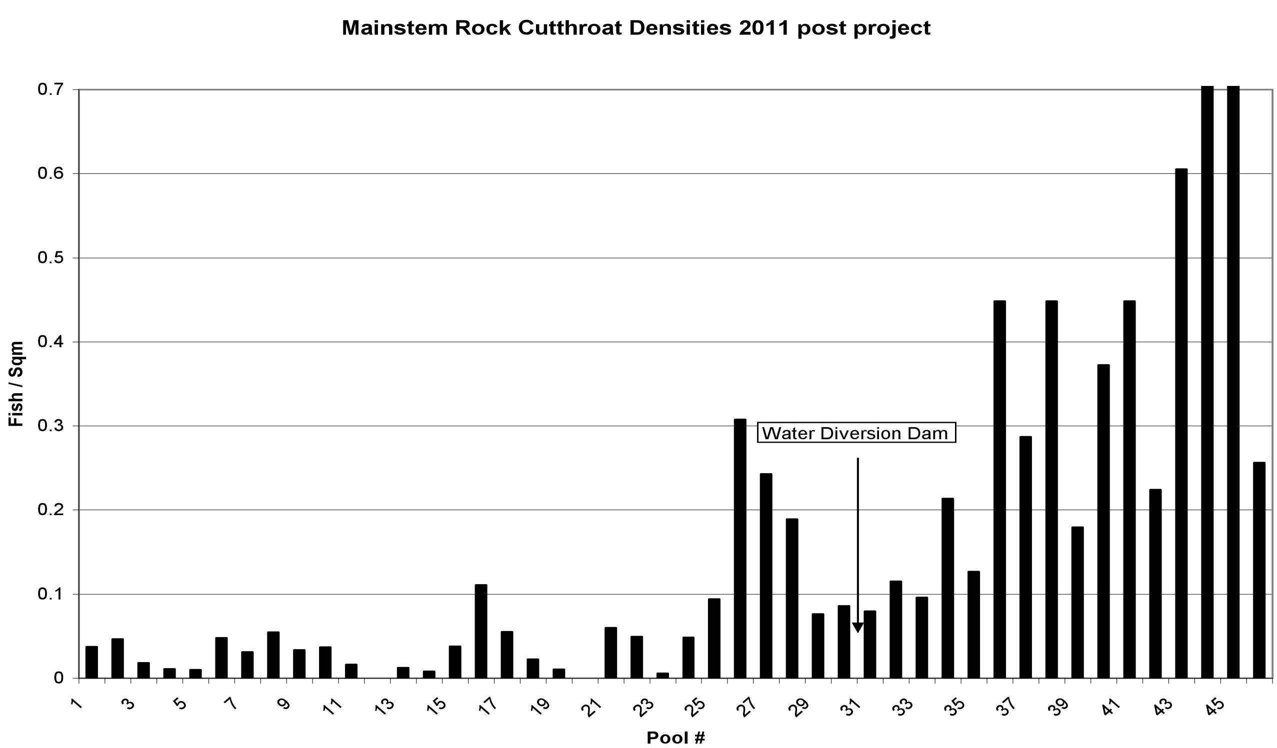

FIGURE 5

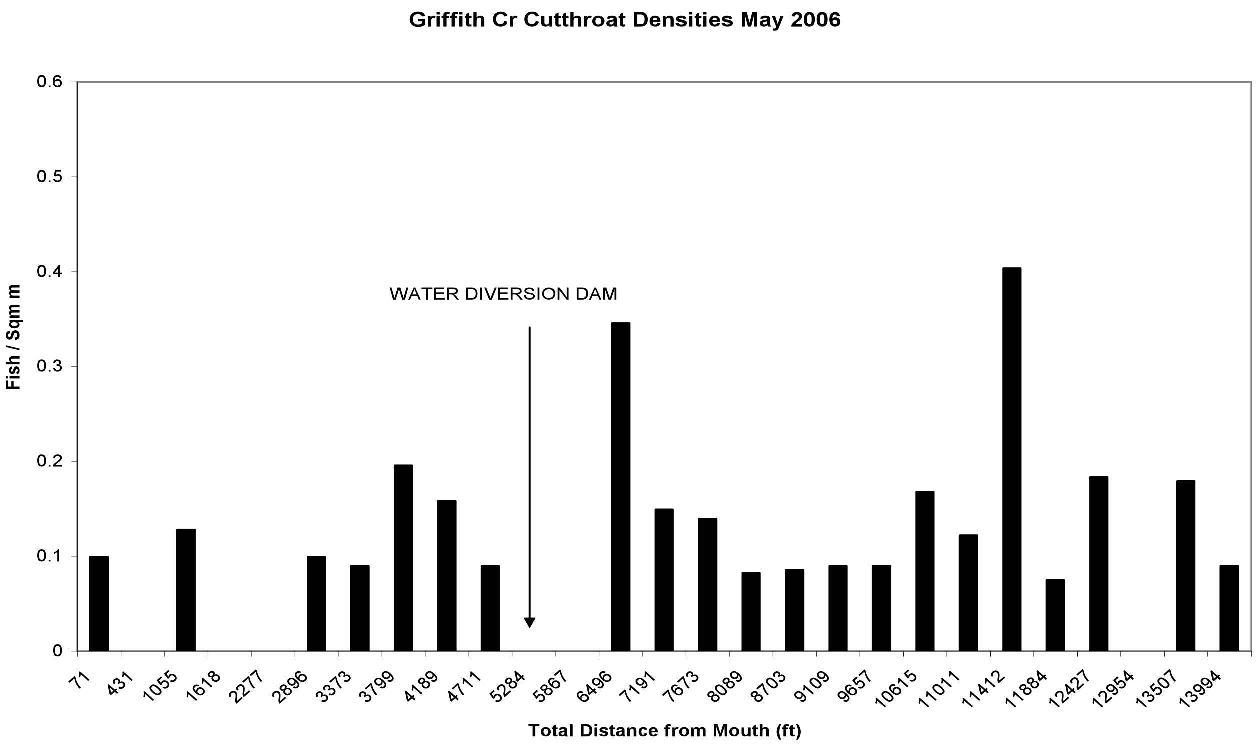

FIGURE 6

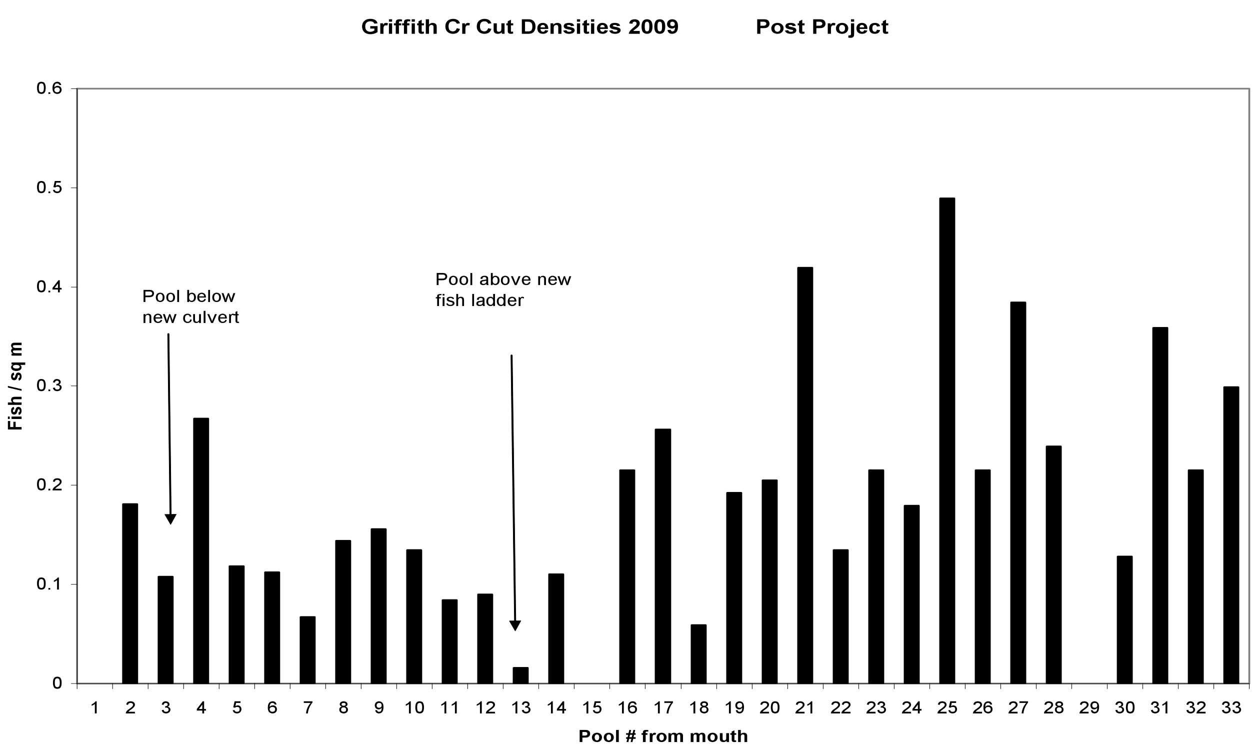

FIGURE 7

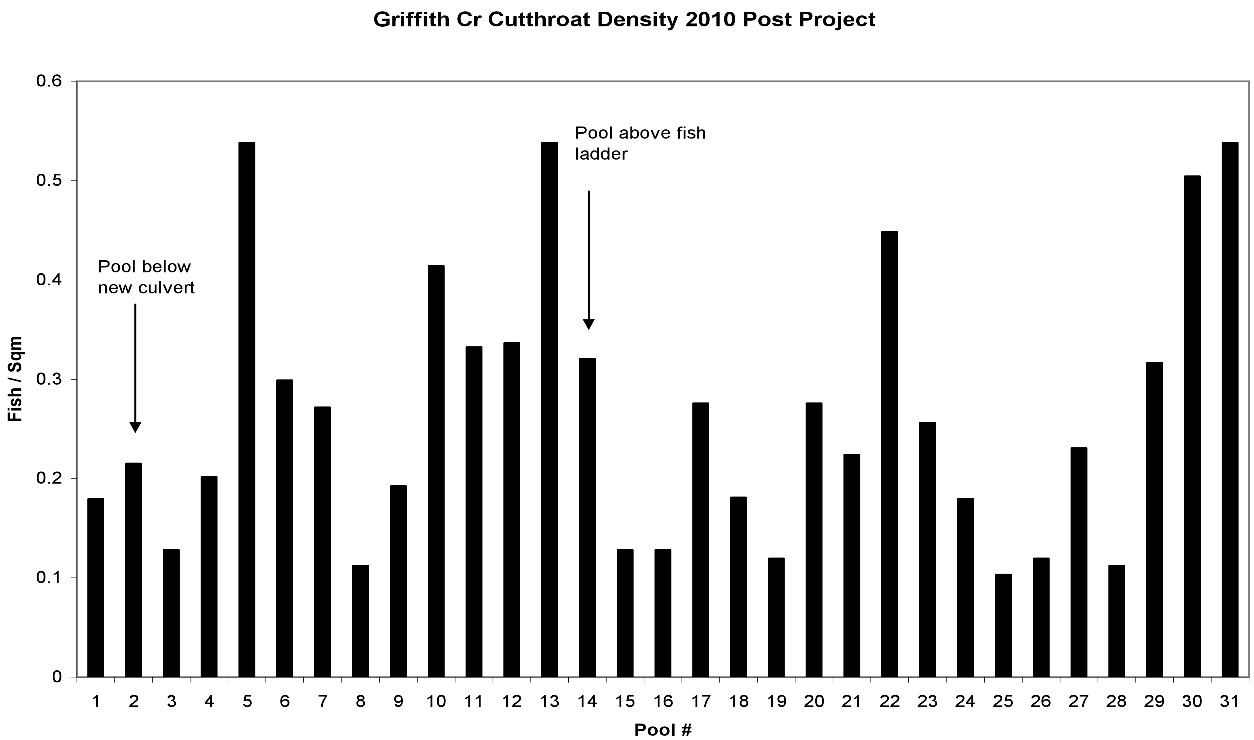

FIGURE 8