Year 2 **7-15-10**

Post Restoration Monitoring Summary Rock Creek Project
Monitoring and Analysis conducted by Bio-Surveys,LLC.

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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 second 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 June 14-16, 2010. 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 (temperature) 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 two post project snorkel inventories have been summarized below.
(Table 1)

Rock Cr Comparative Analysis / Results of 20% snorkel Inventory

Stream	Total 1+ and older Cutthroat				% change in abundance from 2006		
	2006 (Pre)	2009	2010	2011	2009	2010	2011
Griffith (below dam)	60	120	190		100%	217%	
Griffith (above dam)	170	330	255		94%	50%	
MF Rock	135	115	130		-15%	-4%	
NF Rock	265	235	335		-11%	26%	
Stillson	20	45	15		125%	-25%	
Trib D	25	30	5		20%	-80%	
Rock (below dam)	720	385	1035		-47%	44%	
Rock (above dam)	285	490	730		72%	156%	
Total	**1,680**	**1,750**	**2,695**		4%	60%	

Notes:

Highlighted stream segments indicate an increase in Cutthroat abundance

1) No significant change in basin scale population total between Pre and 1st year Post (4%)
2) Large decrease in mainstem Rock Cutthroat below the fish ladder for 1st year post (-47%)
3) Large increases observed above Rock Cr fish ladder, Griffith Cr culvert and Stillson culvert for 1st year post
4) Helicopter placed log structure pools within structure reach (Begin City property - Confl.NF Rock) contained 71% of all Cutthroat observed during 1st post project year.
5) 33.3% of the pool habitat in the structure reach was treated with structure wood.
6) Large increase in basin scale abundance of Cutthroat observed after 2nd post project year (+60%)
7) Large increase in mainstem Rock below the fish ladder after 2nd post project year (+44%)
8) Large increase in mainstem Rock above the fish ladder after 2nd post project year (+156%)
9) Helicopter placed structure logs contained 31% of all Cutthroat observed in the structure reach during the 2nd post project year.

Table 1 suggests that insignificant changes in the basin scale abundance of Cutthroat were observed between the pre and first year post project inventory (+ 4%). This implies that the observed changes in distribution were likely not an artifact of density dependant pressures on the existing population. This was a fortunate condition for this first year of monitoring that assisted in witnessing a clear response to improved access to headwater tributaries. There were however very significant increases in the second post project year in basin scale abundance (+ 60%). One of the hypotheses entering into this suite of restoration prescriptions was that the provision of improved access to high quality spawning habitats above the each of the diversion dams would result in a basin scale increase in population size beginning in year 2 post project. A portion of the 60% increase observed is likely associated with the improved spawning and incubation capacity newly available above each of the diversion dams (Griffith Cr and SF Rock).

Some portion of this basin scale increase in population may also be the result of natural variation in population dynamics that can be observed in the control reach. The NF Rock is a stream segment included in this inventory as a control for possible changes in population structure, distribution or abundance not influenced by migrants from anywhere else in the basin. This is made possible by the impassable dam on the outfall of the NF Reservoir. This stream segment exhibited a decrease in abundance (-11%) in 2009 and an increase in abundance (+ 26%) in 2010 when compared to the baseline population estimate developed for 2006. There was no change in distribution between pre and post inventories.

Some of the more dramatic changes observed 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 segments above the SF Rock water intake structure (see figures 1 & 2) and above the Griffith Cr water intake structure (see figures 4 & 5). The shift in distributions from the mainstem of Rock Cr to stream segments above the diversion dams is a sound and clear indicator of successful upstream passage through the newly constructed fish

ladders as well as the new Griffith Cr culvert installed below the water intake dam. Regardless of the biological driver of this migration (spawning or elevated mainstem temperatures) it is clear that a significant component of the standing population succeeded in passing these known historical barriers.

Additional support for this conclusion was observed at RM 1.5 where a large concentration of older age class Cutthroat (28 individuals) was observed pre project (2006) attempting to jump a 4ft vertical bedrock falls. Only 1 Cutthroat was observed in the pool below this falls in the first post project inventory conducted on the same day in 2009 and only 4 Cutthroat were observed in the pool below these falls on the second post project inventory. The log structure placed above this falls to realign the thalweg appears to be 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 remaining in the treated reach of the mainstem of Rock Cr by 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 Griffith Cr suggest that there was significant improvement in Cutthroat abundance both below and above the dam in both post project inventories when compared to the abundance documented in 2006. There has been however a decline in abundance (compared to the levels achieved in 2009) above the dam in the second post project inventory conducted in 2010. The fact that there is a distinct decrease in the pool densities of Cutthroat associated with the delineation of habitats below and above the dam (see Figure 6) suggests that there may be an issue existing at the Griffith Cr fish ladder that is complicating, delaying or frustrating passage. The likely issues of concern would be:
1) Insignificant attraction flow through the fish ladder
2) Obstruction or blockage in the ladder

Our recommendation is to continue to monitor the relative distribution of Cutthroat above and below the Griffith Cr fish ladder to determine if this was an anomaly or whether it may be a reoccurring issue of concern. Currently there are plans to resurvey this portion of the basin in August of 2010 and again in the spring of 2011.

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 however are minor from a basin scale perspective. Both of these streams exhibited decreases in abundance in 2010 from the 2006 baseline inventory. This may also be a function of extended high spring flows that have kept the mainstem of Rock Cr cool and the small cold water tributaries less of a destination until that mainstem temperature profile deteriorates.

Only one of the passage project sites (MF Rock) has failed to exhibit an increase in the abundance of Cutthroat above the repaired crossing in both post project inventories. No obvious issues were observed upon inspection of the repaired crossing indicating that it would not have the capacity for passing all age classes of migrant Cutthroat. An additional late summer inventory (currently scheduled for August 2010) could be informative for understanding how cold water refugia in the MF Rock may be functioning for upstream temperature dependant migrants.

Conclusion

These are the combined results of two of three scheduled 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 immediately effective in providing access to high quality headwater habitats.

Because unexpected distribution profiles were observed at both the MF Rock Cr culvert crossing and the Griffith Cr fish ladder, we would recommend the following steps be taken to address the observations of retarded passage (Griffith Cr) and limited passage (MF Rock):

1) Conduct a snorkel inventory during peak summer temperatures in MF Rock to determine if the stream may be more of a target for upstream temperature dependant migrants and less of a spawning destination (current surveys conducted in spring only).
2) Increase the height of the intake pool above the Griffith Cr dam by replacing the top dam board with a 2” wider board. This should effectively increase attraction flow at the mouth of the fish ladder and result in decreasing the accumulation of Cutthroat below the ladder (indicating unencumbered passage).

It is expected that the continued monitoring currently scheduled for the project reach (summer 2010 and spring 2011) will continue to indicate an increase in basin scale Cutthroat abundance associated with increases in survival and production. These increases will come as a result of providing unimpeded access to high quality spawning beds and summer thermal refugia.

FIGURE 1

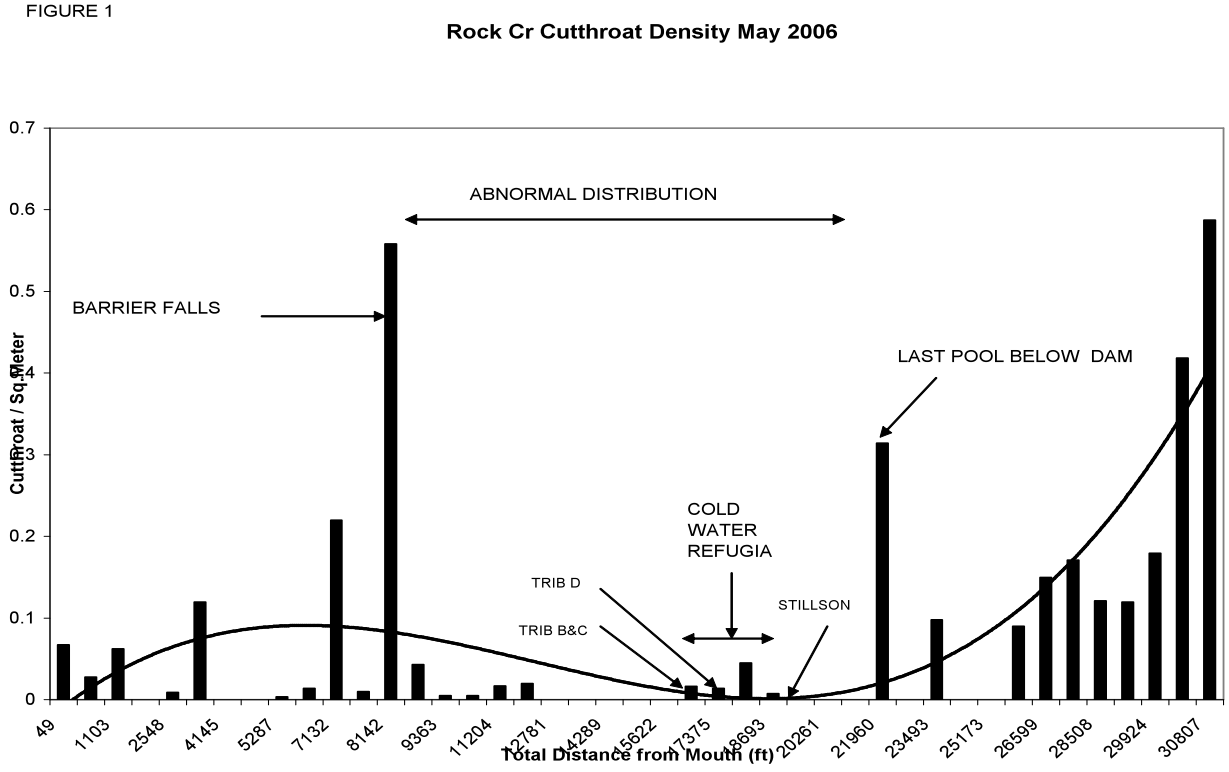


FIGURE 2

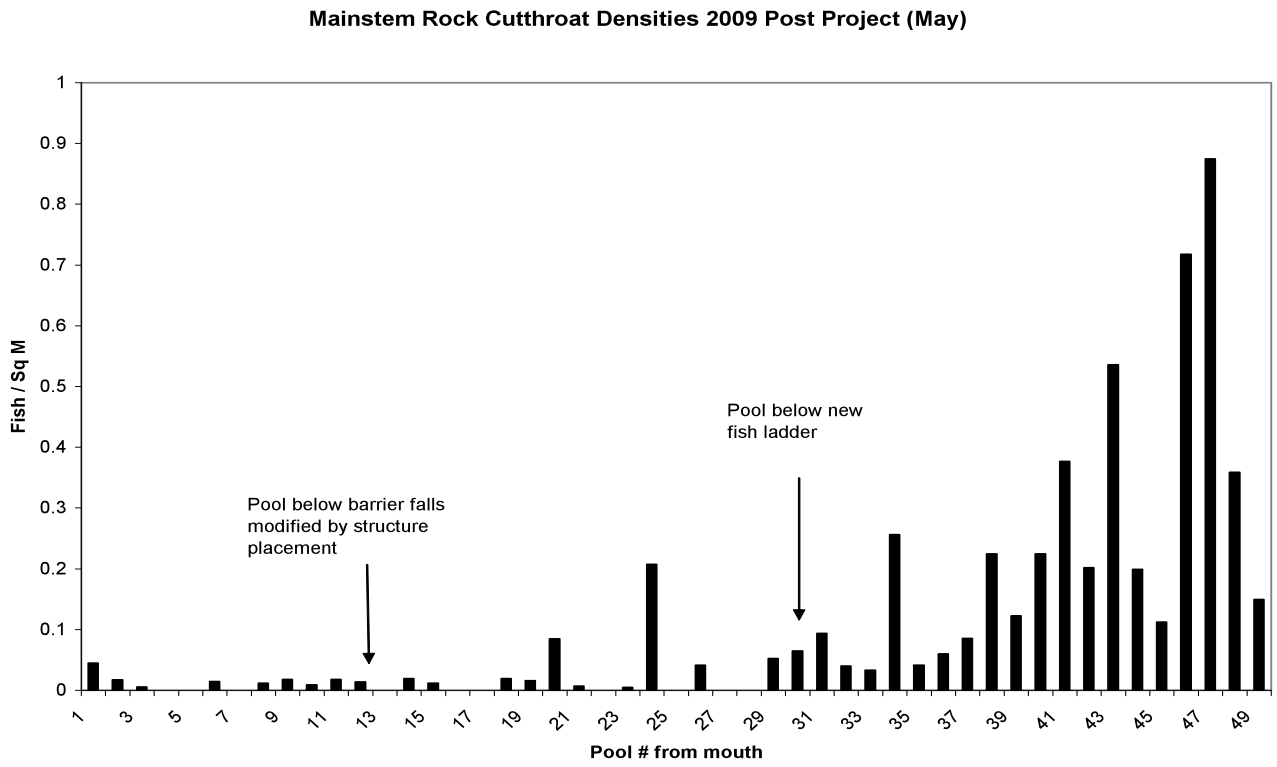


FIGURE 3

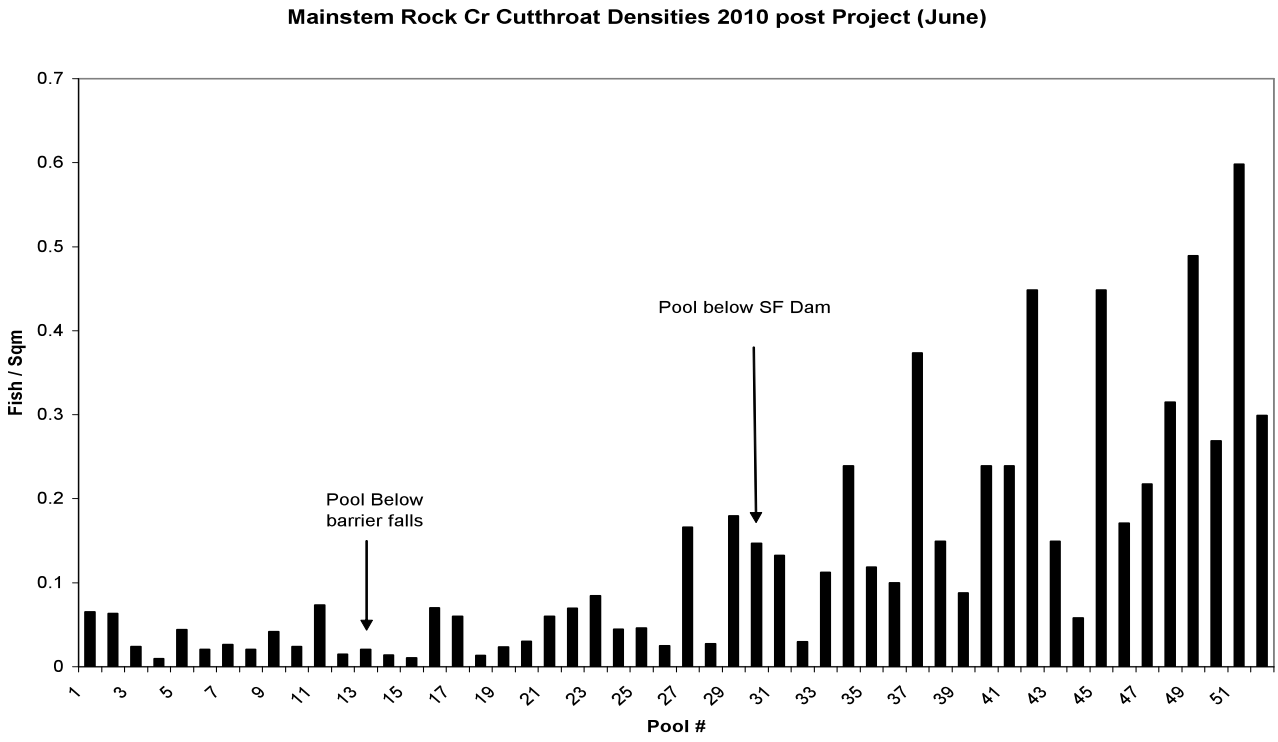


FIGURE 4

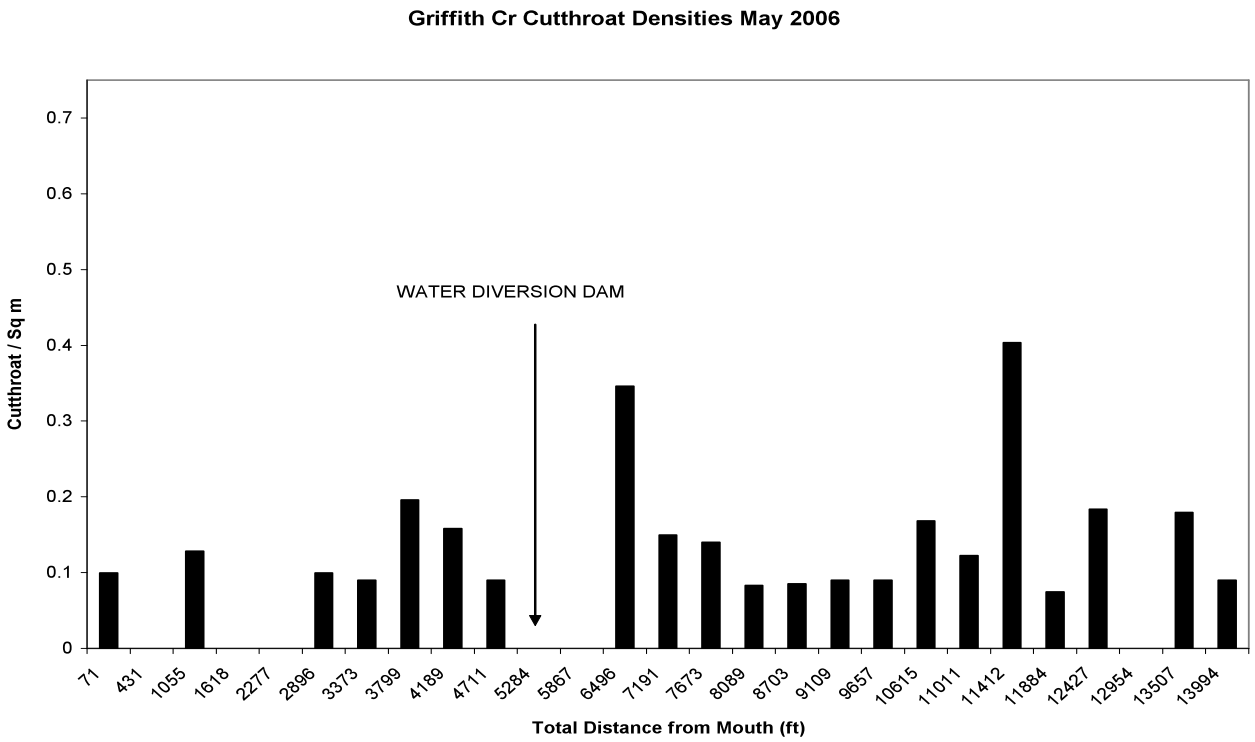


FIGURE 5

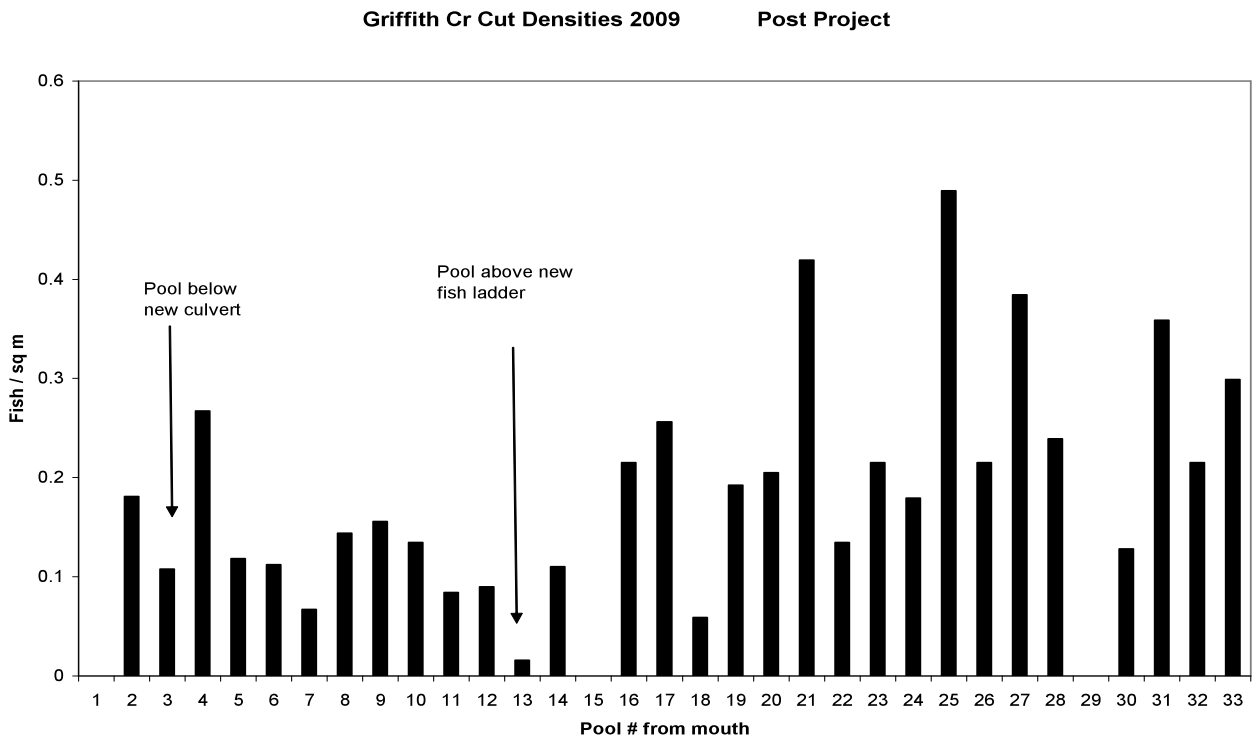
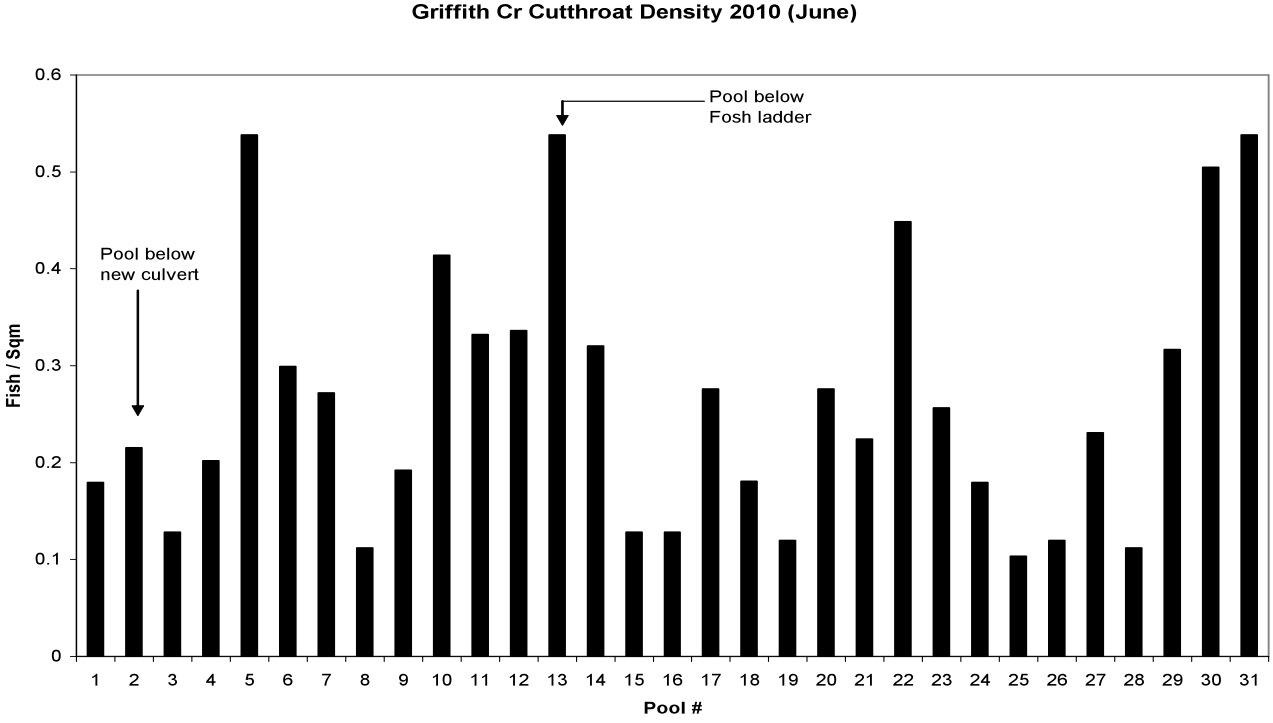


FIGURE 6


Griffith Cr Cutthroat Density 2010 (June)
Fish / Sqm
0.6
0.5
0.4
0.3
0.2
0.1
0
Pool below
new culvert
Pool below
Fosh ladder
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Pool #