FINAL REPORT

Development of a Research Protocol that Relates Culvert Structure to Fish Migration in Southern West Virginia

WVDOT/DOH Research Project RP#181

by

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16. Abstract: Culverts that allow stream passage through and around roadways can be significant impediments to fish migration. Culvert construction is particularly significant in sections of Appalachian where recent remediation might improve stream habitat but improper culvert construction impedes fish migration into it. An understanding of the relationships among culvert structure, stream geomorphology, environmental quality and successful fish migration will facilitate both the planning of future culverts and the remediation of fish obstructions in existing ones. Three analytical tools were used in a preliminary study of the relationships among stream crossings, culvert structure, and swimming ability of fishes in southern West Virginia.

Tools used were:

- GIS and associated raster and vector imagery
- Existing FishXing software with datasheets
- Data on distribution and swimming ability of Appalachian fishes

These three analytical tools were applied to four southern West Virginia watersheds (Pinnacle, Hurricane, Huff, and Whites Creeks) in order to examine the effects of culverts on fish migration. Results of this preliminary study demonstrate the utility of GIS in mapping streams, fish crossings and stream habitat, the need for Rapid Bioassessment and Rosgen protocols for fish habitat assessment, and the utility of FishXing software in modeling culvert impact on fish migration. Mark and recapture studies of Appalachian species are needed to ascertain fish swimming abilities through culverts at a variety of discharge rates.

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TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Background

The effect of culverts on migration of western (primarily salmonid) North American fishes has been extensively studied. Culverts are often a barrier to fish migration due to the high velocity of the water in culverts, the smooth surface and lack of eddies all of which make it difficult for fish to move upstream. Culverts therefore could have a significant impact on the distribution of fish species in Southern West Virginia.

1.2 Problem Statement

After extensive study and software development, a modeling program, FishXing, has been developed that relates fish abilities and culvert structure to likely migration. However, species involved in the model are primarily western and little is known of the effects of culverts on migration of fishes in the highly dissected, dendritic drainages typical of southern West Virginia.

1.3 History of Relevant Research

In stream movements of fishes have been assessed with a large number of published techniques. For a thorough review see Cushing, 1968; Gulland, 1988; or Wooton, 1992. Collection technique, handling times, invasiveness of tags, water temperature, habitat heterogeneity, and the water quality of the stream all play significant roles in fish stress response including mortality.

2.0 REPORT BODY

This study proposes to examine the impacts of culverts on fish migration in West Virginia. An understanding of the relationships among culvert structure, stream geomorphology, environmental quality and successful fish migration will facilitate both the planning of future culverts and the remediation of fish obstructions in existing ones.

Three analytical tools were used in a preliminary study of the relationships among stream crossings, culvert structure, and swimming ability of fishes in southern West Virginia. Tools used were:

- GIS and associated raster and vector imager, section 2
- Existing FishXing software with datasheets, section 3 and
- Data on distribution and swimming ability of Appalachian fishes, section 4

These three analytical tools were applied in section 5 to four southern West Virginia watersheds (Pinnacle, Hurricane, Huff, and Whites Creeks) in order to examine the effects of culverts on fish migration.

Findings (described in section 6) include that GIS can help in mapping streams, crossings and species of fish in order to assess migration patterns and the numerical values produced by the FishXing software can predict whether a culvert will obstruct certain species of fish.

Recommendations are to use the GIS maps created by the project as a tool to aid mark and recapture studies in order to assess the impact of current culvert location on migration patterns of fish and to utilize FishXing software in order to predict the impact of particular culverts on fish migration in Southern West Virginia.

2.1 GIS product

2.1.1 GIS scope of work:

GIS has four applications that were found to be critical for the analysis of culverts as obstructions to fish migration:

- 2.1.1.1 GIS was used to locate potential stream crossing by overlapping vector images of streams and roads;
- 2.1.1.2 Stream crossings located via GIS analysis (2.1.1) were located first on DOQ's and then in the field; these were then characterized with data entered into FishXing datasheets;
- 2.1.1.3 Data from FishXing datasheets were then recorded into Access data tables and linked to vector layers and overlaid onto raster images in ArcMap;
- 2.1.1.4 Access tables of fish distribution were then used to characterize fish distribution in four watersheds relative to these stream crossings. Fish distribution data were interpreted from digital images of fish distributions from Fishes of West Virginia.

2.1.2 GIS Deliverables

- 2.1.2.1 Access databases with tabular data of FishXing data as well as distribution of fishes in southern West Virginia streams are related and overlain onto Digital Ortho Quad and Digital Raster Graphic data. This ARCGIS product was then delivered via the web as an **ArcIMS file @**t gis.marshall.edu. See website.
- 2.1.2.2 Tabular data includes the following attributes for Huff Creek, Whites Creek, Pinnacle Creek, and Hurricane Creek.
    - Tabular data of culvert structure and related fish distribution;
    - Tabular data of fish distributions;
    - Vector images of southern WV streams and roads;
    - Vector images of stream crossings;
    - Digital Raster Graphics of 1:24000 topographic images for these watersheds;
    - Digital Orthoquads (as .sid images) for these watersheds;
- 2.1.2.3 ARCGIS maps delivered as DVD via Marshall University Research Corporation and via web at gis.marshall.edu/ArcIMS.

2.2 Culverts and Hydrology Product

2.2.1 Culverts and Fish Crossing Scope of Work

After reviewing available literature on studies of culverts and their impact on fish movement, we selected the field data sheets for the "FishXing" model, available at http://www.stream.fs.fed.us/fishxing/fieldform.pdf and the associated "FishXing" software program. This form and software contained most of the data fields needed for assessment of culvert impacts on fish movement and contained all attributes necessary for the "FishXing" model. However, some data fields that were relevant to our proposal were not included in "FishXing" data sheets. Consequently, an additional field sheet was used that recorded presence or absence of fish and some data fields from EPA RBA field sheets and Rosgen Level II and III analysis. These fields included stream width and bankful height, presence or absence of riffles, runs, riparian vegetation, bank stability, and sedimentation.

2.2.2 Deliverables -- Culverts:

2.2.2.1 As per the work agreement, the most efficient culvert modeling system was selected (FishXing) and used to model flows on three culverts. Culverts were selected for study from Whites Creek, because of their accessibility.

2.2.2.2 FishXing was found to be a practical application with the following fields of study necessary for calculation of fish swimming ability relative to culvert structure. A summary of the software and its application is given in **the conclusions and findings section of the proposal.**

2.2.3 Deliverables -- Fish Crossing calculations:

2.2.3.1 Are relatively easily generated from field measurement and entered into data forms in the software;

2.2.3.2 Fish crossing values calculated for the three Whites Creek Culverts for the central stoneroller did not predict the culvert was an obstruction and were within values expected relative to the swimming ability of that species and the structure of the culvert;

2.2.3.3 However, few of the fish species listed in the FishXing software are found in West Virginia streams;

2.2.3.4 Most species listed are western and the primary focus of the software calculates water velocity and fish swimming ability primarily for salmonid species.

2.2.3.5 Only Brown Trout, Carp, Central Stoneroller, Greenside Darter, and Longear Sunfish from the software fish species list are found in southern West Virginia streams. And only Central Stoneroller and Greenside darter are species that might inhabit southern West Virginia Streams frequently crossed via culverts.

2.3 GIS/DATABASE SYSTEM MAPS DISTRIBUTION OF WV FISHES

2.3.1 GIS/Database System scope of work:

The large foldout map of West Virginian streams included in The Fishes of West Virginia (Stauffer) was digitized to a raster format (tif) and georeferenced to over 20 points, mostly unique state boundary geography such as points and right angles, but also stream intersections from tributary shapefiles (described below). A shapefile of the WV outline (from WV GIS Data Center) was used as the "correct" spatial alignment.

Stream alignments for the state of West Virginia originated from ESRI data releases from 2002 and 2003. The following is an excerpt from the metadata:

The data set originally comes from several sources. Most of the data is from U.S. Geological Survey topographic quadrangle maps or sources that exceed its horizontal accuracy. These maps were compiled to meet National Map Accuracy Standards. For horizontal accuracy, this standard is met if at least 90 percent of points tested are within 0.02 inch (at map scale) of their true position. At 1:100,000 scale, 0.02 inch is approximately 167 feet (50.8 meters). Data created by: U.S. Geological Survey in cooperation with U.S. Environmental Protection Agency, ESRI

(The sources for both state outline and stream alignments are USGS topographic maps.)

With the georeferenced map and stream data displayed together in ArcMap, streams that matched those on the raster were exported, cleaned up (segments merged to one) and named using stream dataset attribute tables and topographic maps when necessary. A new shapefile was created to contain sample site points, and those points were subsequently digitized and numbered to match the raster. Site descriptions were added to the site attribute table to help in locating them in the field, and related sites to nearby tributary intersections and towns.

2.3.1.1 Tying Fish Samples to Sites

The sample map for each species included in The Fishes of West Virginia was used as reference in connecting site numbers with species in a series of tables that were later imported into MS Access and linked with common fields. As of now, the database can be queried in a multitude of ways, including:

- ✓ Individual species by site
- ✓ Individual species by stream
- ✓ Individual species by watershed
- ✓ Individual species by county
- ✓ All streams containing certain species or combination of species
- ✓ Broader queries for family and genus

2.3.2 Deliverable

The product of this system can be queried at http://gis.marshall.edu/projects.asp.

2.4 EFFECTS OF CULVERTS ON FISH MIGRATION IN SOUTHERN WV

2.4.1 Site Selection

As stated in the agreed upon proposal, four streams were selected representing the types of watershed found in southern West Virginia.

- Pinnacle Creek remains highly impacted by both mining and timber practices and is crossed or impacted by large numbers of secondary roads interconnected with jeep and ATV trails. Pinnacle Creek is representative of the many watersheds in southern West Virginia likely to be impacted in the future by commercial ATV trails and associated commerce.
- Hurricane Creek, a small tributary of the Kanawha River with a limited gradient that drains the southern portion of Putnam County was selected as representative of watersheds highly impacted by rapid expansion of residential and associated commercial development. The creek has a large variety of land uses.
- Huff Creek, like Pinnacle Creek had previously been heavily impacted by mining and timbering practices, but is now largely residential with some commercial development with reduced impact from active mining or timbering.
- Whites Creek was selected as representative of streams draining landforms used primarily for residential and low agricultural purposes.

2.4.2 Marking Methods

Fishes were collected sampled by utilizing a backpack shocking unit. Power settings were intentionally set low to reduce fish stress. Increased stress can lead to higher mortality rates. Probes from a backpack are placed into the stream. The collector moves upstream in a zigzag pattern to increase coverage. Shocked fishes are netted and placed in a bucket. Blocking nets or natural structures such as riffles limit the shocking area. Collected fishes are identified and marked by clipping either the lower or upper edge of the caudal fin. Limited fin blood flow reduces stress and the mark is readable for ten to twenty weeks for most fishes.

2.4.3 Findings by Location

2.4.3.1 Initially two streams were chosen to complete a small scale fish movement studies, Pinnacle Creek in Wyoming County and Hurricane Creek in Putnam County. Tables 1-4 lists the fish species and numbers initially tagged on the two streams.

2.4.3.1.1 Five species were collected from Pinnacle Creek (Table 1). Last year, 2003, was an unusually wet year. Very high stream levels, including some significant flooding prevented access. The high water was widespread and a time extension was requested. Late winter and spring of 2004 was also wetter than average. Based on low species diversity, logistics, and water conditions the Pinnacle Creek site was discontinued.

2.4.3.1.2 Thirteen Species were collected from Hurricane Creek in the initial study (tables 2-4).

2.4.3.2 A second study was begun in June of 2004. Three sites on Hurricane Creek were revisited and fishes re-marked as fin clips have a limited time before they become unreadable due to growth or additional damage. We consistently collected fewer fishes during the second study (Tables 5 to 13). This was due to not marking fish less than 35 mm total length. Marking small fish increases handling time and increase potential for mortality. The power on the electro shocking unit was also lowered to reduce stress on fishes that were to be re-sampled in a very limited time frame.

2.4.3.2.1 Site one was on the main stem of Hurricane Creek on Camp Happy Valley Road. The upstream segment extended into a subdivision with very limited riparian cover. A large box culvert separated a downstream segment with greater riparian cover and a more diverse geomorphology.

Twelve species were collected all three sampling times (Tables 5 to 7). The total number of specimens increased from 90, 142, and 176. This increase was due to dropping water levels. Less than 20% of the recaptures were fin clipped. Low recapture rates are not unusual in small streams. No marked fish moved downstream. One Johnny Darter and one Stoneroller moved upstream during the study. This is a five percent movement rate in less than three weeks.

2.4.3.2.2 Site two was on an unnamed tributary to Hurricane Creek at Popular Fork Road. The upstream segment extended behind a housing development. The downstream segment had greater riparian cover of small trees and shrubs. The number of individuals collected ranged from 56 to 65 (Tables 8 to 10). Species diversity increased slightly from five to seven species. Again recapture rates were low but consistent. No marked individuals at this site were found to move during the study.

2.4.3.2.3 Site three was an unnamed tributary of Hurricane Creek on North Popular Fork Road. The riparian cover was much greater downstream. This site paralleled either side of the road for its entire length. Four species with 89 to 114 individuals were collected from this site each sampling effort (Tables 11 to 13). Two creek chub moved downstream during the study. A single blacknose moved upstream. Two individuals were incorrectly marked and released during the initial sampling. The recollected individual could have been one of these specimens. Four marked fishes from 116 recaptures or approximately 3% of the total were found to move during this study. These fishes included a Stoneroller, a Johnny Darter, and two Creek Chubs. All three species are common in small streams in West Virginia. This study did show movement of a number of species. However additional studies including assessment of movement rates

For the complete results, see the tabular fish distribution data in Appendix I

3.0 CONCLUSIONS AND FINDINGS

3.1 GIS is useful in identifying streams and stream crossings as well as stream features and mapping them relative to fish distribution and indicators (e.g. RBA values) of environmental quality. Elevation (z) data from elevation files is useful in identifying regions where stream gradient might contribute to high stream velocities

3.2 GIS also can identify those species of fish that might normally be found in a stream reach relative to those currently present. If a stream has adequate water quality, the absence of fish in stream reaches, where they have been historically present may indicate that culverts are restricting fish movement and subsequently reducing population numbers and species richness. .

3.3 If the numerical values produced by FishXing software predicts that a culvert obstructs certain fish species, then the benefit of replacing or altering the culvert must be weighed relative to the number of upstream obstructions as well as upstream water quality. These features are best mapped and recorded in a GIS system.

4.0 RECOMMENDATIONS

4.1 The lack of information about fish swimming abilities and movement through culverts of West Virginia fishes can most easily be rectified via mark/recapture studies above and below potential obstructions such as culverts. The means of assessing fish swimming ability involve in situ marking of fishes and re-sampling their locations to determine movement.

Techniques can be grouped into three categories: 1) Batch marks, 2) Individual marks, and 3) Direct measures.

1) Batch marks have the advantages of low cost, speed of tagging, and ease of marking large numbers of specimens. There is a great variety of commercially available tags. Fin clipping has also been utilized extensively. Readability becomes problematic after a short period. A small proportion of fishes may have fin damage and be misinterpreted. This is usually a very small source of error.

2) Individual marks include a number of techniques that inject alphanumeric tags or label into or onto the fish. This allows for the calculation of both population and individual fish movements. Individual movements can be significant since the largest females contribute more to reproduction. Typically they are intermediate to batch marking and direct measure techniques in terms of cost and fish stress impacts.

3) Direct measures of fish movement include many types of radio telemetry. These methods involve the surgical implantation of a tag into the body cavity of fishes.

Researchers then track the location of the fish using an antenna. Regular visits along a predetermined transect are utilized to monitor fish movements over time. In some studies receivers are semi-permanently mounted and readings are taken by a data logger. This allows constant updates on movement through stream segments or through made constriction points such as culverts. By tagging a number of specimens, a mean movement of a population can be more directly inferred. These techniques result in the most accurate and comprehensive data. However, the initial cost of equipment is significant and tags can range from $250 to $500 dollars each. Tag life is limited by battery life. Sixty to ninety days is the most common tags utilized. The surgery results in greater stress on the fishes. Stress can change behavior and even lead to mortality. Tags are small but not minute. Small fishes cannot be tagged utilizing these techniques. There is considerable evidence that major fish movements occur during the smallest size classes (Fisher and Pearson. 1987, Finger 1982).

4.2 FishXing software effectively predicts the impact of a culvert of a specific structure, within a stream of a specific geomorphology, on the probable migration of a fish with a specific swimming ability.

1) FishXing organizes culverts into project folders that can be organized by (1) culverts within a watershed, (2) culverts at a specific site (even with multiple designs), and (3) single culverts for a number of species and migration timings. This last feature is more functional for western migratory species such as salmonids.

2) When installing FishXing a folder "Data" is automatically installed which contains by default all folders of type listed below

3)FishXing inputs are organized into "Fish" and "Culvert" inputs. Where appropriate, additional information may be added via the "Tailwaters Option".

4.2.1 FISH INPUTS

4.2.1.1 Fish input includes: species, age class, length, and Minimum water depth. Default fish swimming abilities for "various" species are accessible by default. Again relatively few of these default swimming abilities are relevant to West Virginia waters.

4.2.1.2 Fish swimming ability is calculated using: prolonged and burst speeds, time to exhaustion, and max leap speed.

4.2.1.3 Fish swimming ability is analyzed for "high passage flow" and "low passage flow". Flood flow is discounted.

4.2.2 CULVERT INPUTS

4.2.2.1 Culvert hydraulics is calculated per type, size, and placement. Shape and construction material are included.

4.2.2.2 Installation is recorded "at grade" or "sunken" and includes a measure of "culvert diameter".

4.2.2.3 Culvert span and rise display "height" and "width" of pipe arches and open-bottom arches. These values are particularly relevant to current studies of culverts, because of recent data that suggests that all newly constructed culverts should be open, with irregular bottoms.

4.2.2.4 Manning's roughness coefficients are calculated as default value, when culvert construction type is selected.

4.2.2.5 Culvert elevation and slope are critical values that must be accurately taken on site. All elevations must be tied to a common datum. Although this calculation can be done by measuring elevation via "total station" or other survey method, this field can be easily measured and entered as "slope". Slope requires minimal equipment and can be accurately used for this data entry.

4.2.2.6 Culvert type and Roughness are the last culvert "inputs" fields.

4.2.3 TAILWATER OPTIONS

Tailwater options are used to define tailwater elevation by (1) constant tailwater method, (2) user defined rating curve method, or (3) channel cross-section method.

4.2.4 VIEWING RESULTS

After completion of all fields and after clicking on "calculate" the user enters a "What Now?" window. After clicking on report, the user is presented with a series of fields that can be selected for inclusion in the report.

APPENDIX I: RESULTS FISH CAPTURE DATA

Table 1. Fishes marked at Pinnacle Creek, Wyoming Co., WV

Fish Species	Downstream	Upstream
Creek Chub	36	72
Blacknose Dace	98	40
Northern Hogsucker	4	1
Mottled Sculpin	13	1
Stoneroller	1	3
Total Number	**152**	**117**

Table 2. Fishes marked at Camp Happy Valley on Hurricane Creek, Putnam Co., WV.

Fish Species	Downstream	Upstream	
Creek Chub	59	51	*2 were bottom fin clipped
Stoneroller	0	34	
Golden Red Horse	7	0	
Bluegill	7	0	
Green Sunfish	2	0	
Spotted bass	1	0	
Common shiner	50	13	
Notropis Sp.	2	0	
Bluntnose minnow	10	5	
Silverjaw minnow	17	3	
Johnny Darter	1	3	
Fantail Darter	0	11	
Southern Redbelly Dace	4	0	
Total Number	**160**	**120**	

Table 3. Fishes marked at Popular Fork on Hurricane Creek in Putnam Co., WV

Fish Species	Downstream		Upstream
Creek Chub	26	1 marked upstream	28
Bluegill	3		0
Common shiner	4		0
Bluntnose minnow	1		0
Silverjaw minnow	1		0
Johnny Darter	4		6
Fantail Darter	1		0
Yellow bullhead	5	1 marked upstream	0
Total Number	**45**		**34**

Table 4. Fishes marked at North Popular Fork on Hurricane Creek, Putnam Co., WV

Fish Species	Downstream	Upstream	
Creek Chub	32	20	*1marked downstream
Blacknose Dace	9	6	
Stoneroller	2	0	
Southern Redbelly Dace	32	3	
Total Number	**75**	**29**	

Table 5. Fishes fin clipped on 6/25/04 in Hurricane Creek at Camp Happy Valley Road.

Fish Species	Downstream	Upstream
Creek Chub	20	4
Stoneroller	1	
White Sucker	1	
Golden Red Horse	1	
Bluegill	4	
Green Sunfish	6	
Spotted bass	2	
Common shiner	10	2
Bluntnose minnow	7	3
Silverjaw minnow	2	
Johnny Darter	4	6
Fantail Darter		17
Total Number	**58**	**32**

Table 6. Fishes collected on 6/30/04 in Hurricane Creek at Camp Happy Valley Road.

	Downstream			**Upstream**		
Fish Species	Top Clip	Bottom Clip	No Clip	Top Clip	Bottom Clip	No Clip
Creek Chub		10	42	1		18
Stoneroller						3
White Sucker						
Golden Red Horse			2			1
Bluegill		3	12			
Green Sunfish		1	4			
Spotted bass			2			1
Common shiner			4			1
Bluntnose minnow		1	6	1		8
Silverjaw minnow			1			5
Johnny Darter		1	1		1	4
Fantail Darter				3		5
	0	16	74	5	1	46
	TOTAL:	90		TOTAL:	52	

Table 7. Fishes collected on 7/12/04 in Hurricane Creek at Camp Happy Valley Road.

Fish Species	Downstream Top Clip	Downstream Bottom Clip	Downstream No Clip	Upstream Top Clip	Upstream Bottom Clip	Upstream No Clip
Creek Chub		9	37			29
Stoneroller		1	3		1	3
White Sucker		1				
Golden Red Horse			2			
Bluegill			5			
Green Sunfish			2			
Spotted bass						
Common shiner			10			5
Bluntnose minnow		1	29			8
Silverjaw minnow			11			2
Johnny Darter		1	8			1
Fantail Darter				1		6
	0	13	107	1	1	54
	TOTAL:	120		TOTAL:	56	

Table 8. Fishes fin clipped on 6/25/04 in Hurricane Creek at Popular Fork Road.

Fish Species	**Downstream**	**Upstream**
Creek Chub	22	23
Green Sunfish	2	
Yellow Bullhead	2	
Bluntnose minnow	1	
Johnny Darter	1	5
Total Number	28	28

Table 9. Fishes collected on 6/30/04 in Hurricane Creek at Popular Fork Road.

Fish Species	Downstream Top Clip	Downstream Bottom Clip	Downstream No Clip	Upstream Top Clip	Upstream Bottom Clip	Upstream No Clip
Creek Chub		7	30	2		11
Green Sunfish		1				
Yellow Bullhead		1				
Bluntnose minnow			9			
Stoneroller			2			
Johnny Darter			2			
Total Number	0	9	43	2	0	11
	TOTAL:	52		TOTAL:	13	

Table 10. Fishes collected on 7/12/04 in Hurricane Creek at Popular Fork Road.

	Downstream			Upstream		
Fish Species	Top Clip	Bottom Clip	No Clip	Top Clip	Bottom Clip	No Clip
Creek Chub		6	21	7		9
Green Sunfish			1			
Bluegill			1			
Yellow Bullhead			1			
Silverjaw minnow			1			
Bluntnose minnow			2			
Stoneroller						
Fantail Darter						1
Johnny Darter			3	2		2
Total Number	0	6	30	9	0	12
	TOTAL:	36		TOTAL:	21	

Table 11. Fishes fin clipped on 6/25/04 in Hurricane Creek at North Popular Fork Road.

Fish Species	**Downstream**	**Upstream**	
Creek Chub	33	7	1 bottom clip*
Stoneroller	2	0	
Redbelly Dace	21	2	
Blacknose Dace	17	7	2 bottom clip*
Total Number	73	16	

Table 12. Fishes collected on 6/30/04 in Hurricane Creek at North Popular Fork Road.

	Downstream			Upstream		
Fish Species	Top Clip	Bottom Clip	No Clip	Top Clip	Bottom Clip	No Clip
Creek Chub		19	14	1		7
Stoneroller			3			3
Redbelly Dace		8	16	2		4
Blacknose Dace		3	5	3		6
Total Number	0	30	38	6	0	20
	TOTAL:	68		TOTAL:	26	

Table 13. Fishes collected on 7/12/04 in Hurricane Creek at North Popular Fork Road.

	Downstream			Upstream		
Fish Species	Top Clip	Bottom Clip	No Clip	Top Clip	Bottom Clip	No Clip
Creek Chub	2	13	34			7
Stoneroller			11			9
Redbelly Dace		3	11	1		1
Blacknose Dace		3	13		1	5
Total Number	2	19	69	1	1	22
	TOTAL:	90		TOTAL:	24	