

# DUNKARD CREEK MUSSEL RESTORATION

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January 14, 2015

Following is a report of freshwater mussel activities associated with implementation of the Dunkard Creek Restoration Plan.

## Introduction

In August and September 2009, a major mussel kill occurred on Dunkard Creek, Monongalia County, West Virginia. An estimated 25,000 mussels died in the West Virginia portion of the mainstem as a result of this toxic event. While only 14 species were encountered during the subsequent kill assessment, it is believed that 17 species, including the federally endangered snuffbox (*Epioblasma triquetra*), still occurred within the watershed at the time of the kill. It is likely that the kill assessment greatly underestimated the number of mussels killed because water clarity was very poor due to the golden algae bloom and only limited excavation for buried individuals was conducted.

Following a settlement with Consol Energy, the "Proposed Dunkard Creek Fish and Mussel Restoration Plan" was finalized in 2011. A copy can be found at <http://www.wvdnr.gov/Fishing/Dunkard.shtm>. Four monitoring stations were also established in 2011 and active mussel restoration began in 2012. To date, mussel restoration activities have occurred at seven locations (Figure 1).

## Restoration Activities

The West Virginia Division of Natural Resources (WVDNR) does not have a mussel propagation facility and thus primary restoration efforts are being conducted through the release of inoculated host fish. This method still requires the collection of mussel broodstock and extraction of their larvae and the collection or purchase of host fish. The WVDNR does maintain the Belleville Complex which was modified for holding mussel broodstock and short-term holding of host fish (Figure 2). The first broodstock for use in Dunkard Creek were moved into the Belleville Complex in 2011. Secondly, restoration is being conducted through the stocking of adult mussels as they become available.

Mussels from various sources have been used for broodstock and adult restoration efforts. Adult mussels used in restoration activities have come from sites in Pennsylvania including the Allegheny River and French Creek and from sites within West Virginia including Middle Island Creek, Ohio River, North Fork West Virginia Fork Dunkard Creek, North Fork

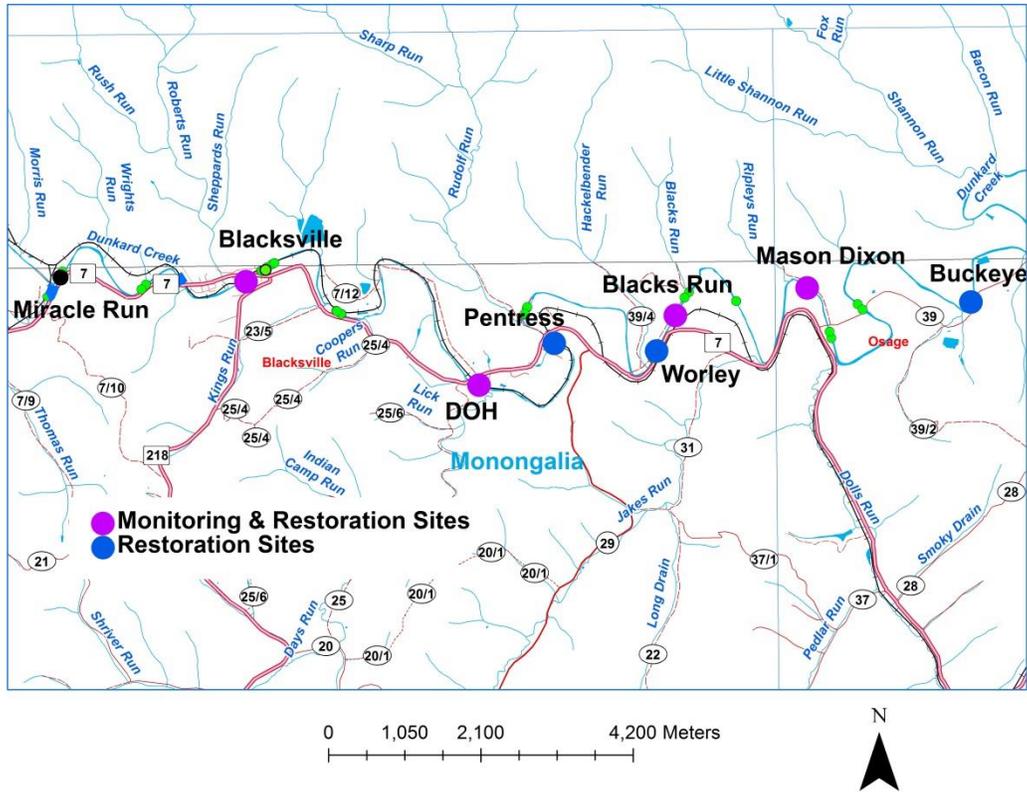


Figure 1. Map showing location of long-term monitoring and restoration sites on Dunkard Creek, Monongalia County, West Virginia.

Hughes River, Elk River, Tygart River and Fish Creek. It is important to keep track of source populations used. Researches in the future may look at genetic variation and it could impact analyses without knowing that mussels have been moved from other watersheds. Table 1 provides a list of source populations used for each species restored. Host fish have either been purchased from Rainbowhead Hatchery or collected from the wild.

### Host Fish Inoculation and Release

Host fish inoculations have typically been conducted using two different methodologies. Smaller fish were inoculated while being held within the hauling tank. If the fish were in the tank for any length of time the water was changed to reduce the amount of fish slime within the water. Mussel larvae were extracted from the broodstock and placed into the hauling tank with the fish. The tank was aerated which aided in keeping the larvae moving within the tank to increase the rate of inoculation. Larger fish like the freshwater drum



Figure 2. Mussel holding tank at DNR Belleville Complex used for over-wintering broodstock. (Clayton photo)

were inoculated by using a syringe filled with extracted larvae. The larvae were then placed onto the gills on one side of the host fish. Only one side was used to reduce the chances of over-inoculating the fish thereby impacting the fish's respiration. The broodstock used were typically tagged and released into a restoration site.

Active restoration of Dunkard Creek began in 2012 with the release of inoculated bluegill into Dunkard Creek at two sites. That year, wild freshwater drum were also electro-fished from the Monongahela River, inoculated, transported and then released at two additional sites. Similar efforts were conducted in 2013 and 2014.

In 2014 the owner of the hatchery developed health issues which prevented the purchase of fish and as a result bluegill were electro-fished from two impoundments in Monongalia County, WV by the WVDNR (Figure 3). The fish were inoculated and then transported and released into Dunkard Creek at the Blacks Run and Buckeye Church sites. Freshwater drum were collected from the Monongahela River on 2 May 2014. Due to boat malfunction only six drum were collected, infested with mussel larvae and then transported to the Buckeye Church site and released. Tables 2 and 3 provide a summary of restoration efforts by inoculation and release of host fish.



**Figure 3. Bluegill being electro-fished by WVDNR personnel in Mason Lake, Monongalia County WV, on 28 Apr 2014. (Clayton photo)**

To date most restoration efforts have been conducted with long-term brooders which are those mussel species that hold their larvae over a long period of time. This allows collection of gravid individuals in advance of when they will be needed. This year an attempt was made to stockpile individuals within their resident waterbody for easier collecting when they are needed. To that end, surveys were conducted in the Blackwater River and Teter Creek Lake in 2014. The Belleville Complex continues to be used as well for overwintering of long-term broodstock. Additionally an attempt was made during the spring of 2014 to collect the short-term brooder, pistolgrip (*Tritogonia verrucosa*), from the North Fork Hughes River but stream conditions did not allow collecting within the short time that this species was gravid. Short-term brooders are those species that spawn and release mature larvae within a short period (weeks to two months).

### **Adult Mussel Stocking**

As previously mentioned, only adult mussels that become available for restoration activities due to other stream activities would be used for stocking. We do not want to disturb or possibly harm existing populations to restore a lost population. To date, four such activities have provided opportunities to salvage mussels for use in Dunkard Creek Restoration. Also, once inoculations are complete as described above, the broodstock used are stocked into Dunkard Creek. All stocked adults are tagged with glue-on tags or in a few instances, the shell was scored. Any mussels brought into West Virginia from out of state undergo quarantine prior to stocking in order to reduce the chance of disease transmission or introduction of an exotic species.

Wildlife Diversity personnel from the WVDNR conducted a unionid survey for the Natural Resources Conservation Service (NRCS) downstream of the North Bend Dam on the North Fork Hughes River in May 2013. This survey was a requirement prior to conducting bank stabilization activities. Common species encountered that were known to be lost from Dunkard Creek were salvaged and relocated to Dunkard Creek. Eleven species were stocked at the Mason Dixon restoration site.

In June 2013 while collecting clubshell from the Allegheny River at Hunter Station, PA for reintroduction into the Little Kanawha and Ohio Rivers, five additional common species were also collected for use in Dunkard Creek restoration efforts. The Hunter Station site was targeted since a bridge construction project will soon require salvage and relocation of resident mussels. These salvaged mussels underwent quarantine at the Belleville Complex before being stocked into Dunkard Creek at the Blacksville restoration site.



**Figure 4. Quarantine tanks at USFWS Middle Island facility awaiting mussels September 2014. (Clayton photo)**



**Figure 5. WVDNR personnel and volunteers stock salvaged mussels into Dunkard Creek, Monongalia County, WV, September 2013. (Everhart photo)**

On 10 Sep 2014, approximately 1600 common mussels salvaged from French Creek, PA were transported and temporarily quarantined at the United States Fish and Wildlife Service (USFWS) Middle Island facility, Pleasants County (Figure 4) until stocking on 15 Sep 2014. These animals were stocked at the Worley and Pentress sites on Dunkard Creek. Also during 2014 the WVDNR received 453 *Lampsilis fasciola* propagated at WSSNFH. These animals were transported and housed at the Palestine Fish Hatchery on 13 Jun 2014 for grow-out prior to stocking. The surviving 370 individuals were stocked into Dunkard Creek on 15 Sep 2014 at the Worley site.

In 2013 and 2014, unionids salvaged from bridge construction projects on French Creek of the Allegheny River, PA were received from Envirosience, Inc. All unionids underwent quarantine at the USFWS Middle Island facility. Table 2 provides information on all adult mussel stockings into Dunkard Creek. To date nearly

2800 mussels of 17 species have been translocated (Figure 5, Table 4) into five locations within Dunkard Creek.

## Monitoring

Four of the six planned long-term monitoring sites were established in 2011. Surveys were conducted using the quantitative three random start systematic sampling design as described by Strayer and Smith 2003 (Figures 6 and 7). All samples were excavated. These sites allowed us to establish a baseline of any surviving extant mussel species and their numbers.



**Figure 6. WVDNR Diversity personnel Craig Stihler and Jennifer Chancey sorting a substrate sample from Dunkard Creek at the Blacks Run long-term monitoring site, Monongalia County, West Virginia. (Clayton photo)**

Figure 1 shows the long-term monitoring sites established thus far as well as those areas where restoration is being conducted. Additional monitoring is slated for 2015.

A fish kill on Miracle Run, an upstream tributary of Dunkard Creek, Monongalia County, WV occurred as a result of a mine impoundment leak resulting in significantly high conductivity levels at nearly 20,000  $\mu\text{S}$  in late September 2014. The mouth of Miracle Run is approximately two miles above the closest mussel restoration site on Dunkard Creek, the Blacksville Bridge site. On 20 Sep 2014 this site was visited to determine if the relocated mussels were being impacted. At the time of the survey, conductivity levels were above 1500  $\mu\text{S}$  but no recent mussel mortality was observed.

## Acknowledgements

The WVDNR would like to thank the Pennsylvania Fish and Boat Commission for their cooperation that has permitted salvaged mussels from Pennsylvania to be used for restoration

These quantitative surveys, conducted from 7 Jun to 24 Aug 2011, found no live native mussels. Given the amount of shell material that remained in Dunkard Creek immediately after the kill event, it was surprising to find a significant lack of shell material two years later. In addition, the shell material that remained was in very poor condition. For this reason, no attempt was made to refine the kill estimates. Although no live unionids were observed, the Asiatic clam, *Corbicula fluminea*, appeared to be making a quick recovery. Density estimates ranged from 3.96 to 9.98 clams/ $\text{m}^2$  at the four sites surveyed. Other aquatic life observed during the surveys included midge, fishfly, mayfly, beetle, and dragonfly larvae, limpets, fingernail clams, oligochaeta, and crayfish.



**Figure 7. WVDNR Diversity Biologists collecting quantitative samples in Dunkard Creek at the Blacksville long-term monitoring site, Monongalia County, West Virginia. (Clayton photo)**

efforts in West Virginia. Thank you to Enviroscience, Inc. for conducting some of those salvage operations and transporting the mussels to West Virginia. Thank you to AllStar Ecology and the US Environmental Protection Agency personnel for volunteer efforts in stocking mussels into Dunkard Creek. Many thanks to the USFWS Ohio River Islands National Wildlife Refuge staff and volunteers for their assistance in constructing, maintaining and care of mussels in quarantine and to White Sulphur Springs National Fish Hatchery for providing algae for feeding of the mussels while in quarantine.

Table 1. Source populations used for Dunkard Creek mussel restoration efforts. Mussels were either used for adult (A) translocations, broodstock (B) for host inoculations and release, or for juvenile (J) propagation.

Species	Source Population
<i>Alasmidonta marginata</i> (A)	FC
<i>Amblema plicata</i> (A)	NFHR, FC
<i>Elliptio dilitata</i> (A)	AR, FC
<i>Fusconaia flava</i> (A)	NFHR
<i>Lampsilis cardium</i> (A)	OR, NFHR, MI, ER, LK, AR, FC
<i>Lampsilis fasciola</i> (A, J)	WSSNFH (?), FC
<i>Lampsilis siliquoidea</i> (A, B)	OR, NFHR, MI, FsC, NFWVD, FC
<i>Lasmigona costata</i> (A, B)	NFHR, MI, AR, FC
<i>Leptodea fragilis</i> (A, B)	NFHR, MI, LK, OR?, FC
<i>Pleurobema sintoxia</i> (A)	FC
<i>Potamilus alatus</i> (A, B)	OR, NFHR, MI
<i>Ptychobranchnus fasciolaris</i> (A)	AR, FC
<i>Pyganodon grandis</i> (A, B)	NFHR, NFWVD, FC
<i>Strophitus undulatus</i> (A, B)	TVR, NFHR, AR, FC
<i>Tritogonia verrucosa</i> (A)	NFHR
<i>Utterbackia imbecillis</i> (A)	NFHR
<i>Villosa iris</i> (A)	FC

Ohio River - OR  
 North Fork Hughes River - NFHR  
 Middle Island Creek – MI  
 Fish Creek - FsC  
 Elk River –ER

Little Kanawha – LK  
 Tygart Valley River - TVR  
 North Fork West Virginia Fork  
 Dunkard Creek - NFWVD  
 Allegheny River, PA - AR  
 French Creek, PA - FC

Table 2. Dunkard Creek freshwater mussel restoration efforts using host fish inoculations and subsequent fish stockings, 2012 to 2014.

Species (Source Population)	Host Fish	Restoration Site									
		Blacksville		Blacks Run			Mason Dixon		Buckeye		
		2012	2013	2012	2013	2014	2012	2013	2012	2013	2014
<i>Lampsilis cardium</i>	Bluegill		x		x	x					x
<i>Lampsilis siliquoidea</i>	Bluegill	x	x	x	x	x					x
<i>Lasmigona costata</i>	Bluegill		x		x						
<i>Leptodea fragilis</i>	Freshwater Drum							x		x	x
<i>Potamilus alatus</i>	Freshwater Drum						x	x	x	x	x
<i>Pyganodon grandis</i>	Bluegill	x		x							
<i>Strophitus undulatus</i>	Bluegill	x		x							

Table 3. Total number of fish by species and year stocked into Dunkard Creek after being inoculated with mussel larvae.

<b>Host Fish</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
Bluegill	~1000	~1000	294
Freshwater Drum	12	26	6

Table 4. Freshwater mussels stocked into Dunkard Creek, Monongalia County, West Virginia, 2012 to 2014.

Stocking Location and Year of Stocking	Mason Dixon		Blacks Run	Blacksville	DOH Garage	Worley	Pentress	Buckeye
	2012	2013	2012	2013	2013	2014	2014	2014
<i>Alasmidonta marginata</i>				11				
<i>Amblema plicata</i>		27		12			10	
<i>Elliptio dilitata</i>				330	200	254	200	
<i>Fusconaia flava</i>		10						
<i>Lampsilis cardium</i>		7		6			10	7
<i>Lampsilis fasciola</i>				12		404		
<i>Lampsilis siliquoidea</i>		21	3	3			7	2
<i>Lasmigona costata</i>		10		15			133	
<i>Leptodea fragilis</i>		32		1			1	3
<i>Pleurobema sintoxia</i>							8	
<i>Potamilus alatus</i>	2	6						4
<i>Ptychobranchnus fasciolaris</i>				194	100	300	336	
<i>Pyganodon grandis</i>		59	1				1	
<i>Strophitus undulatus</i>		2	1	12			22	
<i>Tritogonia verrucosa</i>		14						
<i>Utterbackia imbecillis</i>		1						
<i>Villosa iris</i>				3				
<b>Total Number Individuals</b>	<b>2</b>	<b>189</b>	<b>5</b>	<b>599</b>	<b>300</b>	<b>958</b>	<b>728</b>	<b>16</b>
<b>Total Number Species</b>	<b>1</b>	<b>11</b>	<b>3</b>	<b>11</b>	<b>2</b>	<b>3</b>	<b>11</b>	<b>4</b>
<b>Cumulative Total Individuals Stocked</b>				<b>2797</b>				