

DUNKARD CREEK MUSSEL RESTORATION

West Virginia Division of Natural Resources
Wildlife Resources Section
Wildlife Diversity Unit

Janet L. Clayton
and
Michael E. Everhart

April 14, 2016

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 the following link <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. Restoration is also 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

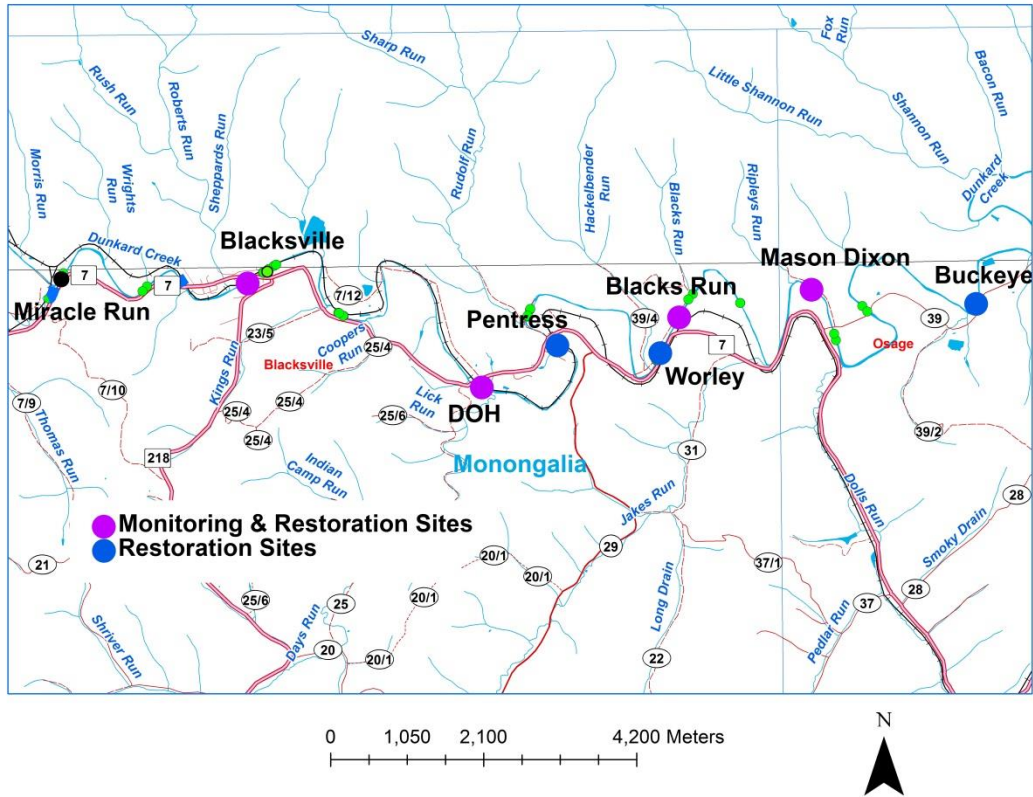


Figure 1. Map showing location of long-term monitoring and restoration sites on Dunkard Creek, Monongalia County, West Virginia.

Hughes River, Elk River, Tygart River, Little Kanawha River and Fish Creek. It is important to keep track of source populations used. Researchers in the future may look at genetic variation and it could impact their 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 (RH) 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 were inoculated by using a syringe



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

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 from 2013 through 2015.

In 2015 the WVDNR again purchased approximately 1,000 Bluegill from RH and inoculated them with the Plain Pocketbook (*Lampsilis cardium*). These host fish were divided in half and released at Blacksville and Blacks Run on 21 May 2015. All broodstock were tagged and stocked at the Blacksville site. Twelve Freshwater Drum were collected on 21 April 2015 from the Monongahela River and inoculated using Pink Heelsplitter (*Potamilus alatus*). Six Freshwater Drum were released each at Mason Dixon Park and Buckeye. The Pink Heelsplitter was marked with an X and stocked at the Mason Dixon Park. Table 2 and 3 provide a summary of all restoration activities since 2012.

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. To that end, surveys were conducted in the Blackwater River and Teter Creek Lake in 2014. Forty-two Creeper (*Strophitus undulatus*) were collected in the Blackwater River in the Little Canaan Wildlife Management Area, Tucker County, WV in 2014 and placed in a holding area of the river for broodstock use in 2015. The Blackwater River experienced unusually high water events over winter and into spring and only eight of these animals were recovered in April of 2015. Three of these eight were female but had already released all or most of their glochidia. The other five did not show signs of gravidity and all were returned to the stream. The Belleville Complex continues to be used as well for overwintering of long-term broodstock. Stream conditions did not allow collecting of the short-term brooder, Pistolgrip (*Tritogonia verrucosa*), from the North Fork Hughes River again in the spring of 2015. 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 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, 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 to reduce the chance of disease transmission or introduction of an exotic species. A temporary quarantine facility at the United States Fish and Wildlife Service (USFWS) Middle Island facility, Pleasants County, WV (Figure 3) has been used in past years for out of state mussels. This facility was not utilized in 2015 as no out of state animals were brought into the state. In 2015, as part of another project, pathogen testing of a subset of mussels from the source population demonstrating negative results allowed for direct stocking of mussels into State waters following cleaning of the mussel shell and one water

change that could be done in transport to the receiving location. This procedure may be used for future translocations into Dunkard Creek as well.

Wildlife Diversity personnel from the WVDNR conducted a mussel 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 2013. This scenario was repeated in 2015 when the WVDNR conducted a systematic survey of the area of direct impact and salvage zone for the North Bend Dam project. Thirteen common species of freshwater mussels were salvaged, tagged and transported to the Blacksville site and stocked on 11 Sep 2015 (Figure 4). To date 3200 mussels of 17 species have been translocated (Table 4) into seven 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. All samples were excavated. These sites allowed us to establish a

baseline of any surviving mussel species and their numbers. 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.

Quantitative three random start systematic surveys as well as qualitative surveys were conducted at the Blacksville, DOH Garage and Mason Dixon sites in June 2015. While no recruitment was observed for any of the native freshwater mussel species there were live adult tagged mussels recovered from previous translocations (Figures 5 and 6). Thirty-two mussels of six species were recorded during those surveys. The Asiatic Clam, *Corbicula fluminea*, and other aquatic life including fish, insects and crayfish continue to thrive in these areas. On 8 Jun



Figure 3. Temporary quarantine tanks at USFWS Middle Island facility. (Clayton photo)



Figure 4. Stocking of common mussels into Dunkard Creek at Blackville, Monongalia County, WV. September 2015. (Doyle photo)

2015 a qualitative survey was conducted downstream of the Buckeye low water bridge where inoculated Freshwater Drum have been released to look for recruitment but no live mussels were encountered. The same day a reconnaissance survey was also conducted to identify a possible additional monitoring site between Buckeye and Mason Dixon Park.



Figure 5. Dunkard Creek quantitative three random start systematic surveys conducted by the WVDNR, Monongalia County, WV. (Everhart photos)

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



Figure 6. Previously stocked adult freshwater mussels recovered during quantitative surveys in Dunkard Creek in June 2015. (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 propagation (J).

Species	Source Population
<i>Alasmidonta marginata</i> (A)	FC
<i>Amblema plicata</i> (A)	NFHR, FC
<i>Elliptio dilatata</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>Ptychobranhus 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 2015.

Species (Source Population)	Host Fish	Restoration Site													
		Blacksville			Blacks Run				Mason Dixon			Buckeye			
		2012	2013	2015	2012	2013	2014	2015	2012	2013	2015	2012	2013	2014	2015
<i>Lampsilis cardium</i>	Bluegill		x	x		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	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.

Host Fish	2012	2013	2014	2015
Bluegill	~1000	~1000	294	~1000
Freshwater Drum	12	26	6	12

Table 4. Adult freshwater mussels translocated into Dunkard Creek, Monongalia County, West Virginia, 2012 to 2015.

Stocking Location and Year of Stocking	Mason Dixon			Blacks Run	Blacksville		DOH Garage	Worley	Pentress	Buckeye
	2012	2013	2015	2012	2013	2015	2013	2014	2014	2014
<i>Alasmidonta marginata</i>					11					
<i>Amblema plicata</i>		27			12	15			10	
<i>Elliptio dilitata</i>					330	1	200	254	200	
<i>Fusconaia flava</i>		10				15				
<i>Lampsilis cardium</i>		7			6	4			10	7
<i>Lampsilis fasciola</i>					12			404		
<i>Lampsilis siliquoidea</i>		21		3	3	56			7	2
<i>Lasmigona costata</i>		10			15	6			133	
<i>Leptodea fragilis</i>		32			1	47			1	3
<i>Pleurobema sintoxia</i>									8	
<i>Potamilus alatus</i>	2	6	1			16				4
<i>Ptychobranchnus fasciolaris</i>					194	1	100	300	336	
<i>Pyganodon grandis</i>		59		1		220			1	
<i>Strophitus undulatus</i>		2		1	12	1			22	
<i>Tritogonia verrucosa</i>		14				4				
<i>Utterbackia imbecillis</i>		1				16				
<i>Villosa iris</i>					3					
Total Number Individuals	2	189	1	5	599	402	300	958	728	16
Total Number Species	1	11	1	3	11	13	2	3	10	4
Cumulative Total Individuals Stocked	3200									