# Returning Mussels to the Mill Creek in Cincinnati

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### Freshwater Mussels

- Approximately 300 species in Eastern North America (Cummings and Mayer, 1992)
- 10 percent are extinct and over half are endangered (Williams et al. 1993; Stein et al. 2000; Haag 2012)
- Sexes separate in most species
- Mussels occur in beds (clusters), males release sperm, enters females through incurrent siphon, eggs fertilized internally
- Eggs hatch as intermediate parasitic larval stage called glochidia

#### Freshwater Mussel Life Cycle

- Glochidia attach to gills or fins of fish
- May be host species dependent
- Attach for 1 to 25 weeks
- Change into adult form and detach
- Long lived, some up to 100 years
- Feed by filtering detritus and plankton
- Filter up to 40 gallons per day

Cummings and Mayer 1992



### Benefits of Mussels

- Improve water clarity by filtering leads to greater clarity, reduced temperature, and increased dissolved oxygen
- Sequester nutrients, metals and other contaminants
- Modify the channel substrate moving around and filtering, "living rocks"
- Reduces substrate embeddedness, provides better substrate for biofilm, aquatic macroinvertebrates, and spawning fish
- Important part of the ecosystem
- Important food source for muskrat, otter, mink, fish and birds
- Indicators of long term water and habitat quality

Mussels are the canary in the coal mine for aquatic ecologists.

# History of the Mill Creek

- Rated "Most Endangered" in 1994 by American Rivers
- 98 Combiner Sewer Overflows: 220,000 kg N/yr and 6000 kg P/yr (OEPA 2004)
- 106 Sanitary Sewer Overflows: 100,000 kg N/yr and 15,000 kg P/yr (OEPA 2004)
- Channelized, concrete lined for flood control
- Dammed by 22 sewer crossings- reduced fish passage

### Why did the musselleave?

- Channel modification
  Habitat modification
  - Fish passage
- Groundwater drawdown, loss of base flow
- Erosion and sedimentation
- Pollution
- Others?
- The actual reasons may never be known and certainly not documented.

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# Return of the Mill Creek

- MSDGC Consent Decree in 2002 results in \$1B in projects mostly in the Mill Creek
- Supplemental Environmental Projects = \$5M
- 2 WRRSP Projects > \$3.5 M
- 8 Clean Ohio Projects
- > 12 Section 319 Projects

The results of all of this money and projects is a reduction in pollution and an increase in habitat.

### Mill Creek Returns to Attainment

- Base Flow- Groundwater and Upper Mill Creek Water Treatment Facility
- Water Chemistry- loss of industry, discharge improvements
- Macroinvertebrates- huge improvements
- Fish- still the limiting factor due to passage issues
- Habitat- restoration projects

Invertebrate Community Index(ICI) measure of macroinvertebrates living in a stream.



Index of Biological Integrity (IBI) a measure of fish species diversity and species populations.



# **Missing Species**

- Mussels extirpated in the Mill Creek sometime 100-150 years ago.
- Fossil shells found in gravel bars and banks during restoration, so they were there
- There are no records of live mussels at the Cincinnati Natural History Museum
- Corbicula is abundant
- It is safe to assume that there is a large amount of carrying capacity available for mussels

# Is the Mill Creek Ready for Mussels?

- Reduction in CSOs and SSOs due to Consent Decree
- Restoration of whole segments of the creek creating habitat
- Groundwater elevations have risen 80 feet and are connected to the creek
- Removal of over a dozen fish passage barriers and replacement with riffles
- Many segments of the Mill Creek are in full attainment for Warmwater Habitat
- Fish and aquatic macroinvertebrates metrics say yes

### Williamsburg Dam

- East Fork Little Miami River
- Constructed in 1936
- 130 feet wide, 4 feet of elevation
- Impounds 2000 lineal feet of river
- WRRSP Grant from OEPA

# Mussels at Williamsburg Dam

- Subsampling showed a significant population, none endangered
- Estimated 700 mussels would be collected
- Many were species that are pollution tolerant and live in impounded areas with sandy substrates
- 2000 linear feet of this habitat was being removed
- No good candidate relocation areas on the East Fork

What to do with these salvaged mussels?

### Mussel Salvage Plan

- Breech dam
- Collect mussels from along river banks with 65 volunteers
- Sort by species
- Relocate sensitive species upstream
- Relocate portion of the tolerant species to the Mill Creek
- Required approval from the Ohio Department of Natural Resources and US Fish and Wildlife Service for interbasin transfer of species
- Collection, Relocation, Reintroduction, and Restoration

### Volunteers

65 people representing5 universities and6 environmental groups

#### Breach Dam and Drawdown

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### Collect Mussels from Exposed Banks

# Collecting



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### Identification and Sorting



### Mussels Collected and Salvaged

Mussel Species		Salvaged Individuals		Relocated to:	
			Relative		Mill
Scientific Name	Common Name	Abundance	Abundance (%)	EFLMR <sup>1</sup>	Creek
Alasmidonta viridis	slippershell	2	0.3	2	0
Amblema plicata	threeridge	1	0.1	1	0
Fusconaia flava	Wabash pigtoe	1	0.1	1	0
Lampsilis cardium	plain pocketbook	1	0.1	1	0
Lampsilis siliquoidea	fatmucket	40	5.7	12	28
Lasmigona complanata	white heelsplitter	539	76.6	351	188
Lasmigona costata	fluted shell	11	1.6	11	0
Pyganodon grandis	giant floater	40	5.7	15	25
Quadrula quadrula	mapleleaf	1	0.1	1	0
Strophitus undulatus	creeper	9	1.3	9	0
Tritogonia verrucosa	pistolgrip	52	7.4	52	0
Utterbackia imbecillis	paper pondshell	7	1.0	7	0
TOTAL		704	100.0	463	241

### Loading for Transport





### Reintroduction to the Mill Creek

Reintroduction into the Mill Creek

### Next Steps

- Monitor the present population (No formal plan in place)
  - Survival (To date only one mortality)
  - Reproduction
- Introduction of additional populations to new locations
- Introduction of additional species
- Identification of champion (Willing to monitor)
- Development of a formal plan
- Monitor for water quality
- Implications for other streams in the state and country

### View of Dam



### View Downstream



### View Downstream



# View Upstream









#### **Project Partners**

- Village of Williamsburg
- Ohio EPA, Division of Environmental & Financial Assistance (DEFA)
- City of Akron
- Williamsburg Township
- Dualite, Inc.
- Clermont Soil & Water Conservation District
- Clermont County Park District
- Wood, Environment & Infrastructure Solutions
  - Design, Permitting, Project Management
- Sunesis Construction
  - Construction, restoration activities
- Environmental Solutions & Innovations
  - Mussel survey and relocation
- Olde Firehouse Brewery
  - Sponsor for volunteer event
- Mill Creek Alliance
  - Participant

