Vermilion River Mussel Projects – from reintroductions to dam removal

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Vermilion River of the Wabash

**Basin facts**
- 4,000 km² watershed in “corn desert”

- Substrates = sand, gravel & cobble

- 100+ fish species, including 14 darters

- 45 species of freshwater mussels

- One of the “highest quality streams” in Illinois (Smith 1968)
  - Illinois’ only National Scenic River
  - ORBFHP Priority Watershed

- ~200,000 people live in basin
  (largest cities = Urbana & Danville)
Problems of the Vermilion River basin

- Impoundments (4 dams... for now)
- Sedimentation
- Water quality degradation
- Stream dredging & channelization
- Channel destabilization
- Invasive species (*Corbicula*)
- Reduction in host fishes
  - 15 threatened & endangered species
- Future threats - coal and selling of water
Problems of the Vermilion River basin
Reintroduction of the Federally-Endangered Northern Riffleshell and Clubshell
Northern Riffleshell (*Epioblasma rangiana*)

**Habitat** – Medium to large rivers in clean riffle areas with sand, gravel & cobble

**Historical Range** – Ohio River and Lake Erie drainages

**Current Distribution**
- Reproducing in Ohio & Pennsylvania
- Extant in Kentucky, Indiana(?), Michigan, West Virginia & Ontario
- Extirpated from Illinois

**Host fishes** – various darters
Clubshell (*Pleurobema clava*)

**Habitat** – Medium to large rivers in clean riffle areas with sand, gravel & cobble

**Historical Range** – Ohio River and Lake Erie drainages

**Current Distribution**
- Reproducing in Indiana, Kentucky, Michigan(?), Ohio, Pennsylvania & West Virginia
- Extant in Illinois(?) & New York(?)
- Extirpated from Alabama & Tenn.

**Host fishes** – darters, minnows, or suckers
Northern Riffleshell and Clubshell

**Status** – Federally Endangered
(~95% range reduction!)

**Threats** – not due to any one cause but to several compounding problems*

- Dams
- Siltation
- Industrial pollution
- Dredging & channelization
- Exotics (e.g., zebra mussels)

* Other issues
- Short life spans & low fecundity
- Sampling (e.g., bury in substrate)
Objective: Establish viable populations in 10 separate river basins throughout its range via augmentations and reintroductions

- Vermilion River selected as a pilot to assess translocation success
Clubshell and Northern Riffleshell Recovery Plan

Translocation

U.S. Hwy 62 bridge over Allegheny River being replaced in 2018’ish
- Estimate take = 20,000 Northern Riffleshell & 30,000 Clubshell!!!
Objective

Reintroduce both species into Illinois
Game Plan

– Select sites based on suitable habitats (e.g., free-flowing riffles) with diverse mussel fauna and high densities of host fishes

– Stock at densities similar to Allegheny River (~5 indiv/m²)
Site Selection – The Future is Looking Bright

The Vermilion River basin?
Translocation – The Journey Begins in Quarantine

Allegheny River, Pennsylvania

INHS Research Ponds - Champaign, Illinois

“PITy” party
Tagging mussels
Translocation – Welcome to Illinois!!!

Red line is historical range of mussels in Vermilion River

Animals with PIT and plastic tags

Releasing mussels at similar densities as source population.
Translocation – Monitoring

USGS 03336900 SALT FORK NEAR ST. JOSEPH, IL

Gage height, feet

Stats Time – old dog, new tricks

Jeremy, I can help you use the Program MARK to estimate apparent survival and detection probability.

Thanks Alison.
Stats Time – old dog, new tricks

When a mussel is not found during a sampling event, has it perished or is it simply not-detected?

Interested in **both** detection and survival

- Utilized robust design mark recapture model that incorporates detection, survival, and influential variables of each
Detection and Survival – Program MARK

**Project summary:** 2,099 Northern Riffleshells & 1,766 Clubshells released during 4 events (2010, 2012, 2013 & 2014) at 8 sites
- 13 monitoring periods

**Detection:** Detection rate has differed by sampling period and species
- *Temperature* – detection higher in warmer months
- *Species* – Clubshell more likely to be encountered
Detection and Survival – Program MARK

The graph illustrates the probability of detection as a function of temperature. As the temperature increases, the probability of detection also increases.
Detection and Survival – Program MARK

Detection

Temperature (°C)

Probability of detection

Breeding season
Detection and Survival – Program MARK

Encounter rate vs. Years post-translocation

- Year 1: 100%
- Year 2: 80%
- Year 3: 60%
- Year 4: 40%
- Year 5: 20%
**Detection and Survival – Program MARK**

**Survival:** ~98% monthly survival (=78% annual)
- ~30% of our original (2010 year class) animals predicted alive
- Survival most influenced by species, mussel size, river, and floods
  - *Species* – Clubshell 3x more likely to survive
  - *Length* – Larger mussels more likely to survive
  - *River* – Salt Fork Vermilion mussels more likely to survive
  - *Max Flow* – Series of high discharge events reduces survival

![Graph showing water levels]

*Source: USGS 0333900 SALT FORK NEAR ST. JOSEPH, IL*
Baseball is the only field of endeavor where a man can succeed three times out of ten and be considered a good performer - Ted Williams

If you find half of them, you done good - G. Thomas Watters (Ohio St. Univ.)

Ohio project = ~50% encountered riffleshell
Illinois project = 42% riffleshell & 70% Clubshell encountered
What is Success?

Model estimates incorporate more information

- Simultaneously account for detection and survival
- More realistic survival estimates
  - Naïve counts consistently lower than modeled estimates
- Ability to incorporate explanatory variables
  - Environmental variables
  - Site level variables
Concerns – where are the mussels?

Some PIT tags detected near the limits of their range (5"")
  - Northern Riffleshells known to vertically migrate >6”

Reasons for not detected = eaten, tag fell off, tag interference, wanding too fast, washed downstream, etc.
Concerns – where are the mussels?

30 year floods

USGS 03336900 SALT FORK NEAR ST. JOSEPH, IL
Concerns – where are the mussels?

Placed in 2012
Encountered in Summer 2015

Encountered here in Fall 2015

~0.75 km
Future Plans for Illinois

Plans include rigorous monitoring of sites, including excavation
- Target missing adults or new juveniles

Adding more mussels
- Potential for future translocations being evaluated by recovery team
Adding more mussels (cont.)
White Sulphur Springs Hatchery making strides in propagation
- Augment w/ propagated juveniles?
- Infest darters with glochidia?
Bridge scheduled to be replaced in 2018’ish
  - Estimated take = 20,000 Northern Riffleshells & 30,000 Clubshell!!!

Ongoing relocations in Illinois, Ohio, Kentucky & West Virginia
  - Indiana and New York recently began pilot projects

Recovery team discussing conservation issues and weighing options
Stony Creek Manure Spill

Stats – 11 September 2015

- >100,000 gallons of manure
- ~10 miles of stream affected
- ~100,000 dead fishes
- >1 dead mudpuppy
- 0 dead mussels
Damn those dams – their effects on stream ecosystems
History of dams

- 87,000+ dams in the U.S.
  - Most are privately owned
- 77% of all major river basins are impounded
  - ~600,000 miles river (~17%)
- Longest unimpounded river in U.S.
  - Western U.S. = Yellowstone River (692 mi)
  - Eastern U.S. = Wabash River (411 mi)
History of dams

- States with most dams
  - 1st – Texas (7,310)
  - 2nd – Kansas (6,374)
  - 3rd – Missouri (5,119)
  - 4th – Georgia (5,132)
  - 5th – Oklahoma (4,925)
  - 6th – Iowa (3,927)
  - 18th – Illinois (1,592)
  - 25th – Wisconsin (1,185)
  - 30th – Indiana (927)
History of dams

- Dams created for...
  - Irrigation
History of dams

- Dams created for...
  - Irrigation
  - Navigation
History of dams

- Dams created for...
  - Irrigation
  - Navigation
  - Flood control
History of dams

- Dams created for...
  - Irrigation
  - Navigation
  - Flood control
  - Recreation
History of dams

- Dams created for...
  - Irrigation
  - Navigation
  - Flood control
  - Recreation
  - Hydropower
History of dams

• Dams created for…
  * Irrigation
  * Navigation
  * Flood control
  * Recreation
  * Hydropower
  * Drinking water supply
History of dams

- Dams created for...
  - Irrigation
  - Navigation
  - Flood control
  - Recreation
  - Hydropower
  - Drinking water
  - Industrial plants
So what’s the problem?

“Of all the aquatic habitat alterations, dams and their impounded waters are the leading cause of decline and imperilment of mussels”
– Williams et al. (1993) - *Fisheries*
More dam info

- U.S. dam building heyday
  - Mill dams and lock-&#38;-dams built pre-1930s
  - Reservoir dams built 1950s-1980s

- FERC license – 50 year license

Homer Park Dam, Homer, IL

Lake Shelbyville, Shelbyville, IL
What are our options?

- Repair
- $ Costly $
What are our options?

- Repair
  - $ Costly $

- Replace
  - But why?
What are our options?

- Repair
  - $ Costly $
- Replace
  - But why?
- Remove…
In the last 75 years, ~1,150 dams have been removed in U.S. Quinn's 2006 Dam Safety Initiative >20 dams have been removed in Illinois thus far More to come!!!
Danville dam removals???

Funding for dams' removal in danger

Tue, 03/17/2015 - 7:00am | Tracy Moss

DANVILLE — A freeze on state grants for park and forest preserve districts has Danville city officials even more concerned about whether two local river dams that have been the site of multiple drownings will be removed this year as planned.

From Illinois DNR – 15 October 2015 –
“Looks like a section of the dam that had a weap before has blown out. Have not visited the site yet... Just an FYI
Danville dam removals???
Danville dams study – mollusks

- Hand-picking
- Four site-types
  - Control upstream
  - Impounded area
  - Plunge pool
  - Control downstream
- Extant richness
  - 10+ sp / site
  - 7-9 sp / site
  - 3-4 sp / site
  - 0-1 sp / site

ANOVA --- P = 0.02
Danville dams study – mollusks

- Hand-picking
- Four site types
  - Control upstream
  - Impounded area
  - Plunge pool
  - Control downstream

Relative abundance:
- 25+ indiv./hour
- 4-6 indiv./hour
- 0-1 indiv./hour

Danville dam Study site

ANOVA --– P = 0.002
Danville dams study – mollusks

Black Sandshell, *Ligumia recta*
Status: State-threatened
Hosts: *Sander, Lepomis*, and *Micropterus* sp.
Dam removal – au naturel

Homer Park Dam, Salt Fork Vermilion River, Homer, IL = Built ~1830s – Destroyed ~1940s
Homer Park Dam

- Baker and Smith (1919) – dam “appears to form a barrier to the migration up stream of several species”
Dam removal benefits

- Safety / improved recreation

Photo credit: Jason Lindsey
Dam removal benefits

- Safety
- Improve fisheries
Dam removal benefits

- Safety
- Improve fisheries
- Return stream to natural state

Photo credit: Robert Shaw
Northern Riffleshell “Honey-hole”
Allegheny River, Pennsylvania

**Illinois Nat. Hist. Survey + Univ. of Illinois**
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**Illinois Nature Preserves Commission**
**Illinois Endangered Species Protection Board**
**Illinois Wildlife Preservation Fund**

**U.S. Fish & Wildlife Service**
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- Angela Boyer
- Jon Duyvejonck
- Mike Coffey
- Kraig McPeek
- Donovan Henry

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**Pennsylvania Fish & Boat Commission**
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- Western Pennsylvania Conservancy

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- OSUM & Zoo staff

**West Virginia Dept. of Natural Resources**
- Janet Clayton

**The New Gazette**
- Tracy Moss

**Pennsylvania Department of Transportation**
**Illinois Department Of Transportation**

**Northern Riffleshell “Honey-hole” Allegheny River, Pennsylvania**