# *Damn those dams – their effects on stream ecosystems*

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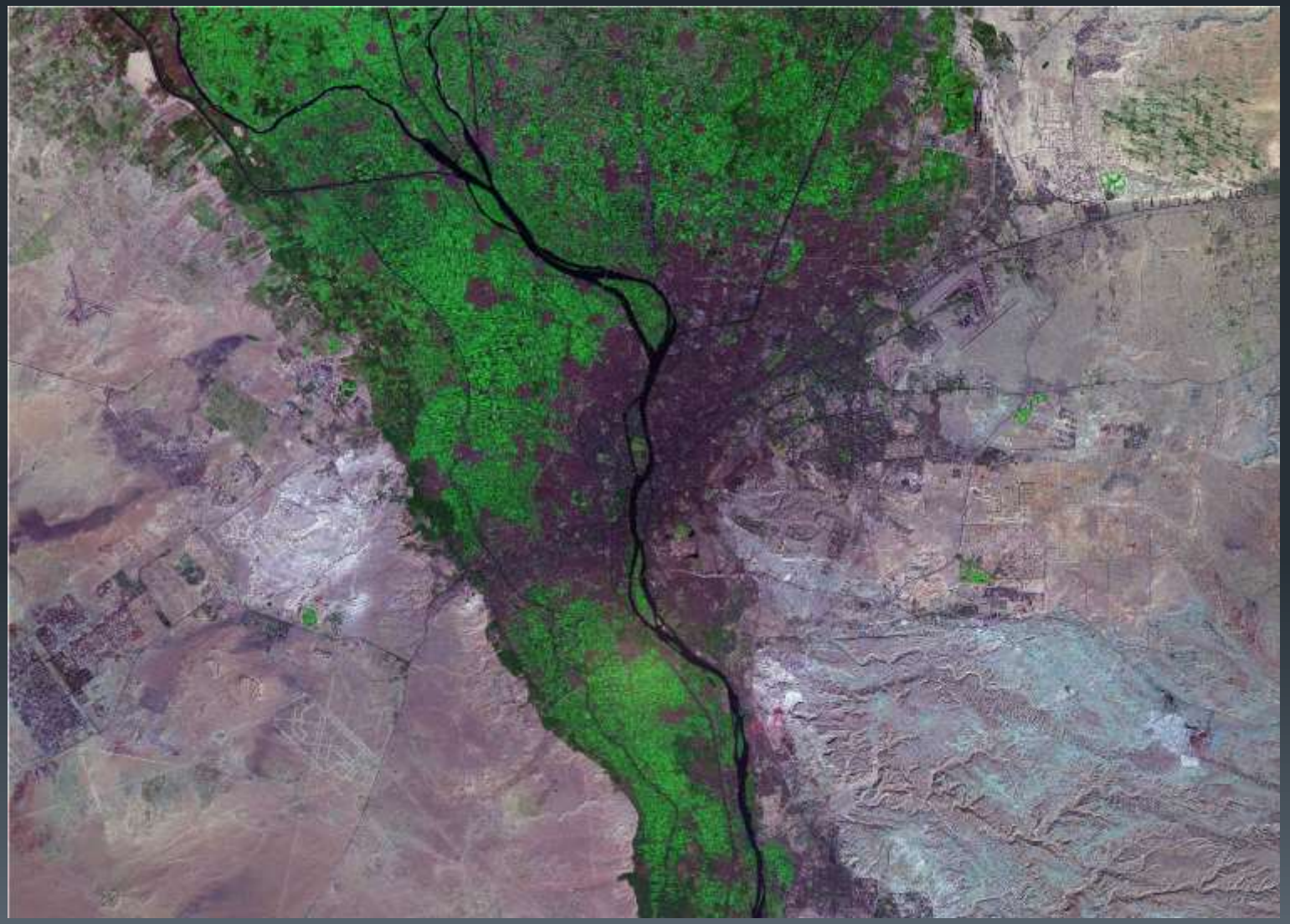
# History of dams



# History of dams

First evidence of dams >4,000 y ago

- 100,000 $m^3$ of rock and rubble for its construction
- Length = 100 m
- Width = 13 m at top & 24 m at base
- ~600,000 $m^3$ of water capacity
- Never finished - destroyed by rains ~10 y into making

# 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

- Largest dams in U.S.
  - Height = Oroville Dam, CA = 770 ft
    Feather River
  - Capacity = Ft Peck Dam, MT = $3.39 \times 10^9$ $ft^3$
    Missouri River
- Oldest dam in U.S.
  - Mill Pond Dam, CT = 1677
    Connecticut River

# 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…
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  - *Flood control

# History of dams

- Dams created for…
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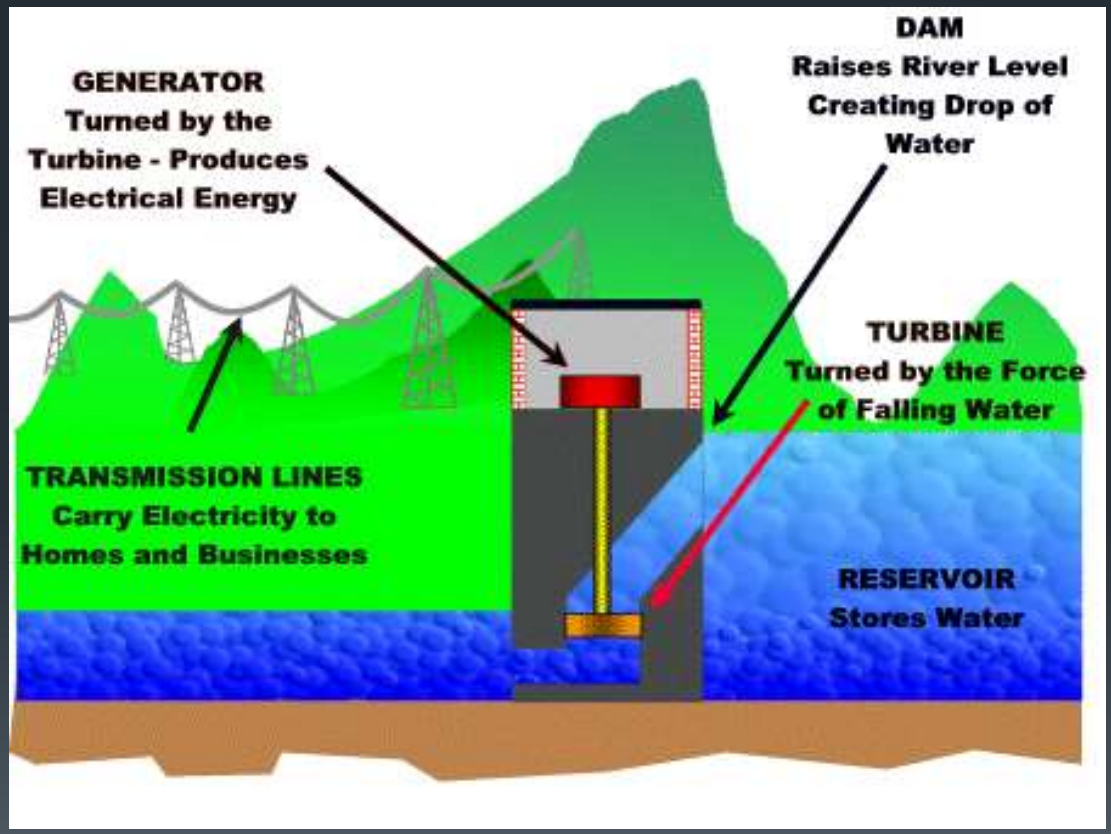
  - *Navigation
  - *Flood control
  - *Recreation

# 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

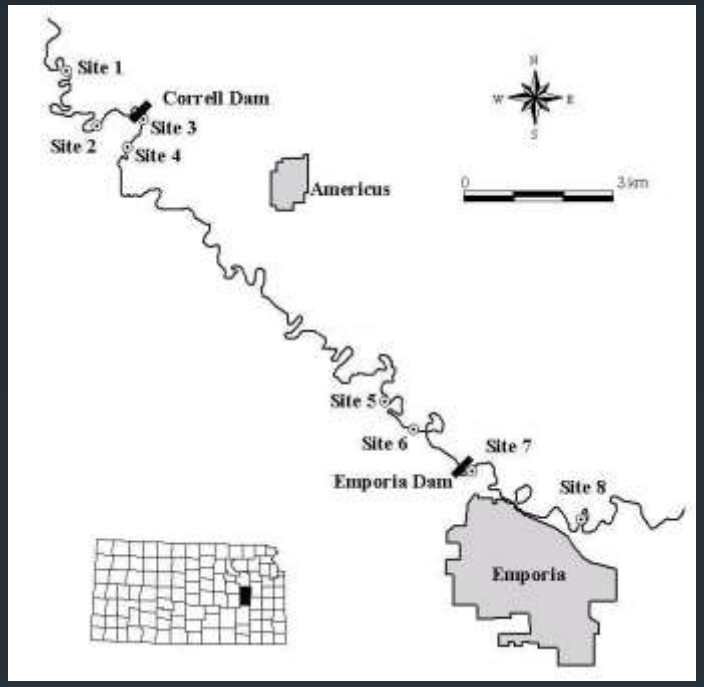
- Dams created for…
  - *Irrigation
  - *Navigation
  - *Flood control
  - *Recreation
  - *Hydropower
  - *Drinking water
  - *Industrial plants

# So what's the problem?

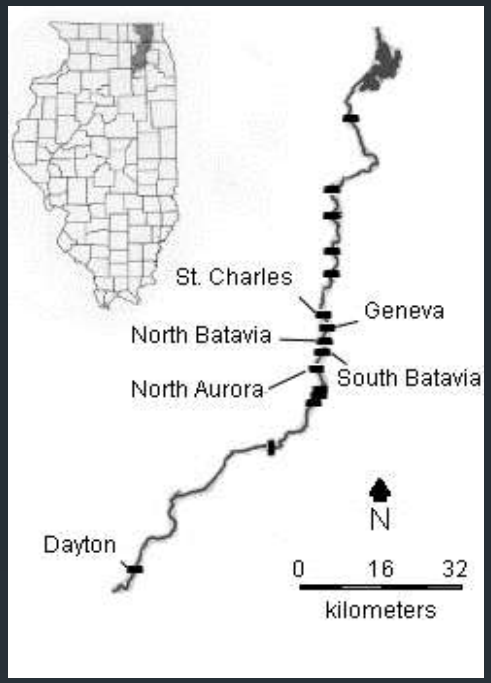
"Of all the aquatic habitat alterations, dams and their impounded waters are the leading cause of decline and imperilment of mussels"

– Williams et al. (in press) - *Fisheries*

# Study areas

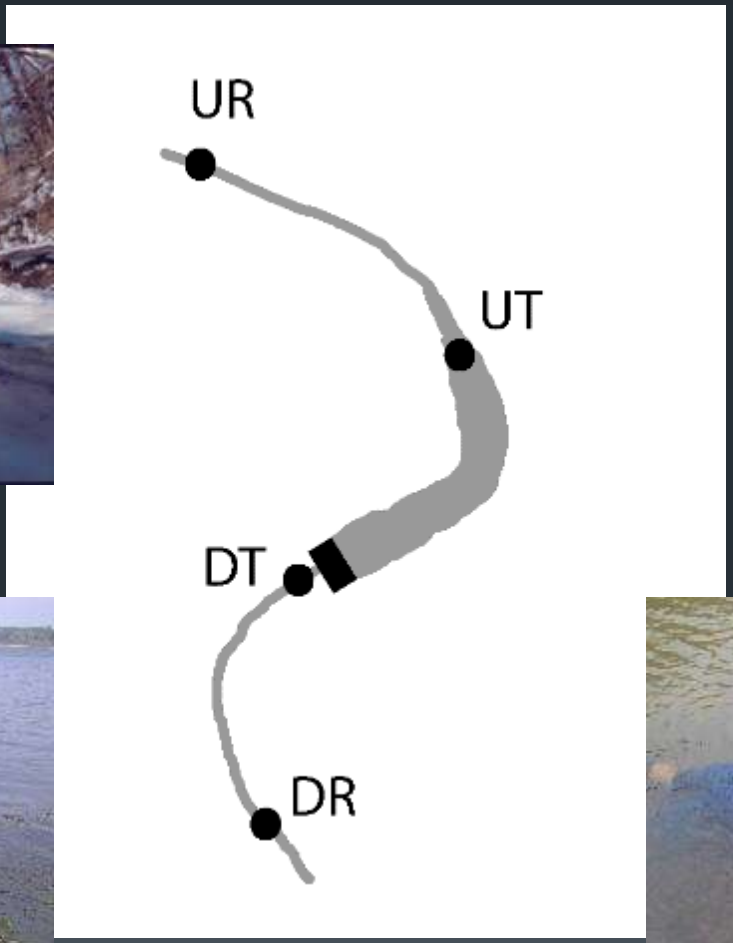



- Neosho River
- Coauthors = J. Dean, D. Edds, D. Gillette, J. Howard, S. Sherraden, & M. Wildhaber




- Fox River
- Coauthors = S. Butler, H. Dodd, N. Owens, & D. Wahl
- Fish = Santucci et al. (2005)

# Study design




# Dam(n) problems

- Changes in stream habitats
  - Upstream – Convert free-flowing habitats to lake habitats

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  - Upstream – Convert free-flowing habitats to lake habitats

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- lost hydrologic diversity
- reduced velocities
- lost riparian zones
- increased bank erosion
- altered gradients
- increased siltation
- more compact substrates
- altered channel morphology

# Dam(n) problems

- Habitat changes = changes aquatic communities
  - Reduced & fragmented populations for many groups


# Dam(n) problems

- Changes in stream habitats
  - Downstream – scour substrates and create plunge pools
    - lost hydrologic diversity
    - altered sediment loads
    - scouring of substrates
    - destabilization of substrates
    - increased bank erosion
    - lost riparian zones
    - altered gradients
    - altered channel morphology

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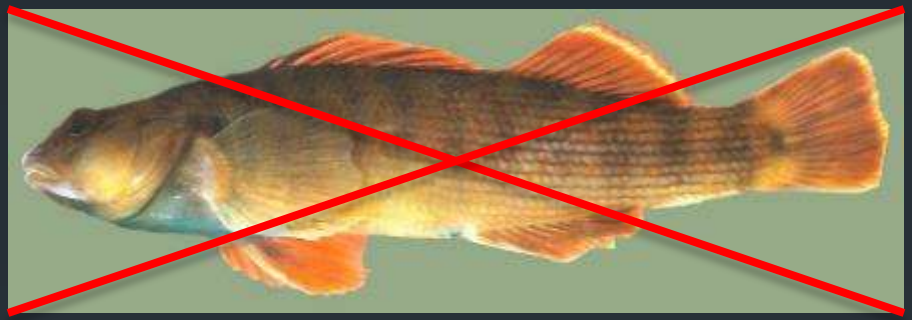
# Dam(n) problems

- Habitat changes = changes aquatic communities
  - Reduced & fragmented populations for many groups



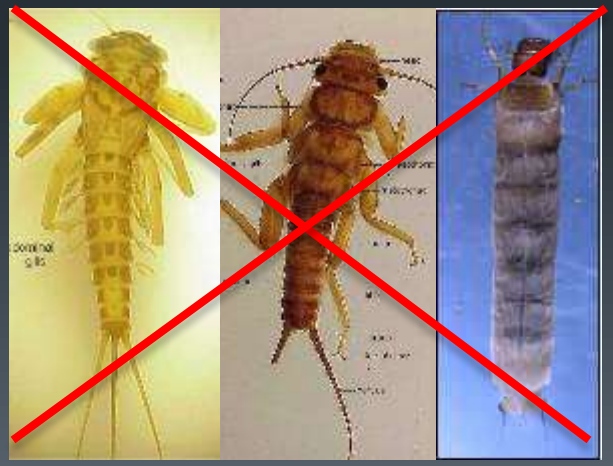
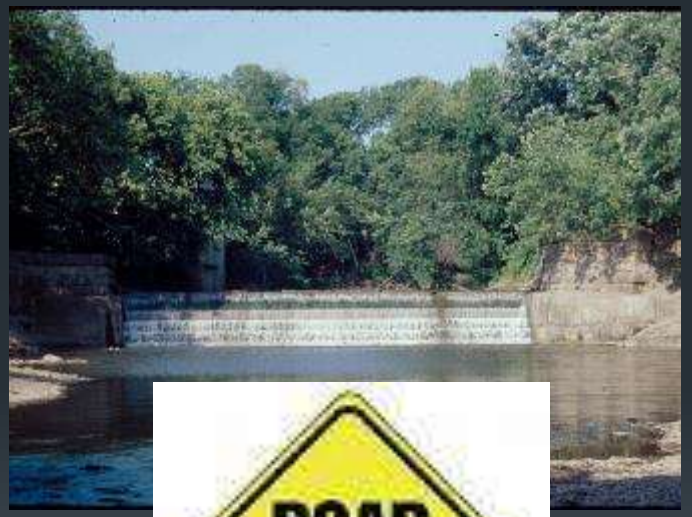


Photo credit: Kevin Cummings

# Dam(n) problems

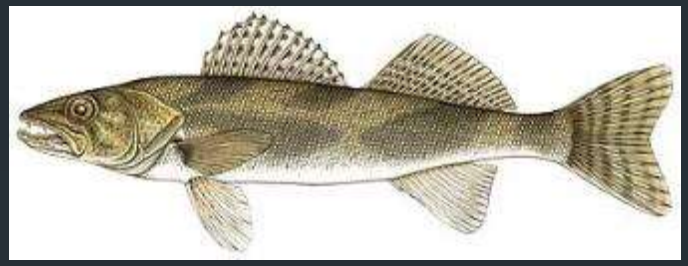
- Physical barrier = altered spawning runs
  - Dams impede fish movement

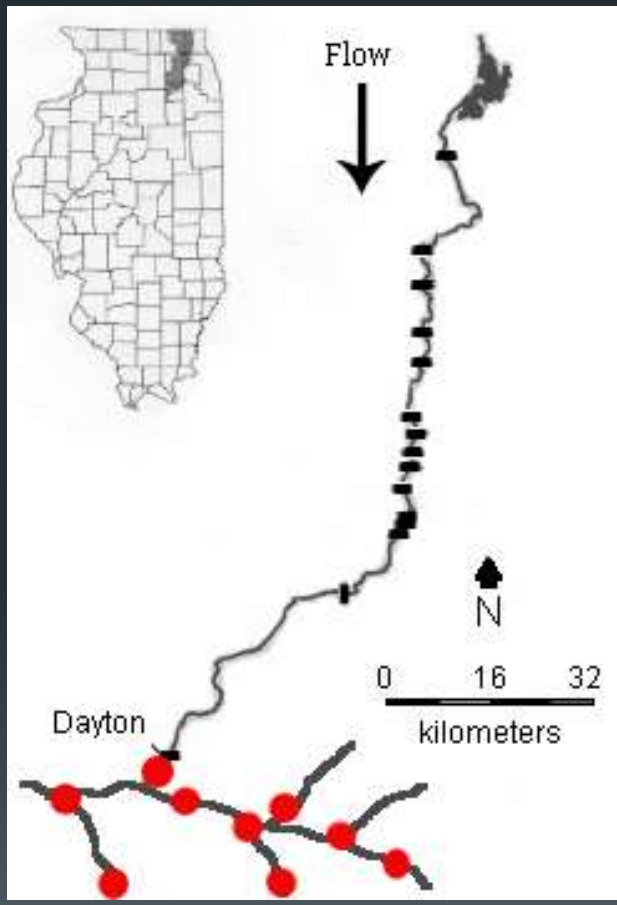



# Dam(n) problems

Dams limited distributions

- Case study: Fox River
  - Fish = Sauger

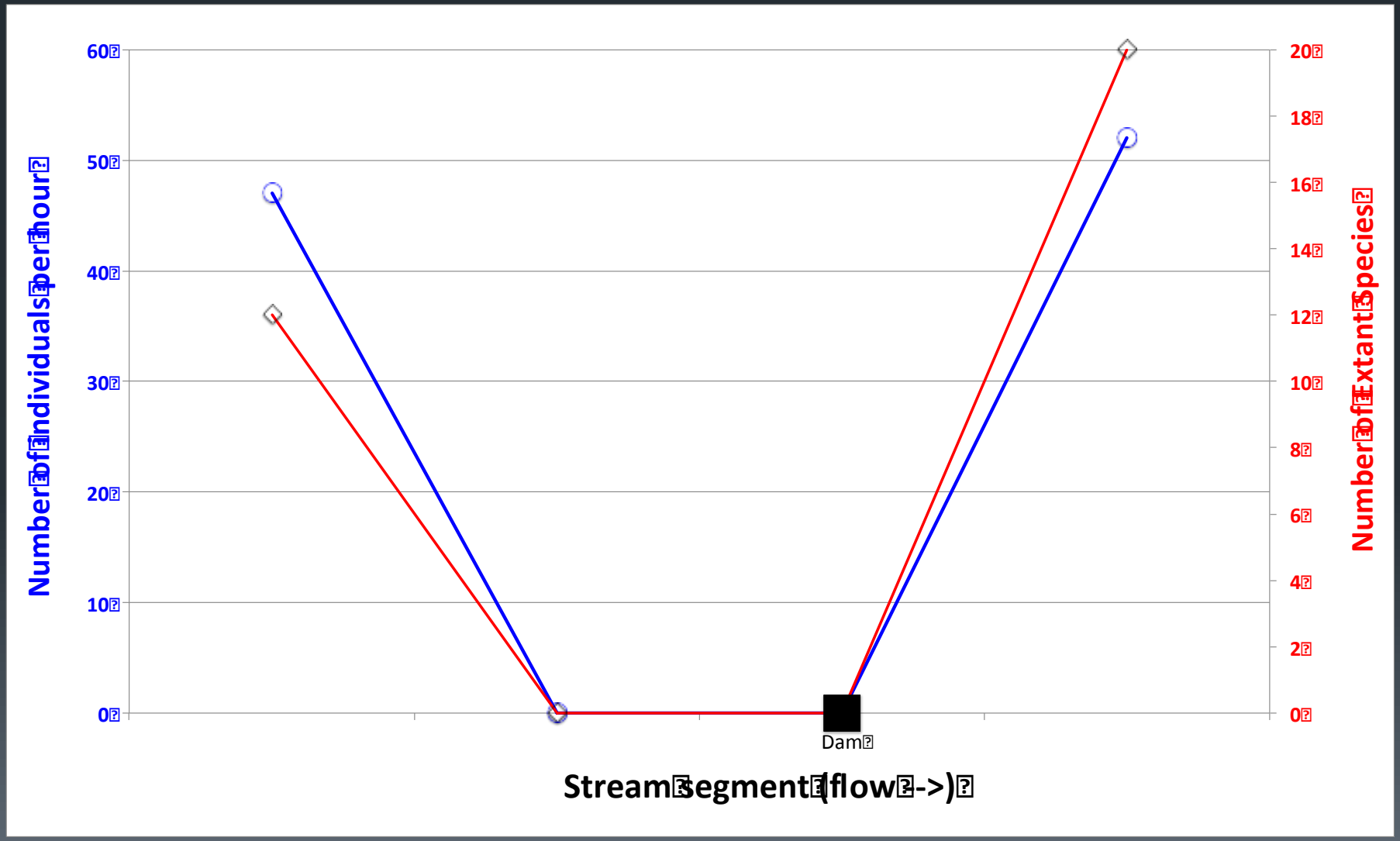





Ditto for catfishes


Dam!

# Dam(n) problems



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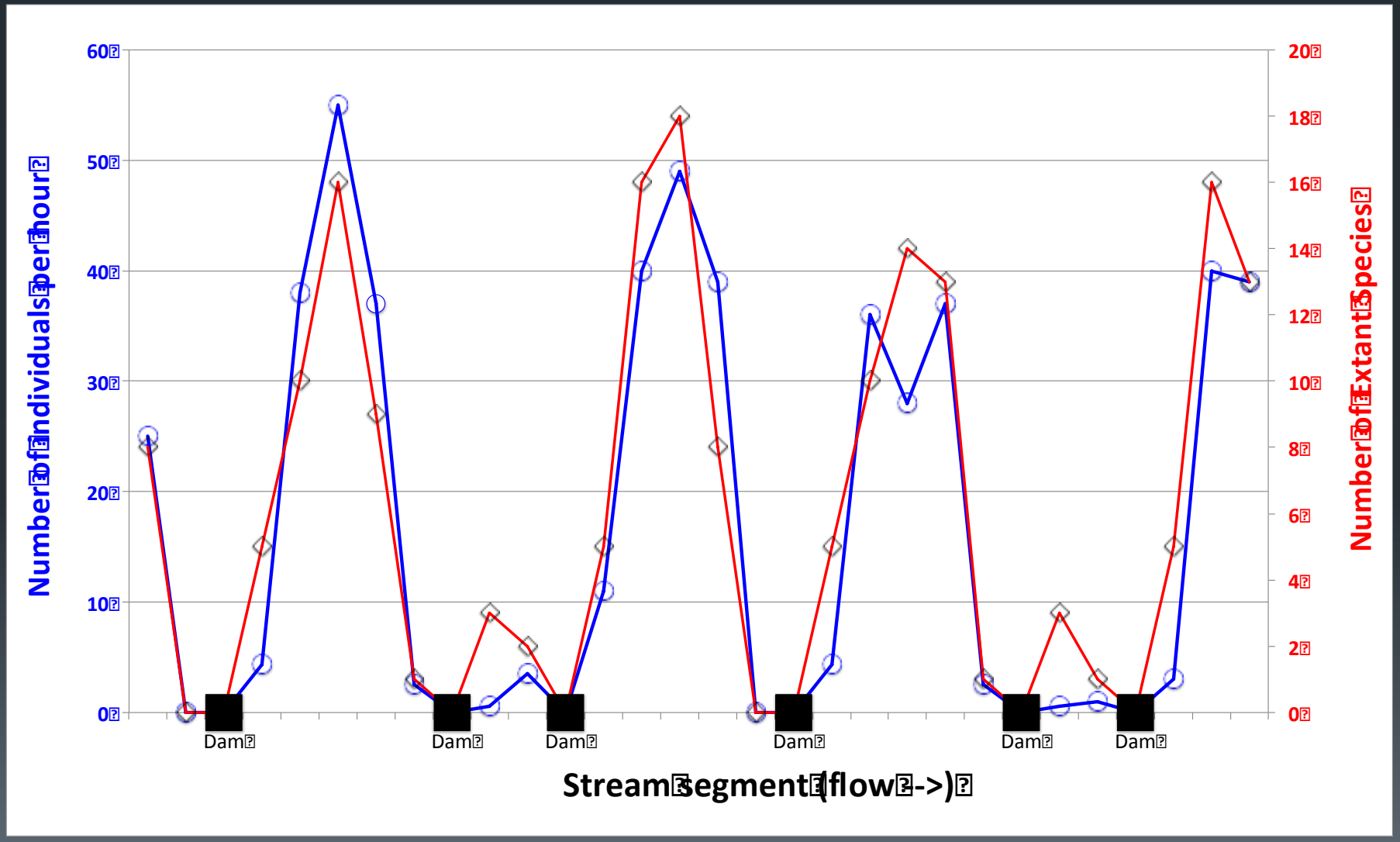

# Freshwater mussels

## Cool critters - mean mothers

Video credit: M.C. Barnhart

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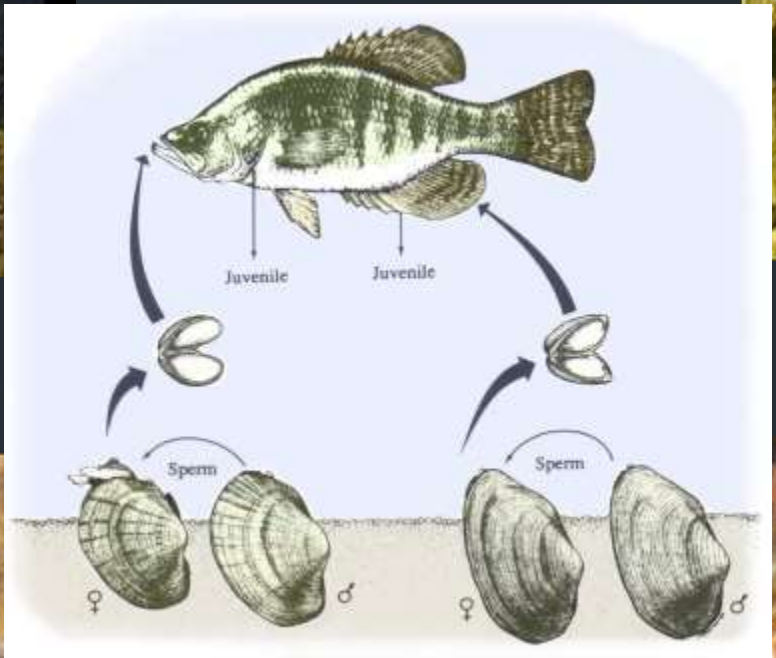


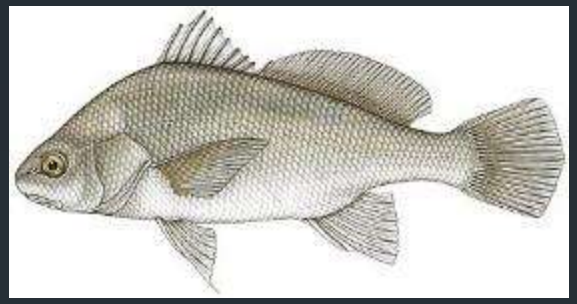

Photo credit: Cummings and Mayer, 1992

Freshwater mussel life cycle

Video credit: M.C. Barnhart

Photo credit: M.C. Barnhart

# As go the fishes, so go the mussels



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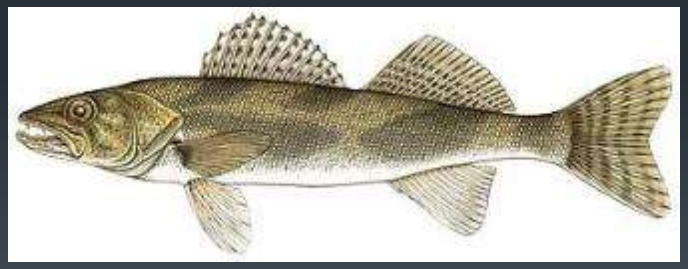

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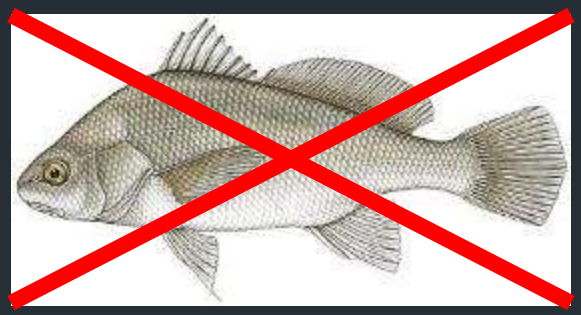

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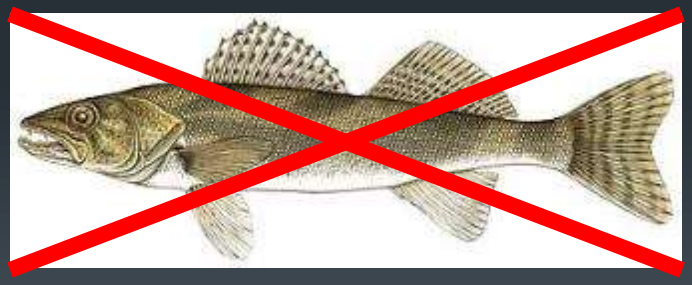

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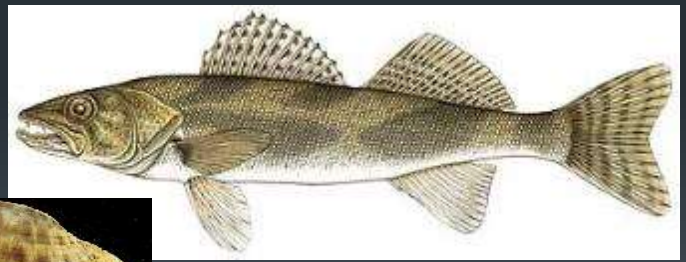
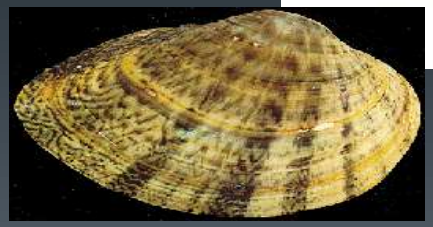
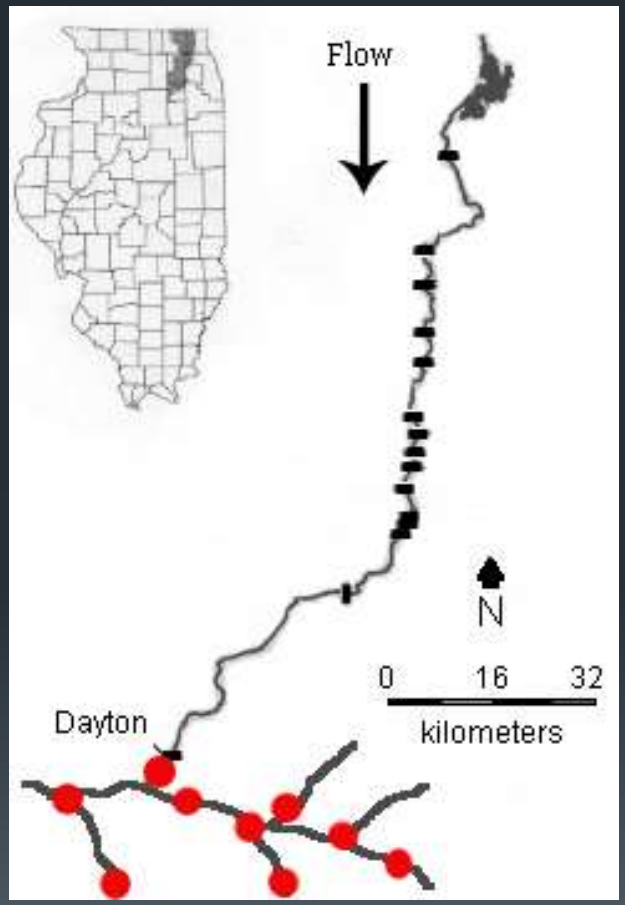
# As go the fishes, so go the mussels

Dams limited distributions

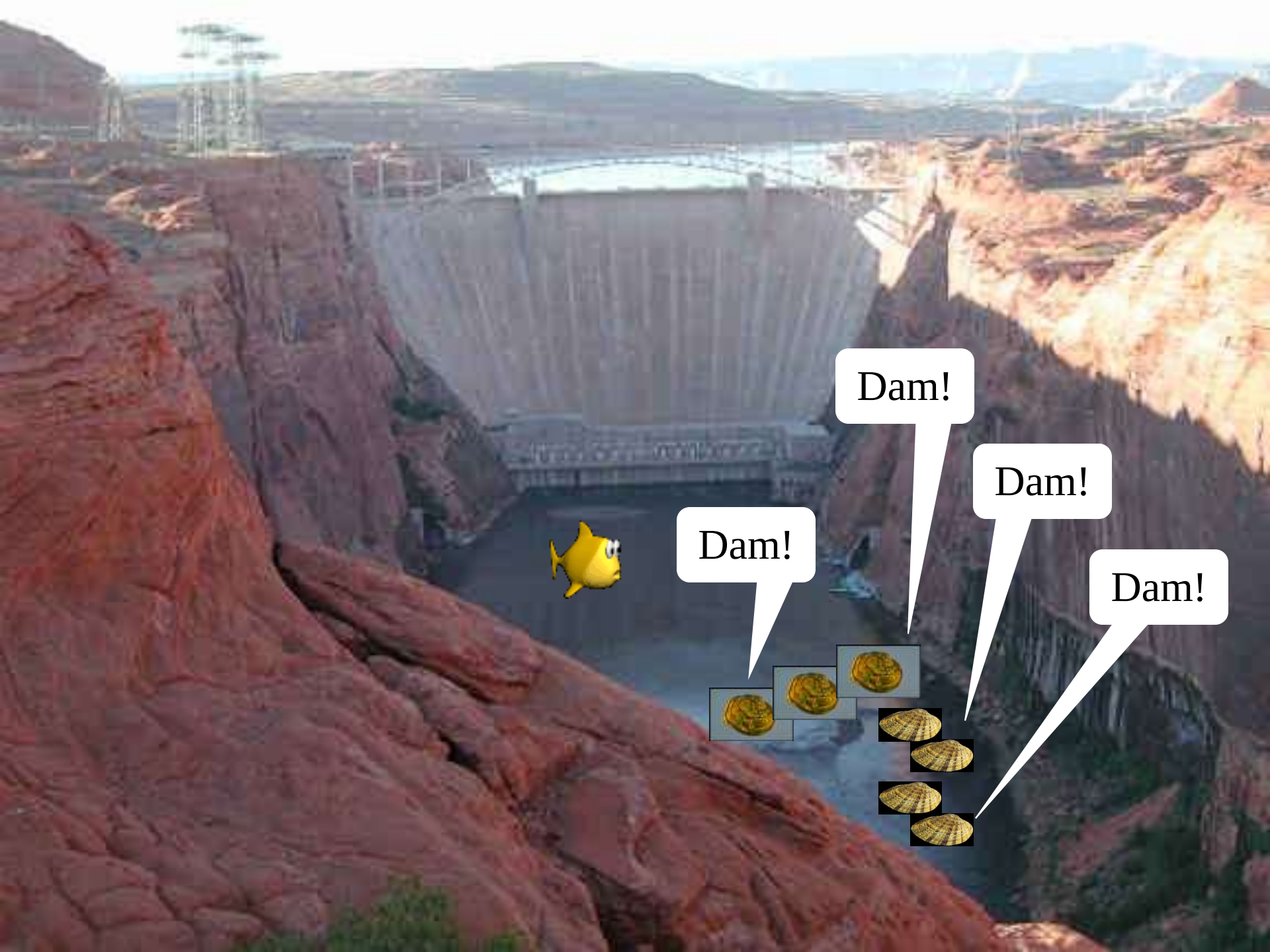
- Case study: Fox River
  - Mussel = Fawnsfoot
    - Host fish = Sauger







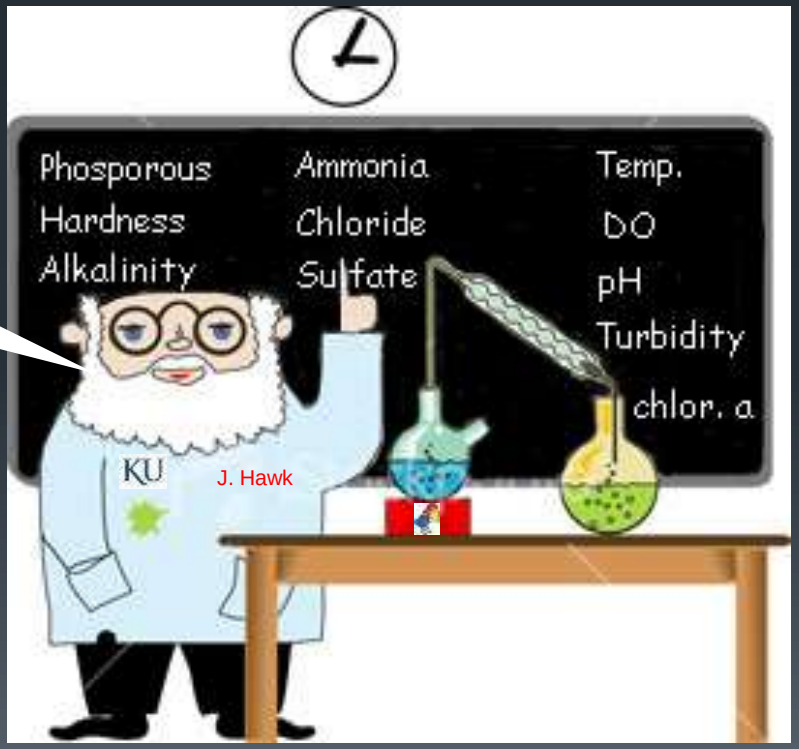

Ditto for catfish-hosted mussels


Dam!
Dam!
Dam!
Dam!

# What about water chemistry?

- No differences upstream or downstream*

Perhaps water retention isn't long enough




*Not true for large dams

# Can dams stop exotic species?

Probably not

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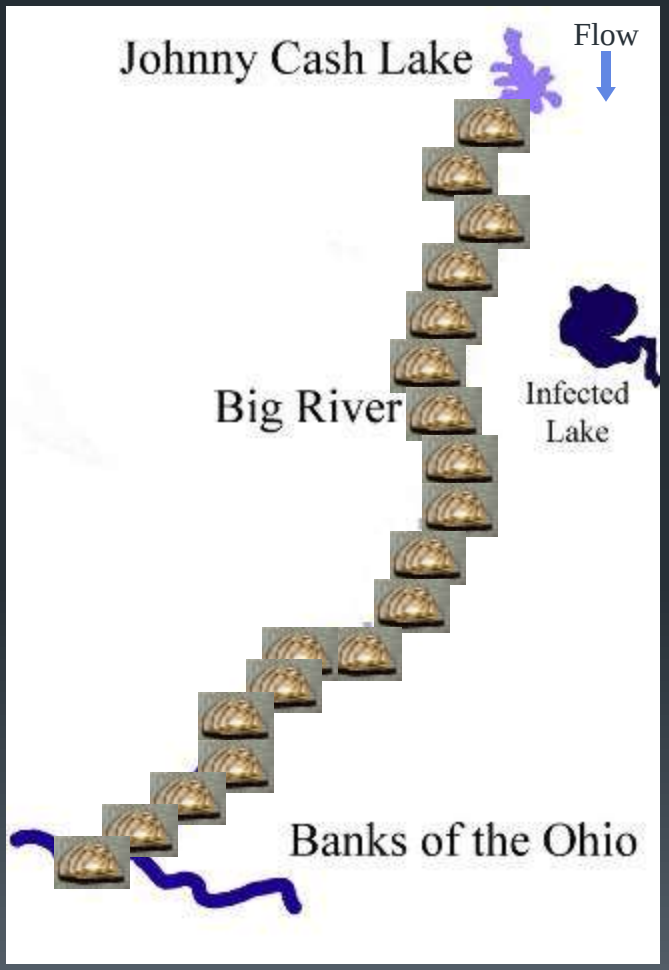
Probably not



# … but what about moving upstream?

Maybe?

# Other problems dams can cause

- Reduce summer flow
  - Municipal water extraction > stream base flow
- The “Ebonyshell story”
  - Mussel disappeared after host extirpated
- Loss of floodplain wetlands and forests
  - Fragmented terrestrial corridors
  - Changes in various terrestrial communities
    - Avian, Reptilian, Mammalian

# More dam info

- U.S. dam building heyday
  - Mill dams and lock-&-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 $

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- Repair
  - $ Costly $
- Replace
  - But why?

# What are our options?

- Repair
  - $ Costly $
- Replace
  - But why?
- Remove…

# Dam removal

- One of the first dams removed *by humans* was the Washington Water Power Dam on the South Fork Clearwater River in Idaho – in 1962

# Dam removal

- 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!!!

Key to dam removal = sediment control!

Photo credit: IDNR

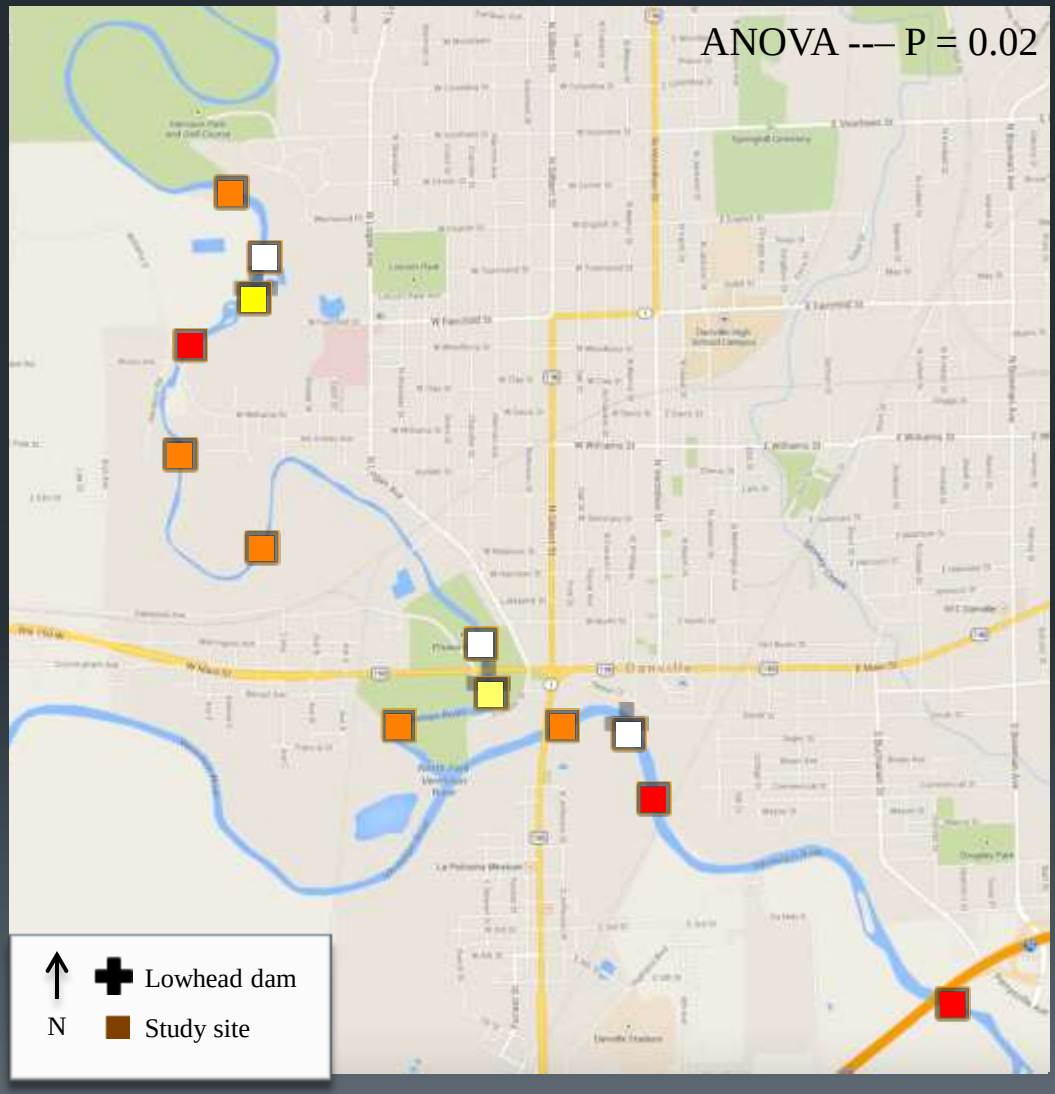
# Vermilion River of the Wabash

**Basin facts**

- 4,000 km$^2$ 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)

# 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



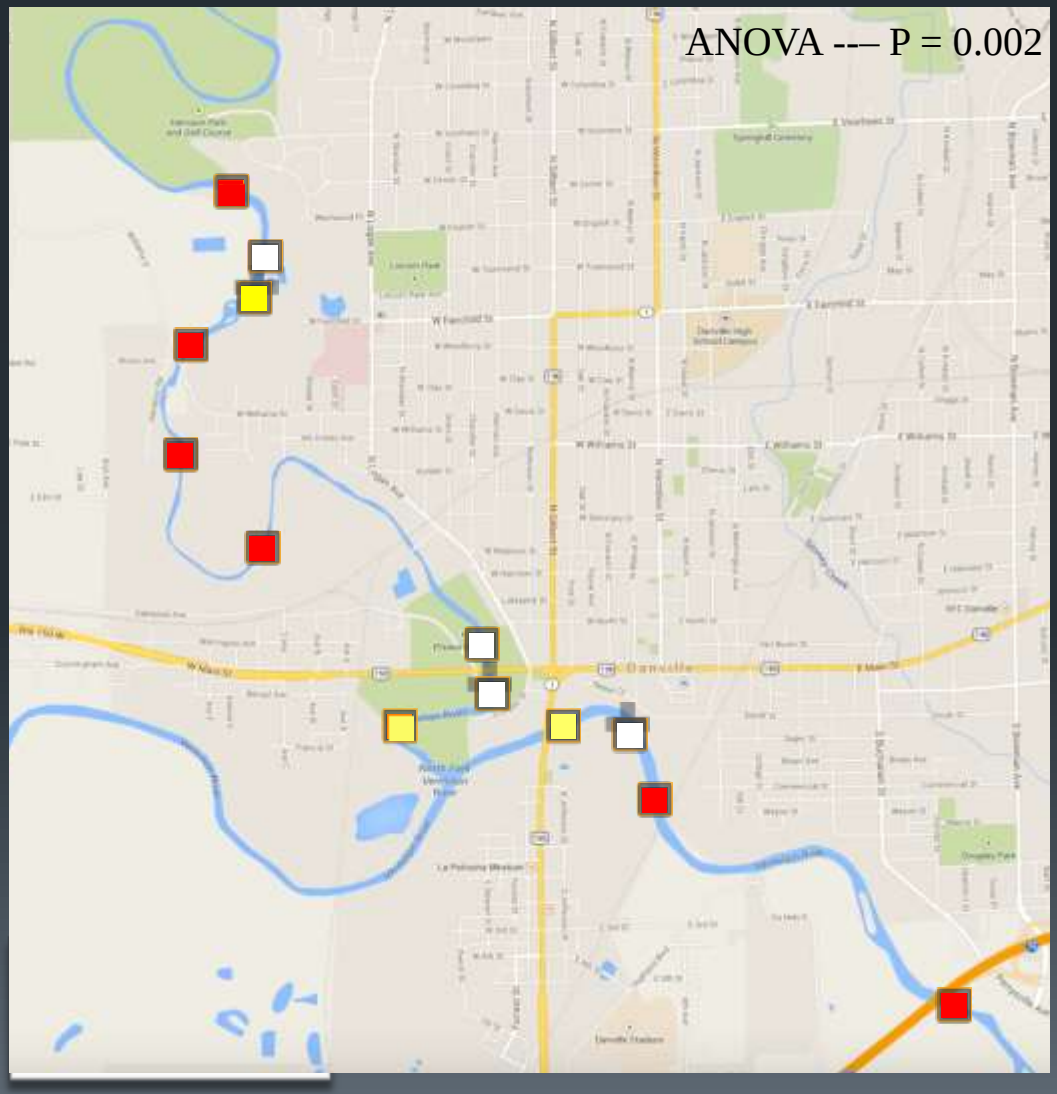
# Danville dams study – mollusks

- 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 dams study – mollusks

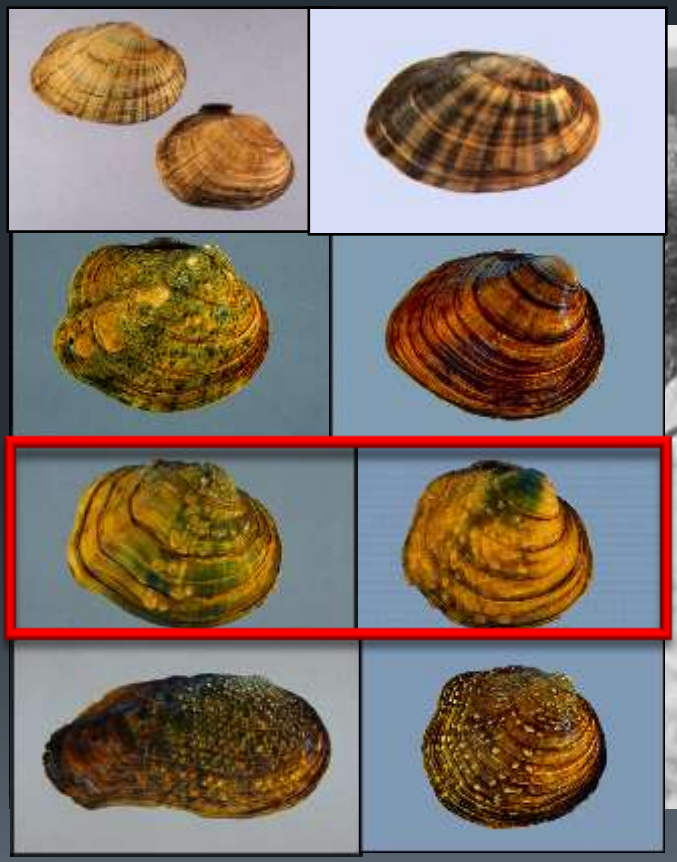

Black Sandshell, *Ligumia recta*
Status: State-threatened
Hosts: *Sander*, *Lepomis*, and *Micropterus* sp.

# 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

Photo credit: Bob Clouser

# Dam removal benefits

- Safety
- Improve fisheries
- Return stream to natural state

# Thank you

## Help wanted – snail collectors

- Data label

State: County
Body of Water
Date collected
Collector(s)
GPS
Comments (bridge crossing, habitat description, methods, effort, etc.)

Illinois Natural History Survey, Champaign

- Mail to

INHS - Attn: Mollusk Collection
1816 South Oak Street
Champaign, Illinois 61820

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