Case Study: Mollusk Surveys at MSD Outfalls on the Mississippi and Missouri Rivers

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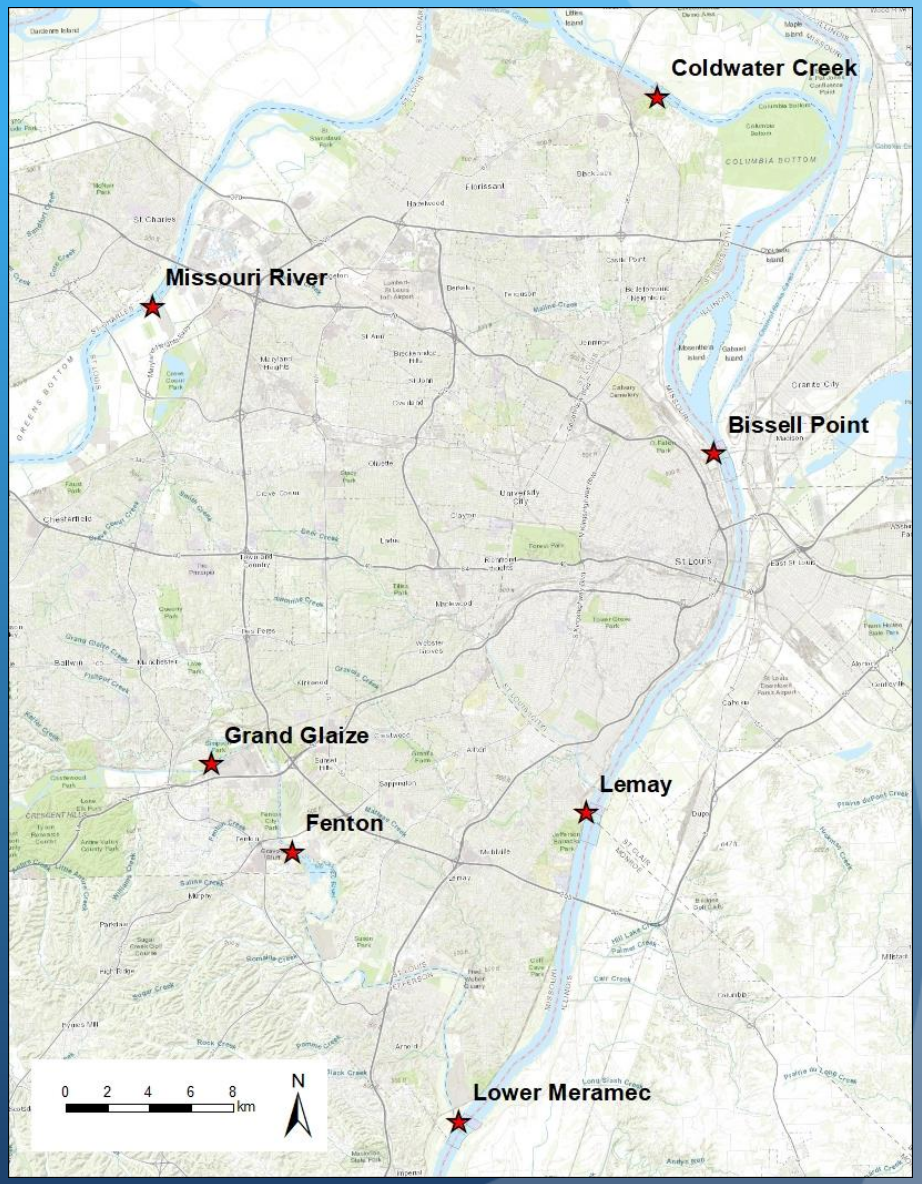
Background

- MSD operates 7 wastewater treatment facilities in the St. Louis area
  - Mississippi River (3)
  - Missouri River (2)
  - Meramec River (2)
- Do freshwater mollusks (mussels and snails) occur in rivers near the facilities?

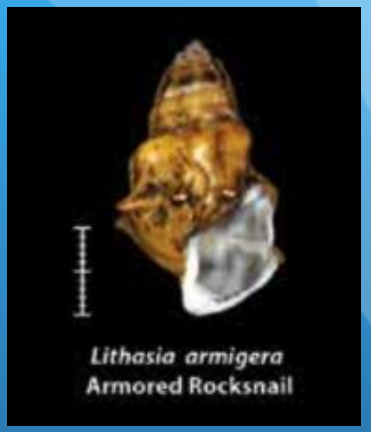


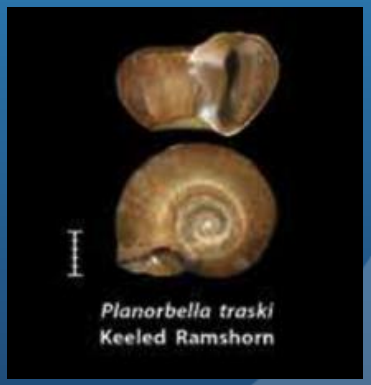
Freshwater Mussels

- Native bivalves in Order Unionoida/Unionida
- Evolved to live in freshwater riverine ecosystems
  - Dependent on hydrological cycle
- Unique life cycle (use of fish host)
- Value
  - Cultural
  - Commercial
  - Ecosystem services
- Highly imperiled

Freshwater Snails

- Native snails in Class Gastropoda
- Prosobranchs
  - Gill-breathing snails
  - Rivers & springs
  - Mature slowly
- Pulmonates
  - Modified mantle or lung
  - Lakes, ponds, river edges
  - Mature quickly
- Over half of U.S. species considered threatened or endangered





Mollusks and Water Quality

- Freshwater mussels are highly sensitive
  - Among most sensitive to ammonia and copper
  - Lower 15% for chloride and zinc
  - Acutely tolerant to some other toxicants
- Freshwater snails
  - Ammonia sensitivity similar to mussels
- 2013 EPA ammonia guidance incorporates toxicity tests on freshwater mollusks
- Improving water quality can help protect mollusks

Mollusk Study Considerations

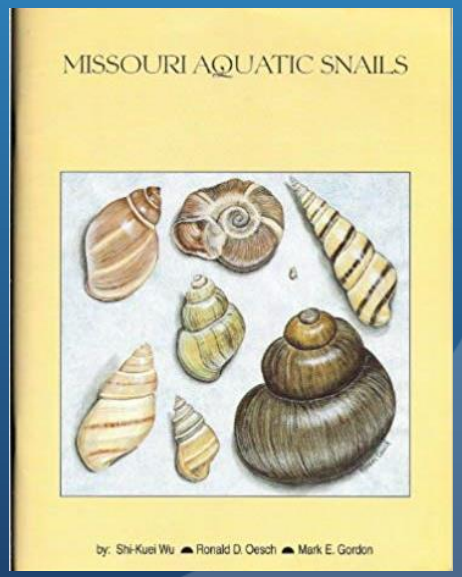
- Where do mollusks live?
  - Are there places they can't live?
  - Are all species the same?
- How do we sample mollusks?
  - Presence/absence
  - Species composition
- How do we define a site?
  - How far downstream?
  - Can mollusks move back in?

Tiered Approach

- Delineate site and define presence/absence
  - Upstream (reference)
  - Zone of initial dilution
  - Mixing zone
  - Downstream (reference)
- Check databases, literature, reports
  - No mollusks
  - No good habitat, but a few mollusks
  - Mussel beds, good snail habitat
- Conduct survey if needed

Literature Review

- Review existing data to determine what mollusk species (if any) may occur near MSD facilities
- Agency biologists (MDC, IL DNR)
- Mollusk databases/collections (INHS, OSU)
- Previous surveys/reports
- Output
  - List of species in receiving streams
  - Map mollusk occurrence near MSD facilities



Literature Review

- Mississippi and Missouri Rivers
  - Mostly unstable substrate (loose shifting sand)
  - No mussel beds reported
  - A few tolerant species may occur
  - Pleurocerid snails possible in rocky habitat
- Meramec River
  - Species rich
  - Mussel beds abundant
  - 5 federally endangered species

Conduct Surveys

- Mollusks assumed present near Meramec River facilities – no surveys conducted
- Mollusks may occur near Mississippi and Missouri River facilities – surveys conducted
- Evaluate habitat, mollusk presence, species composition

Define Survey Area

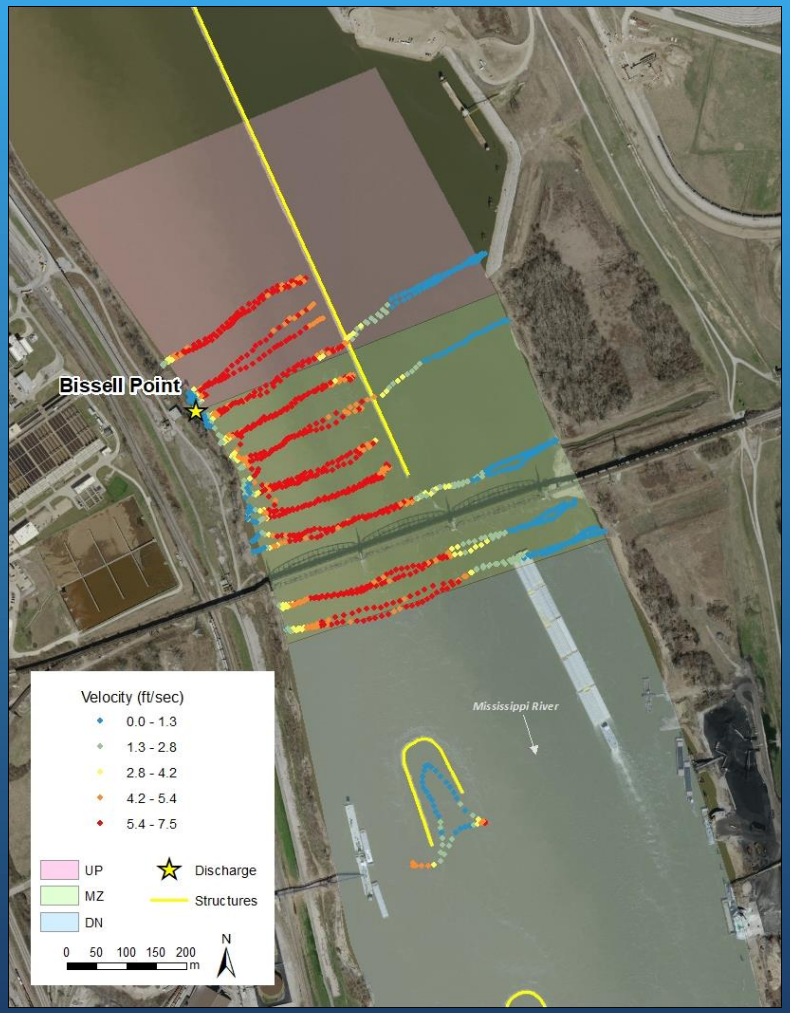
- Divide into 3 areas
  - Up of facility (~0.25 mi)
  - Mixing zone (~0.25 mi)
  - Downstream (>0.25 mi)
- Full width of river
- Areas upstream & on opposite bank – compare habitat and species composition

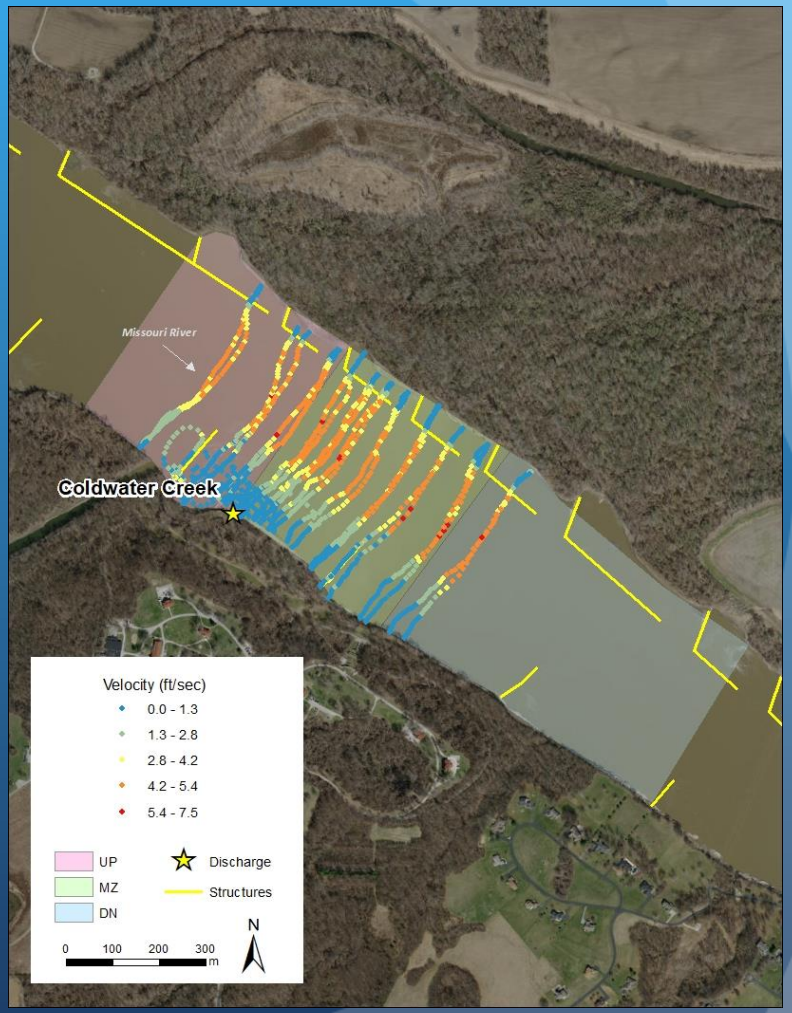
Define Survey Area

- Focus on areas with best habitat
  - Stable substrate
  - Lower velocity
  - Adjacent to banks (particularly protected areas)
  - Within dike fields; adjacent to/behind/downstream of dikes
  - Side channels (Lower Meramec site)

Define Survey Area

Geosyntec bathymetry/velocity mapping





Survey Methods

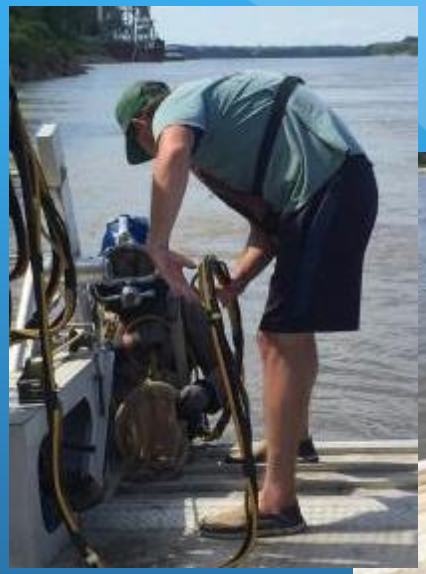
- No one-size-fits-all approach
- Select method to best address study objective
  - This study: presence/absence, species composition
  - Community change over time
  - How did an activity affect community
  - Population estimates
- Select method appropriate for conditions
  - Small stream vs. large river
  - Anticipated substrate and flow conditions
- Basic techniques/methods in USEPA 2013
- Need experienced malacologist to design and implement study

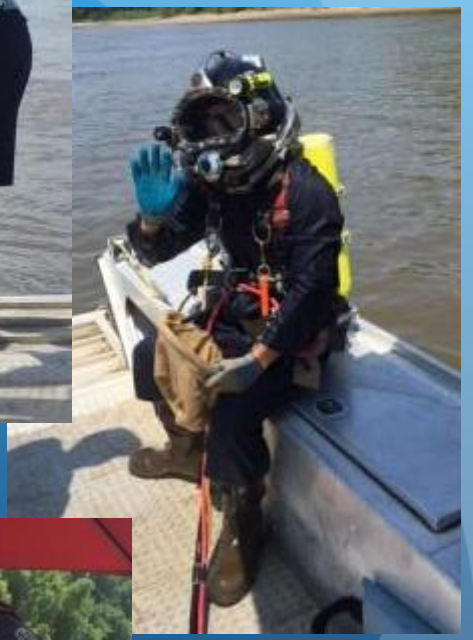
Survey Methods

- Quantitative sampling
  - Collect all animals in small area
  - Statistically comparable
  - Likely not useful here
    - Anticipated low mollusk abundance
- Semi-quantitative sampling
  - Search a fixed area (e.g. along transect line)
  - Map animal/habitat distribution
  - Less useful here
    - Difficult to implement in high velocity
    - Can be expensive over large areas
- Qualitative sampling
  - Free search (usually timed)
  - Collect as many individuals/species as possible
  - Biased toward larger individuals
  - Cover large area relatively quickly
  - Easier to implement in high velocity

Survey Methods

- Qualitative searches
  - 10-min increments
  - Depth and substrate composition
  - 550 – 820 min (9 – 13 hr) per site
- Quantitative samples
  - Added to increase likelihood of collecting snails, if present
  - Depth and substrate composition
  - 15 – 20 samples per site

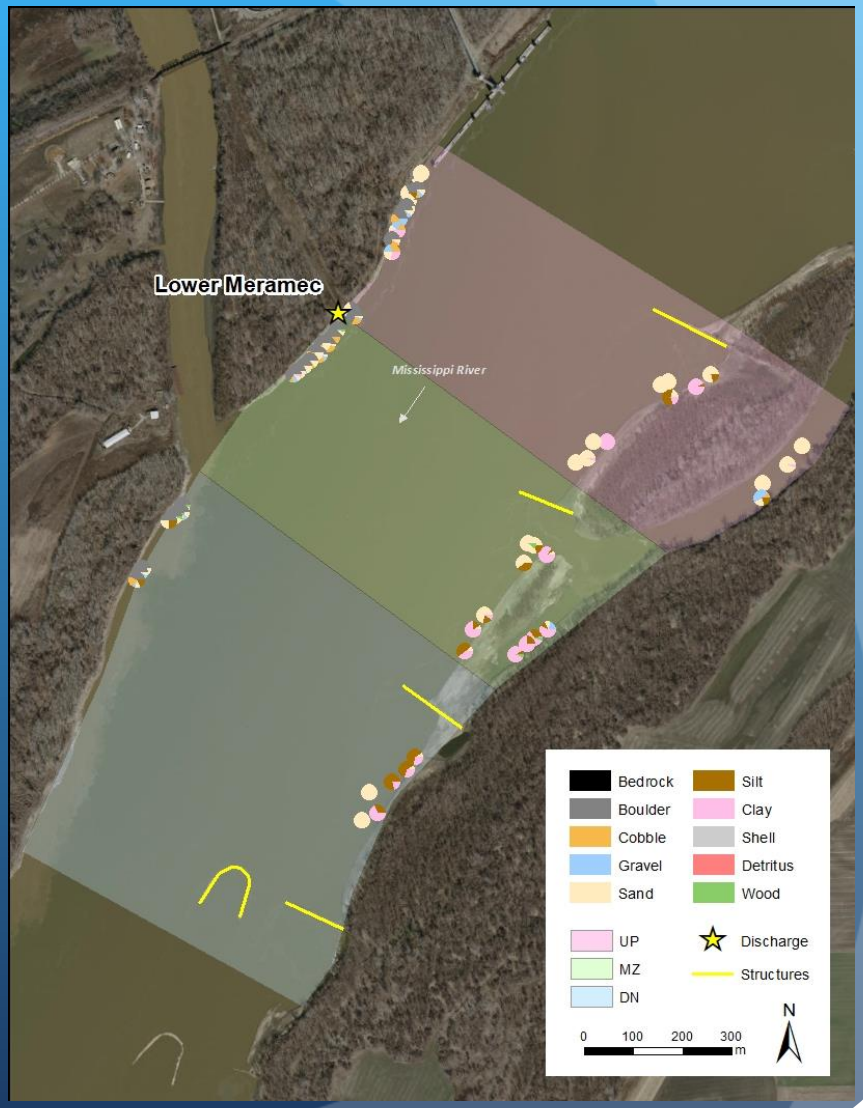




Survey Results

- Habitat
  - Similar conditions at most sites
  - Frequently rocky (boulder/cobble) adjacent to banks and dikes
  - Silt/clay or sand in slower-flowing areas (in dike fields)
  - Depth to >30 ft
    - Scour holes immediately below dikes, but generally shallower in dike fields
  - High current velocity outside of dike fields
    - Diver unable to maintain position

Survey Results



Survey Results

- Low mollusk abundance at all sites
  - 0 – 5 live mussel species per site, a few additional dead shells
  - Mostly thin-shelled, tolerant species
  - 0 – 1 live snail species per site, few additional dead shells
- Most mollusks found in silt/clay substrate (more stable)

Discussion

- Low mollusk abundance at all sites
- Suitable habitat is limited
  - Many mussels in silt/clay – small pockets detected by depth/flow patterns
  - Coarse substrate in high velocity areas – nowhere to burrow
  - Loose sand in lower velocity areas – not stable
- Generally, if mussels were present, they were present throughout areas

Discussion

- No mussel beds, or good habitat for mussel beds, observed near any MSD facilities on Mississippi or Missouri Rivers
- Species collected are opportunistic species that move with bedload
  - Not permanent residents
- Could move through any of the mixing zones
- Mollusks should be considered on river by river basis

Questions?