Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds

John A. Tiedemann
Associate Dean
Monmouth University
School of Science, Technology and Engineering

NJ Water Monitoring and Assessment Technical Workshop
April 2006
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds

Use Impairments Caused By Bacterial Contamination of Coastal Waters

• Monmouth County estuaries are classified as condemned or special restricted for shellfish harvest
• Monmouth County accounts for the majority of condemned waters statewide
• Relay and depuration programs are needed to allow hard clams from special restricted waters to be utilized
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds

Use Impairments Caused By Bacterial Contamination of Coastal Waters

• Clean coastal waters provide opportunities for recreation and tourism in coastal communities
• Monmouth County accounts for most of New Jersey’s beach closures
• The majority of these closures occur at ocean beaches adjacent to watershed outflows during storm events
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds

Tier 1 – GIS Analysis

- Selection of sampling stations
  - NJDEP Bureau of Marine Water Monitoring
  - NJDEP/County Health Department CCMP
  - NJDEP/County Health Department AMNET
  - Other Stations As Appropriate
- Land Use/Land Cover
- Density of marinas
- Locations of major tributaries
- Sewer service area; storm drain outfall locations
- Other potential land based sources of contamination
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds

• **Tier 2 - Coliphage Analysis**
  – Used to distinguish human and animal waste contaminants by grouping isolates into one of four subgroups
  – Subgroups I and IV are generally associated with animal waste
  – Subgroups II and II are generally more sewage specific
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds

• Tier 3 – Antibiotic Resistance Analysis
  – Used to discriminate among fecal bacteria from various host groups
    • Human vs. Nonhuman
    • Nonhuman
      – Livestock
      – Wild animals
      – Avifauna (birds)
      – Domestic pets
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds

Manasquan River Estuary
Glimmer Glass at Debbies and Watson Creek
GG-1

- Unclassified: 7%
- Human: 0%
- Pets: 5%
- Wild Animals: 23%
- Livestock: 26%
- Avifauna: 39%
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds

Manasquan River Estuary at Crabtown Creek
GG-2

- Avifauna: 38%
- Livestock: 24%
- Pets: 21%
- Human: 3%
- Unclassified: 3%
- Wild Animals: 11%
- Unclassified: 3%
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds

• Tier 4 – Other Advanced Techniques
  – Detection of host-specific molecular markers
    • Target specific polymerase chain reaction (PCR)-based methods
      – Quantitative PCR
        » qPCR
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds

- **Chemical Methods?**
  - Caffeine: Excreted in urine; however, levels of caffeine in receiving waters may be low due to dilution and the fate of caffeine in aquatic environments is uncertain
  - Optical Brighteners/Fluorescent Whitening Agents: Chemicals found in laundry detergents; may generally indicate a domestic source by not reliable as an indicator of sewage or fecal pollution
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds
Development of a Tiered Approach to Microbial Source Tracking in NJ Coastal Watersheds