2015 Maine Beaches Conference Notes

Meagan Sims

Session: Coastal Beach Water Quality: Multiple Perspectives

First Speaker: Keri Kaczor

- Maine Healthy Beaches Program Coordinator
  - University of Maine Cooperative Extension

Title: Addressing the Challenges for Maine's Coastal Beaches

General discussion regarding the Healthy Beaches Program.

- Locally run program. Coordinated by Keri, Meagan, and Taylor (intern). Managed by Maine Department of Environmental Protection (Maine DEP).
- Data collected informs local decisions.

Beach Management Challenges

- Indicator (Enterococci) doesn't differentiate bacteria sources. Often multiple sources compounding together to cause the problems.
  - Limitations of FIB
    - Inconsistent correlation with pathogens.
    - Poor correlation with human health risk.
    - Can persist and regrow in the environment. Diverse and dynamic systems.
    - Doesn't differentiate sources (human vs. wildlife/pets/etc.).
    - Variability in results and results of test not available until the following day. Implications for beach postings. Lack of illness data to inform decisions.
- Watershed health = beach health. Watersheds shared by multiple towns with varying policies.
- Runoff & Impervious surfaces. Warmer and wetter climate will likely result in increased exceedances.
- Trying to hone in on suspected issues. Once remediated other issues emerge.
- Aging infrastructure and cross connections between sewer and stormwater. Wastewater disposal is costly and options are limited. Need to expand infrastructure.
- Insecure funding. Funded through 2016 but 2017 is unknown.

Informing Decisions and Addressing the Issues

- With more funding historically, MHB partnered with municipalities to augment beach sampling efforts and help hone in on suspected sources. Some efforts are ongoing but many are not due to funding constraints. Efforts include:
  - Circulation studies, source tracking, GIS risk analysis, sanitary surveys, education, forming an advisory committee, collaboration with researchers, etc.
  - Also, created the Municipal Guide to Clean Water and other outreach materials.

Second Speaker: Fred Dillon

- Stormwater Program Coordinator
  - South Portland Water Resource Protection Department

Title: Assessing the Challenges for Maine's Coastal Beaches. A Local Perspective-South Portland's Willard Beach

Why Stormwater Program is Needed

- Basic regulatory framework.

- National Pollutant Discharge Elimination System (NPDES) permit program authorized by the Clean Water Act (CWA). Regulates water pollution from point sources discharging. Includes wastewater and stormwater.
- Most individuals are unware of how the municipal piped infrastructure works.

Stormwater Program Elements

- MS4 program associated with 6 minimum control measures (MCMs).
- Emphasis on number 3 which involves illicit discharge and detection and elimination (IDDE) efforts.
  - Goal is to identify and eliminate pollution sources and maintain and update stormwater infrastructure mapping.
  - Concerned with infiltration and exfiltration.

Willard Beach-Case study

- Willard Beach has 2000 ft. sandy beach with 7 access points and is used year round.
- Water quality monitoring since 1997, MHB participant since 2003.
- History of elevated bacteria and numerous advisories.
  - 33% of samples collected for MHB program at Willard beach exceeded EPA safety threshold in 2014.
- What they have been doing?
  - Sanitary surveys, water quality monitoring, stormwater drainage study, sewer separation and CSO elimination, source tracking, EPA virtual beach, canine source tracking and illicit discharge removal.
  - Tandem enterococci and optical brightener analyses to hone in on human sources.
  - Recent work testing for chlorine and detergents.
  - 2014 Canine Detection Study:
    - Canines indicated bacteria contamination but tandem water sample collections did not.
    - Why?-The dogs are believed to be very sensitive and can pick up trace levels below the laboratory enterococci detection limit.
  - 2014 cross connection (illicit discharge removal). Detected and remediated.
- Where's the bacteria contamination coming from?
  - Stormwater outfalls, beach activities, Casco Bay, wrack, sanitary sewers, impervious surface (research community has found more development tends to lead to higher bacteria).
- Suspect issues are at least in part due to infiltration and exfiltration.
  - Infiltration (Water coming into the pipe that can overload treatment plant.) .
  - Also sewer can exfiltrate and get into stormwater line because the drainage networks are often close together.

Third speaker: Abby Barrows

- Marine Research Scientist
  - Marine and Environmental Research Institute

Title: Microplastic Pollution

Marine Microplastics

- Characteristics: less than 5 mm in size, non-biodegradable, adsorb and release toxins, petroleum product.
- Found in all world oceans and many large lakes.
- Two types of microplastics
  - Primary and secondary
  - Primary: nurdles (these are melted down to make other plastics) and microbeads (tiny round pieces found in personal care products for exfoliants and in items such as toothpastes).
  - Secondary: plastics crated from mechanical degradation and chemical degradation.
    - Chemical degradation includes synthetic clothing. Released when clothing is washed.
- Issue: the association between plastics and persistent organic pollutants.
  - Toxins associated with plastics: PBDEs, phthalates, DDTs, PAHs, styrenes, PCBs, and BPA.

- Plastics can leach these harmful components out.

Microplastic Ingestion

- Many plastics find permanent homes in marine animals and release toxins in them.
  - Thought to contain concentrated levels of toxins.
  - This has effects ultimately on human health if these animals are ingested.
- Bioaccumulation and biomagnification occurs because plastics are taken into the organisms at the bottom of the food chain and then the concentration increases as those organisms are consumed in large quantities.

MERI Tissue Study

- Dissect organisms and look for toxins associated with microplastics.
  - Currently they are unable to look at these samples due to funding constraints.
- Can digest the animals and take out the digestive tract and other organs and filter and look for plastics.
- Preliminary results:
  - Mussels: Examined 10 individuals and found on average 161 pieces of plastic per one mussel.
    - Wild caught mussels contained higher plastic amounts.
      - Likely because wild mussels are older and have had more time to sequester plastics.
  - Oysters: taken from a narrow river with potential plastic inputs. 199 average pieces of plastic per 17 grams of soft tissue.
  - Clams: Examined 6 individuals but hard to process. Found 43 pieces of plastic per 1 gram of soft tissue.
  - Lobsters results TBD.

Microplastics Research Protocol

- Pilot study initiated in 2011.
- Method: Throughout cleaning of containment jar, wade to depth, scoop liter of surface water, simple pump filtration system over a small micron gridded filter, count along the grid and categorize by color and shape.
- Found microplastics in almost every sample with more counts in more populated areas.
- High volunteer interest and turn out.

Microplastic Source Study

- Sites: waste water treatment facility (WWTF) outfall, locations with high fishing gear, high energy control sites (locations more than 100 ft. deep with strong currents and high water turnover).
- Results: Found an average of 12 pieces per 1 liter water. WWTF outfall had highest plastic density. Control sites had higher plastic concentrations than fishing sites.
- No significant seasonality shift.

Looking Forward:

- Legislative support success (2016 start of microbead ban).
- Examining toxins in tissue.
- Collecting samples at depth to understand distribution of plastic in water column. Research shows more plastic at depth compared to surface water.
- Looking at the fresh water interface (storm drain runoff, streams, etc.

Fourth speaker: Steve Jones([1,2]) & Derek Rothenheber([2])

- University of New Hampshire
  - 1-Department of Natural Resources and the Environment
  - 2-Department of Molecular, Cellular, and Biomedical Sciences.

Title: Monitoring Bacterial Pollution: A look at York, Maine Beaches

2014 York Beach Study

Goal: Provide science based management tool for York to post precautionary advisories under conditions associated with elevated levels of pollution.

Background Information

Compiled by various entities over the past several years.

- Environmental Protection Agency (EPA), Maine Healthy Beaches (MHB), FB Environmental, Town of York.

Procedures/Methodology

- Enterococci beach water monitoring (July 3-September 18). 52 sampling days.
- Assessment of potential enterococci sources.
- Study area (predominantly aligned with MHB monitoring locations).
  - Cape Neddick, Short Sands, Long Sands North, Long Sands South, York Harbor.
- Determined factors significantly affecting enterococci concentrations at York beaches.

Findings-Water Quality

- Findings consistent with water quality data collected by MHB.
  - 3 sites along Long Sands Beach with very good water quality.
  - Shorts Sands Beach and York Harbor Beach water quality slightly worse.
  - Most bacteria issues concentrated at northern Long Sands Beach and Cape Neddick Beach.
- Geometric mean concentrations over time
  - All sites below the EPA recommended geometric mean threshold of 35 (MPN/100 ml sample water).
    - Indicates that samples exceeding the 104 single sample EPA threshold are variable.
    - All sites below geomean of 35 indicates that for overall water quality, exceedances aren't very frequent.

Findings-Storm drains

York has many storm drains potentially impacting beach water quality.

- Sampled four consistently flowing storm drains. During this time period, EPA did an MS4 evaluation of storm drains. Monitoring of the drains continued after the evaluation.
  - Daily geomean calculated for each drain.
  - Results consistently greater than 100 MPN/100 ml sample water. Some readings greater than 1,000 and others above 10,000.
    - Indicates storm drains are a potential source of contamination to York beaches.
    - Looked at storm drain concentrations and corresponding beach sites.

Findings- Cape Neddick

Identified priority sites based on previous work done (FB Environmental, Town of York, MHB).

- Investigated in close proximity to the beach as well as several tributaries and the main stem.
- Found most sites had high frequency of samples above EPA bacteria standard.
- Bacteria concentration at the mouth lower than those upstream. Indicates high bacteria concentrations upland does not necessarily translate to impaired beach water quality.

Findings-Seaweeds

- August 2014 storm resulted in excessive amounts of invasive seaweeds.
- Bacteria proliferate in seaweed.
  - Bacterial concentrations exceeded laboratory testing threshold (greater than 24,000 MPN/100 ml sample water) at site 11 (Long sands) in association with high seaweed levels.
- Advisories put in place because the relationship to public health is unclear.

Overall Findings and Statistical Analysis

- Enterococci concentrations are generally low at York beaches but elevated bacteria concentrations do occur particularly in stormdrains, Cape Neddick River tributaries, and seaweed.

- Factors significantly affecting bacteria concentrations at York's beaches vary but the best developed model (generalized linear model) indicates 48hr. antecedent rainfall, salinity, and tide stage to be the most important.
    - Higher probability of elevated bacteria at lower tide stages and for samples collected closer to Spring.

Rainfall Advisory Approach

- Devised a rainfall advisory system specific to each beach in York that incorporates 48 hour antecedent precipitation amount and the length of time it takes each beach to flush out. Based on this information, the following protocol was developed:
    - Short Sands Beach: 1.5 inches antecedent rainfall, 2 day advisory duration
    - Long Sands Beach-North: 1.5 inches antecedent rainfall, 2 day advisory duration
    - Long Sands Beach-South: 1.5 inches antecedent rainfall, 1day advisory duration
    - York Harbor Beach: 1.5 inches antecedent rainfall, 1 day advisory duration
    - Cape Neddick Beach: 1.5 inches antecedent rainfall, 2 day advisory duration
        - OR 1 inch in 24 hours and 2 day advisory duration
- During rainfall events, data for York has shown:
    - Bacteria conditions worse during extreme rain/runoff events.
    - Higher bacteria in storm drains during rain and increased flow in storm drains leads to increased bacteria loading to beaches.
- Storm drain pollution a good management target.

EPA 2012-2014 Storm Drain Chemical Analysis

- Examined enterococci, caffeine, acetaminophen at Long Sands Beach and Short Sands Beach.
- Results indicate some evidence of human sources in storm drain.

Microbial Source Tracking

- Goals
    - Identify human and non-human and/or actual source species.
    - Track pollution in space and time.
    - Determine most significant sources of fecal pollution and help inform management decisions.
- Current UNH Method
    - Bacteroides PCR
        - Bacteriodes is a strict anaerobe meaning it must have a host. Cannot reproduce or survive in environment alone.
        - PCR: Use source specific DNA marker. Can detect low concentration in target DNA and can take as little as 3 hours.
        - Targets general fecal contamination and human.
            - Working on targets for ruminants, dogs, gulls.
    - Method wide usage in labs and has been rigorously tested in the field and lab.
- Results to date
    - General trend for enterococci:
        - Low in June and increase throughout season in storm drains.
            - Spring to summer: increasing human population increasing temperature.
    - PCR findings:
        - General fecal marker (mammal contamination) is at almost 100% of storm drains. Same for general human marker.
        - Compare PCR to enterococci. See that the contamination is fecal and humans are a source.
        - Finding low enterococci levels in ocean environment but still detecting both markers when enterococci is low.
- Future Plans
    - Continue working with towns to help modify beach advisories and assist with finding pollution sources.
    - Continue marker detection and quantifying marker levels.

Fifth speaker: Forrest Bell

- FB Environmental (Owner/Project Manager)

Title: Addressing Bacterial Pollution- Best Practices for Municipalities

What is bacterial pollution and how is it measured?

- Presence of fecal waste at streams, lakes, beaches.
- Measured using indicator bacteria (i.e. E. coli, enterococci, fecal coliforms).
    - Results 12-24 hours later and indicate quantity of pollution but not source.
- Sources are diffuse in environment and can lead to posted beach advisories, shellfish closures, etc.

How are bacteria sources located?

- Water quality sampling/data review, surveys and field work, mapping, MST, smoke tests, canine detection, watershed based management plans.
    - Canine Scent Tracking (IDDE)
        - Detect human sources only, Screening tool, cost effective, quick results, can be used to rule out non priority sites.
        - Field trials for a year and zero false negatives.

Example 1: Parsons Creek Watershed (Rye NH)

- Impaired watershed (enterococci, PCBs, Mercury, Dioxin).
- Formulated a watershed plan (2011). Targeting primary sources (stormwater and septic systems).
- Best Management Practices implemented, ordinances strengthened, residents and municipal staff educated, and a septic database was created.
- Water Quality Sampling (2013-2014)
    - Results indicated higher concentrations in wet weather and later in the summer season.
    - 2013 numbers higher than 2014 (this is also impacted by when samples are collected).
    - Indicate likely sources include stormwater runoff and septics.
- Beach Investigation (2013-2014)
    - Canine detection, weekly/nightly sampling.
    - Results indicate human sourced bacteria.
- Parsons Creek Watershed Plan Implementation Project, Phase I (2012-2013)
    - Funds to implement stormwater BMPs, create a septic database, conduct septic socials/surveys, and perform water quality monitoring.
    - Used data from NRCS to overlay data layers and determine high risk parcels. Followed up with surveys.
- Future Plans
    - Septic feasibility study proposed.
    - Continued bacteria monitoring.

Example 2: The Spruce Creek Watershed (Kittery, ME)

- Watershed-based management plans (2008 & 2014)
- Kittery has received ME DEP 319 grants (2008-present) to implement the Spruce Creek Watershed Improvement Project.
    - To date, 62 BMPs have been installed. Various education and outreach events (reaching over 1,300 individuals), smoke tests, water quality monitoring (2009-2013), bacteria source tracking (2011-2014) creation of a septic/sewer database.
    - Example: Manson Avenue Outfalls
        - Bracket sampling to hone in, catch basin investigation, smoke testing and septic/sewer database.
    - Example: Shoreline Investigation (Fort Foster)
        - Canines indicate human sourced bacteria at all site locations.
        - Source located: abandoned outhouse in marsh upland. Removed and revisited with no human sourced bacteria detected.