

# MST and Recreational Water Quality Criteria Development

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## Slide Acknowledgements

- MST research
  - Orin Shanks
  
- Critical Path Science Plan
  - Shari Barash
  - Samantha Fontenelle
  - Chuck Noss

## Recreational water quality criteria development

- Oct. 2000 Beaches Environmental Assessment and Coastal Health Act
  - Requires:
    - EPA to conduct studies on pathogens/human health and:
    - Publish new/revised recreational water quality criteria for pathogens and indicators based on these studies.

## EPA's Critical Path Science Plan for New/Revised Recreational Water Criteria

- Describes research and science for establishing the scientific foundation for new/revised criteria
- Is an integrated approach to answering key science questions for scientifically sound criteria
- <http://www.epa.gov/waterscience/criteria/recreation/plan/index.html>

## Goals of the Science Plan Research

- Assess Human Health Risk
- Develop Indicators
- Develop Methods
- Extrapolate Research Results

## Key Research Questions (1)

- *What is the risk to human health from swimming in water contaminated with human fecal matter as compared to swimming in water contaminated with non-human fecal matter?*
  - **Risks from Human Sources of Fecal Contamination**
  - **Risks from Non-Human Sources of Fecal Contamination**

## Key Research Questions (2)

- *How well do culture and molecular methods for various indicators (singly or in combination) correlate with swimming-related illnesses?*
  - **Develop, Evaluate and Validate Indicators and Methods**
  - **Assess Linkages between Indicators and Methods**
  - **Characterize Temporal and Spatial Variability in Measurements**

## Key Research Questions (3)

- *Are the indicators, methods and models suitable for use in different types of waters and for different CWA programs?*
  - **Assess Variability in Diverse Geographic and Aquatic Conditions**
  - **Assess Methods Suitability to Different CWA Purposes**
  - **Develop, Evaluate and Validate Predictive Models and Tools**

## Categories of Research Activities

- Epi Studies and/or QMRA
- Indicators, Methods
- Fate & Transport Studies
- Predictive Modeling
- Site Characterization Studies
- Research to Support Extrapolation to Inland Waters

# Criteria Development Plan

- Ongoing scientific research (July 2007 – December 2010)

Data analysis

Peer-review

Public comment



- Publish criteria document (or publish notice of availability) in the Federal Register (December 2012).

# Epidemiological Studies at Goddard Beach, Rhode Island and Fairhope, Alabama

**Marine beaches impacted by POTWs**



# Epidemiological study at Avalon Beach, California

- Marine beach impacted by mixed sources of fecal contamination including bird droppings, urban runoff, and leaking sanitary sewers
- In collaboration with the Southern California Coastal Water Research Project (SCCWRP)



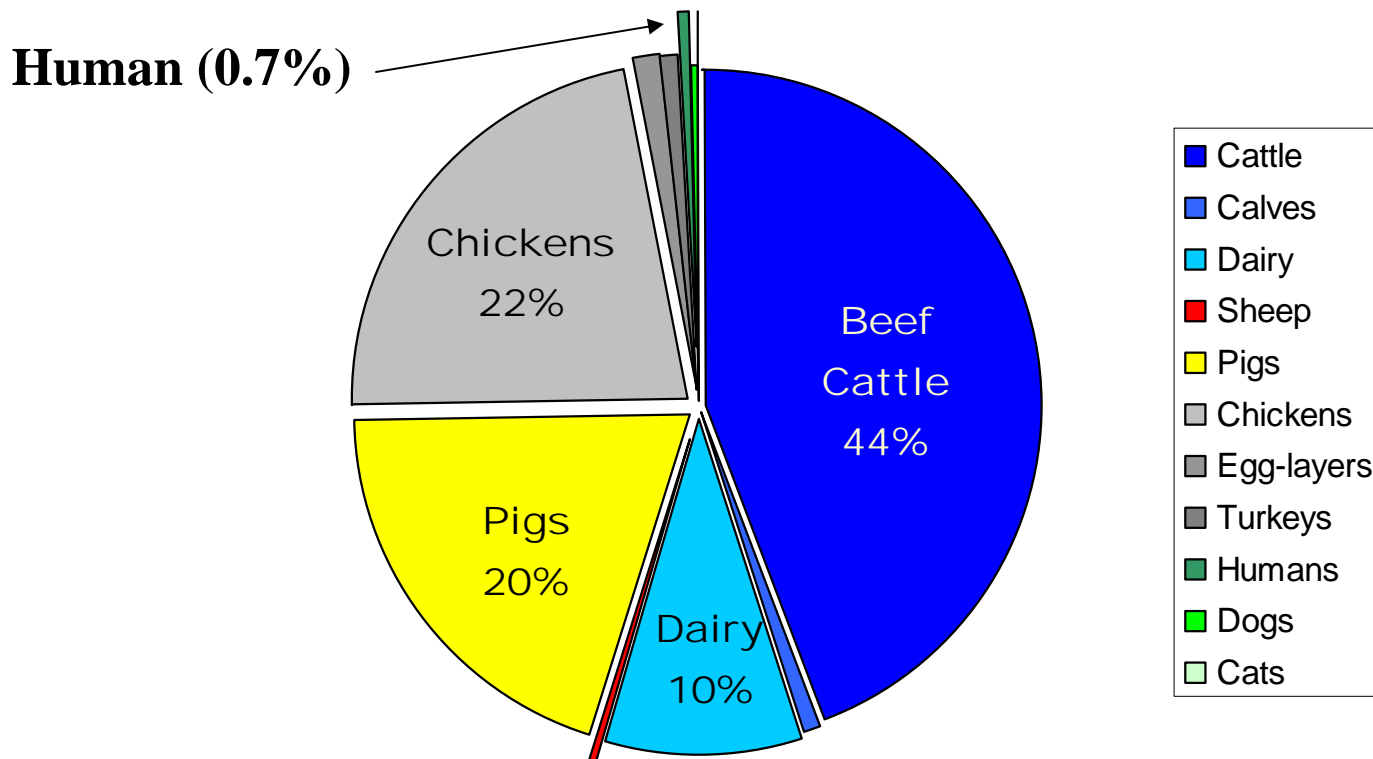
## Status of Epidemiological Studies

- Collected data in summer of 2007
- Analyses of results underway
  - Relationship between indicators and illness in swimmers (both GI and non-GI)
  - Differences in illness rates
    - Swimmers versus non-swimmers
    - Adults versus children
  - Best indicator for predicting illness
  - Exposure-response curves for criteria development
- Complete data analysis, then peer review and publish results.

## Other work we are aware of

- Epidemiological study at Doheny Beach, California
  - In collaboration with the Southern California Coastal Water Research Project (SCCWRP)
  - Marine beach impacted by storm water runoff
- Epidemiological study at Tampa Bay, Florida in design
  - University of South Florida
  - Impacted by storm water runoff
  - Tropical marine and freshwater beaches
- Epidemiological study at Miami Beach, Florida, underway
  - University of Miami and others as partners
  - Tropical marine beach
  - Non-point source urban runoff

# *Feces Production in the U.S.*



•  $1 \times 10^{12}$  kg/year

# Why Should Microbial Source Tracking Work?

**Intestinal microbes of animal groups are expected to be different:**

- **Gut conditions**
  - Temperature
  - Diet
  - Digestive system
- **Natural selection**
  - Space
  - Nutrients



## ***“Source Identifiers”***

**Definition . . . microbial populations that are particular to a specific animal host**

### **Ideal Candidates:**

- **Exhibit host-specificity**
- **Abundant in host**
- **Temporal stability**
- **Spatial continuity**

# When are MST Methods Useful

- To supplement sanitary surveys
  - Identify sources of beach contaminants
  - Identify sources of TMDL violations
- For risk analyses
  - **Human vs animal**
  - Domestic animal vs wildlife

## Cincinnati MST Research- CPSP

- Develop novel cattle and human microbial source tracking methods and complete performance assessment with similar previously published methods



## PCR Method Selection

Focus on bacterial host-specific PCR approaches

<b>Cattle-Specific</b>		<b>Human-Specific</b>		<b>Fecal Indicator Bacteria</b>
<i>PCR</i>	<i>qPCR</i>	<i>PCR</i>	<i>qPCR</i>	<i>qPCR</i>
4	3	4	12	5

- 7 End-Point PCR Methods (presence/absence)
- 20 Real-Time qPCR Methods (quantitative)

## Performance Assessment Criteria

Real-Time qPCR	End-Point PCR
Precision	Specificity
Range of Quantification	Sensitivity
Linearity	False Positive Rate
Specificity	False Negative Rate
Sensitivity	Limit of Detection
Sample Limit of Detection	Sample Limit of Detection
DNA Target Abundance	Robustness
Robustness	
Link to current AWQC methods	

## Fecal Reference Library

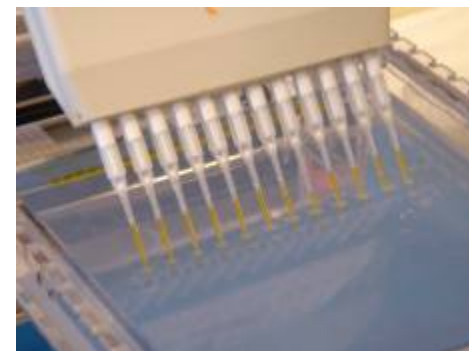
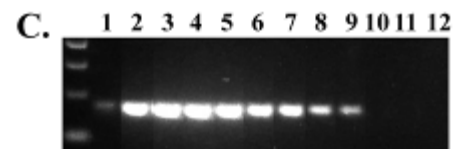
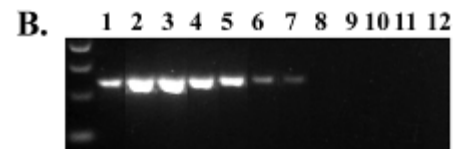
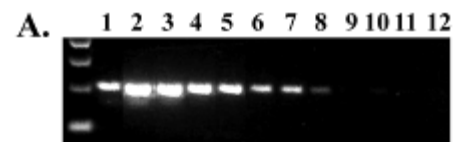
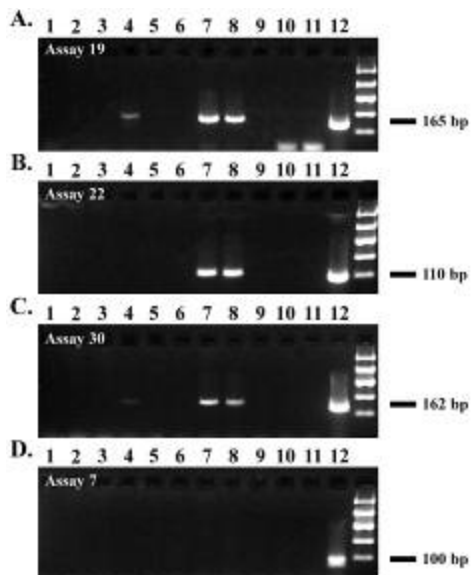
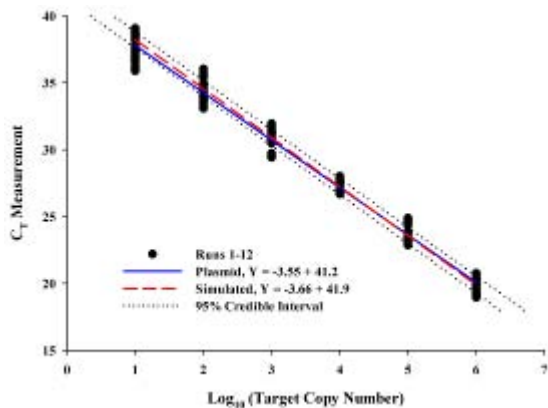
- 496 individual fecal samples
- represents 30 species





# Single Laboratory Performance Assessment

- 16,000 Real-Time qPCR reactions
- 11,000 End-Point PCR reactions
- 600 DNA extractions
- And counting...



# Thank you.