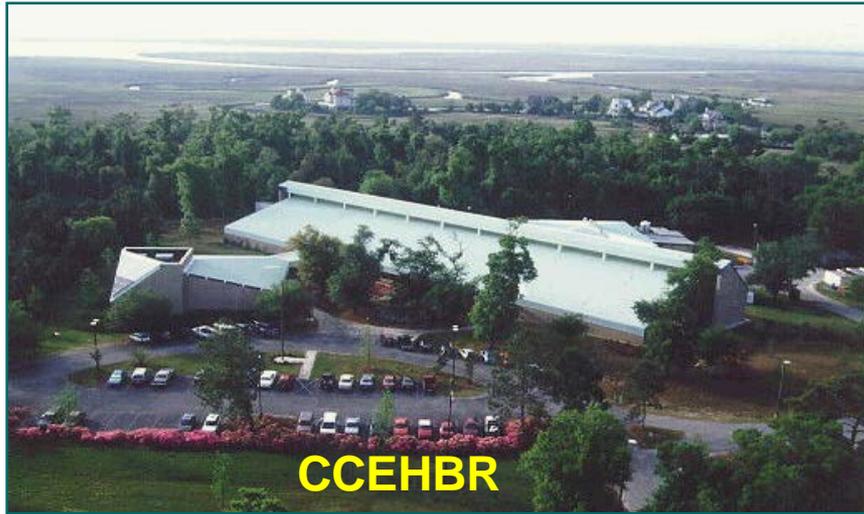




# “NOAA/NCCOS Activities ”



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Environmental Health and Biomolecular  
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# SCCWRP CEC REPORT

- ❑ **Known Knowns** - chemicals for which we have developed analytical methods, have begun collecting ambient data on environmental concentrations and/or developed laboratory toxicity data (e.g. PBDE, PFOS, Contemporary Use Pesticides).
- ❑ **Known Unknowns** - These are chemicals for which there is a potential for effects, but for which there are inadequate biomonitoring and bioeffects data to make a determination (e.g. Antibiotics, Nanomaterials, Transformation Products of Known and Unknown Chemicals).
- ❑ **Unknown Unknowns** - These are chemicals being rapidly developed for commercialization which there is little information on both potential environmental concentrations and possible adverse ecotoxicological effects. Unknown unknowns also include synergistic effects of multiple new contaminants that have not been previously investigated. Use of *in vitro* bioassays that target CEC exposure in ecological receptors based on a common mode of biological activity (e.g. Adverse Outcome Pathways such as endocrine disrupting activity) provides multi CEC Assessment and is more cost effective.



# SCCWRP CEC REPORT



- ❑ **Known Knowns**
- ❑ **Known Unknowns**
- ❑ **Unknown Unknowns**
- ❑ **Acute and Chronic Effects Data** (Growth, Development and Reproduction)
- ❑ **Safety Factors** [Acute vs. Chronic Effect (10); FW vs SW (10)]
- ❑ **Antibiotics Treated Differently – *needed to address both chemical and plasmid risks***

# $Bla_{M-1}$ Genes Measured in Charleston Harbor, SC

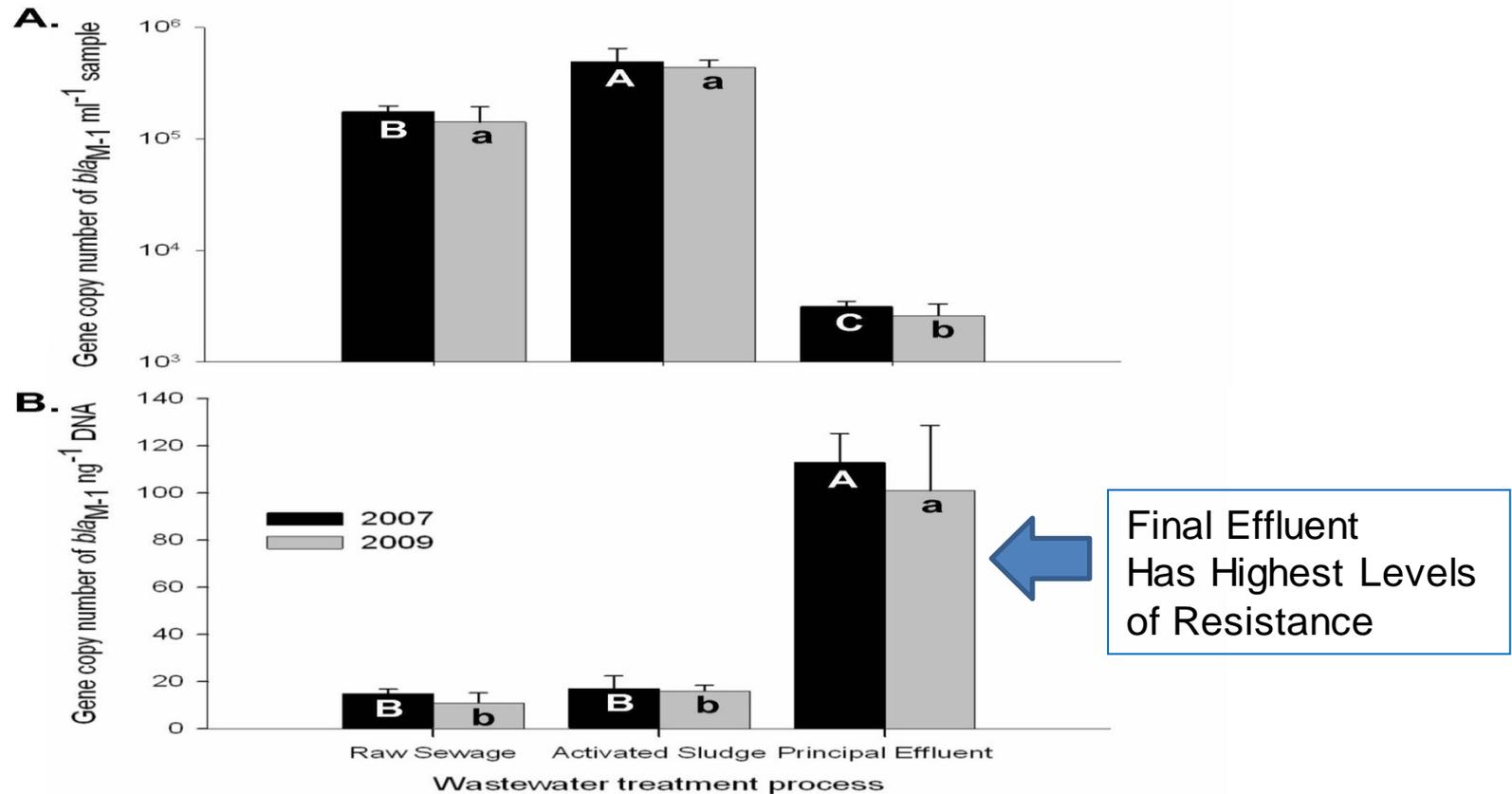


FIG. 3. Copy number of the  $bla_{M-1}$  gene ml<sup>-1</sup> of sample (A), and ng<sup>-1</sup> of DNA (B). Copy numbers were quantified by qPCR using metagenomic DNA extracted from 3 stages in the WWTP: Raw sewage (RS), Activated sludge (AS), and Principal effluent (PE). Black/gray bars represent GCN means for each treatment (n=3) during years 2007 and 2009 respectively. Error bars indicate standard deviations. Means with different upper and lower case letters indicate significant differences across treatment for years 2007 and 2009, respectively.

(Uyaguari et L., 2011. *Journal of Applied Env. Microbiology* 77: 8226–8233)

# Bla<sub>M-1</sub> Genes Measured in Charleston Harbor, SC

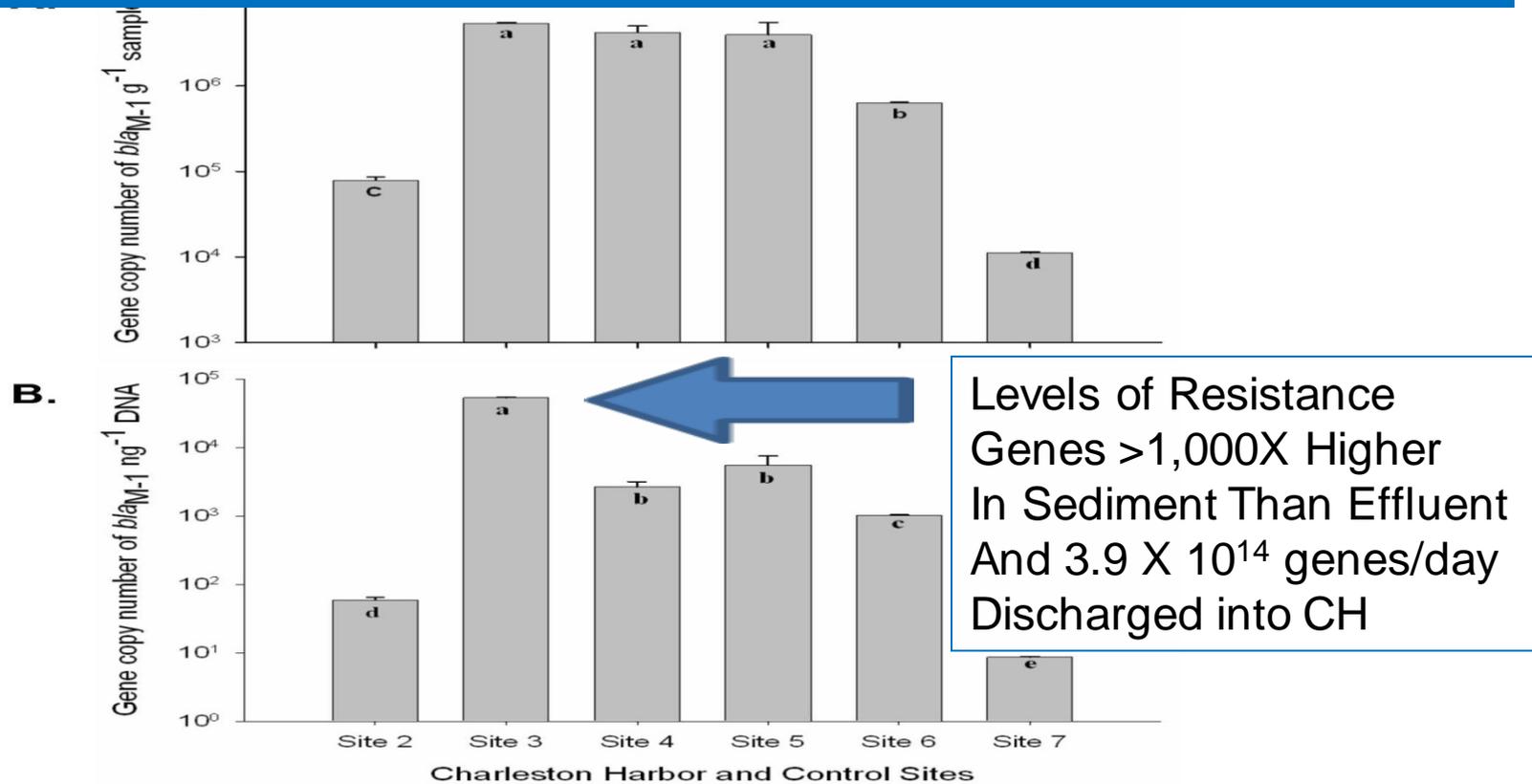


FIG. 4. Copy number of the *bla*<sub>M-1</sub> gene in sediments g<sup>-1</sup> of sample (A), and ng<sup>-1</sup> of DNA (B). Copy numbers were quantified by qPCR using metagenomic DNA extracted from 5 different sites in the Charleston Harbor area: Site 2 (WWTP outfall), Site 3 (Ashley River), Site 4 (Ashley and Cooper River mixing zone), Site 5 (Cooper River), Site 6 (Charleston Harbor mouth), and Site 7 (NI control site). Bars represent the mean for each treatment (n=3). Error bars indicate standard deviations. Means with different letters indicate statistical significance at the 0.05 level.

(Uyaguari et L., 2011. *Journal of Applied Env. Microbiology* 77: 8226–8233)



# Assessment of Antibiotic Risks



- ❑ **MICs** = estimated bacterial toxicity to each antibiotic
- ❑ **Range of Minimum Inhibitory Concentrations (MICs)** – indication of the variability of response of bacteria to each antibiotic & may provide some insight to plasmids effects
- ❑ **Addressing Uncertainty - SF = 10-1000** – Applied to:
  - Results from non aquatic indicator bacteria results (SF=10)
  - Lack of ABR data from plasmids or other molecular constituents (SF=10)
  - Incomplete (lacking a range of MICs) data sets (Additional SF=10)



# Comparison of MICs

<u>Class</u>	<u>Range of MICs<sup>a</sup></u>	<u>Mean MIC<sup>a</sup></u>
Cell Wall Inhibitors	1,000 - 32,000	13,667
DNA/RNA Inhibitors	60 – 32,000	6,541
Metabolic Inhibitors	250 – 512,000	118,857
Antibacterial Agents	25 (0.1) – 80,000	37,461

<sup>a</sup> = MICs Reported in ug/L



# Antibiotic Resistance Comparisons



**Ampicillin (CAS number 69-53-4)** NOEC <1,000  $\mu\text{g/L}$ . The MICs ranged from 1,000 to 32,000  $\mu\text{g/L}$ ; the lowest MIC value was 1,000  $\mu\text{g/L}$ , which was used as a LOEC. The NOEC was estimated to be <1,000  $\mu\text{g/L}$ . The ratio between the highest and lowest MIC values was 32 (32,000  $\mu\text{g/L}/1,000 \mu\text{g/L}$ ), indicating the variability of bacterial response to exposure to this antibiotic.

**Triclosan (CAS number 3380-34-5)** NOEC <25  $\mu\text{g/L}$ . The MICs ranged from 25 to 80,000  $\mu\text{g/L}$ . The lowest MIC value reported for the most sensitive species of 25  $\mu\text{g/L}$  was used as a LOEC. The NOEC was estimated to be <25  $\mu\text{g/L}$ . The ratio between the highest and lowest MIC was 3,200 (80,000  $\mu\text{g/L}/25 \mu\text{g/L}$ ) indicating the variability of bacterial response to exposure to triclosan.



# SCCWRP CEC REPORT



- ❑ 12 new CECs identified which should be added to future monitoring and assessment efforts in coastal and marine ecosystems.
- ❑ This list includes contemporary use pesticides, industrial chemicals, flame retardants, and pharmaceuticals and personal care products.
- ❑ **Triclosan** was on the only antibiotic that made this list through our assessment processes

Compound	Scenario 1 Inland Waters Aqueous	Scenario 2 Embayment Aqueous	WWTP Effluent	FW Stream - Storm- water (Aqueous and Sediment)	Scenario 2 Embayment Sediment	Scenario 3 Marine Sediment	All Scenarios Tissue
Bis(2-ethylhexyl) phthalate	NA	NA	M-O	NA	NA	M	NA
Bisphenol A	M	M	M-E/F	M	NA	NA	NA
Bifenthrin	M	M	M-E/F	M	M	NA	NA
Butylbenzyl phthalate	NA	NA	M-O	NA	NA	M	NA
Permethrin	M	M	M-E/F	M	M	NA	NA
Chlorpyrifos	M	M	M-E/F	M	NA	NA	NA
Estrone	M	M	M-E/F	M	NA	NA	NA
Ibuprofen	M	NA	M-F	M	NA	NA	NA
17-beta estradiol	M	M	M-E/F	M	NA	NA	NA
Galaxolide (HHCB)	M	M	M-E/F	M	NA	NA	NA
Diclofenac	M	NA	M-F	M	NA	NA	NA
p-Nonylphenol	NA	NA	M-O	NA	NA	M	NA
PBDE -47 and 99	NA	NA	M- E/F/O	M	M	M	M
PFOS	NA	NA	M- E/F/O	M	M	M	M
Triclosan	M	NA	M-F	M	NA	NA	NA

**M = Monitoring at WWTP Effluent and Stormwater**



# SCCWRP CEC REPORT

Monitoring trigger quotient estimates for antibiotics/antibacterial agents in the effluent dominated inland waterway (Scenario 1).

Antibiotic	MEC (ng/L)	NOEC (ng/L)	Safety Factor	MTL (ng/L)	MTQ
Triclosan	510	25,000	100	250	> 2.0

(**MEC** = Max. Exposure Conc.; **MTL** = Monitoring Trigger Level;  
**MTQ** = Monitoring Trigger Quotient)

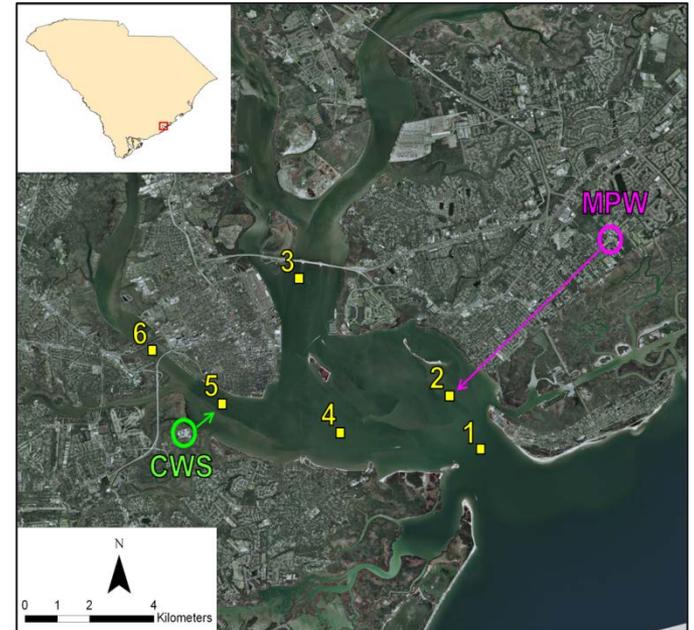
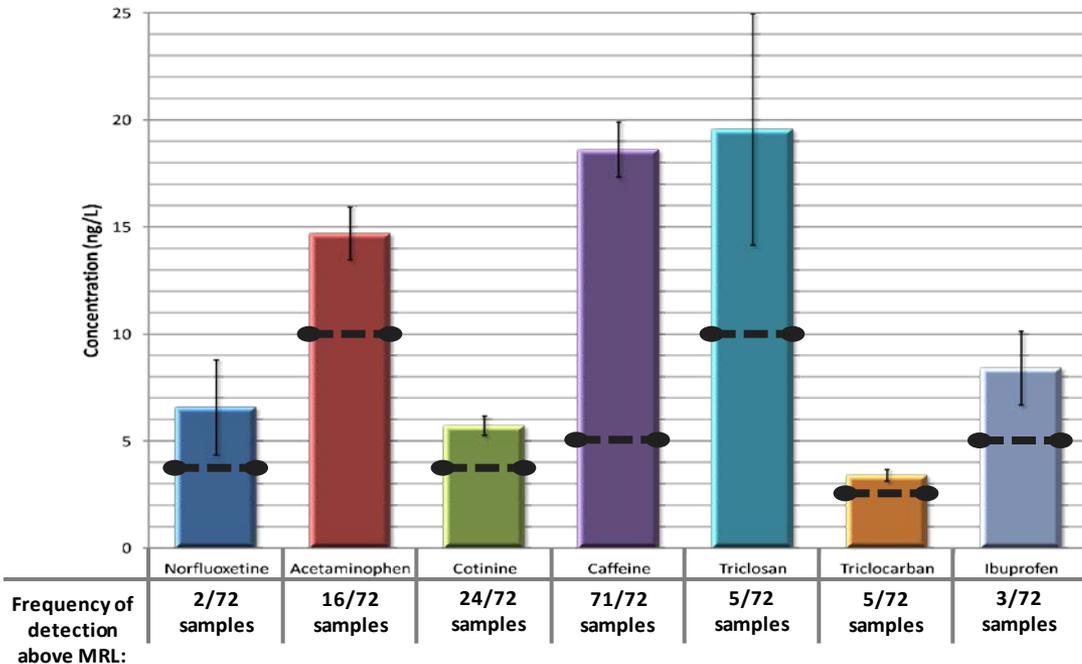
## Develop and apply analytical capabilities related to Contaminants of Emerging Concern

- ✓ Collaborative effort involving local wastewater utilities and university
- ✓ Understanding the distribution and source of pharmaceutical and personal care products (PPCPs) in coastal environments

### HIGHLIGHT

- ✓ Removal efficiencies from influent to coastal waters generally >95%
- ✓ 7 (of 19) PPCPs evaluated detected in surface waters

Average annual concentrations for Charleston Harbor samples detected above the Method Reporting Limit (MRL)





# Next Steps: Future Assessments Needs



- ❑ **Future Workshop on Antibiotic Resistance** – to compare current assessment methods and evaluate new tools/approaches to assess risks for water, sediments and tissues
- ❑ **Interim Suggested Guidance**
  - Measure ABR in bacteria at WWTPs or other PS discharges
  - Compare ABR with whole effluent (dissolved & particulate antibiotics + plasmids) versus filtered (sep pak, etc. = dissolved & particulate antibiotics)
- ❑ **Remaining Issues** – Sediment and Tissues Exposures



# NCCOS FY 13 Activities



- ❑ **Mussel Watch Integration** – trace metals and organics inter-laboratory calibrations (NOAA,NIST)
  
- ❑ **Role for NIST in this working group ?**
  
- ❑ **Great Lakes Special Areas of Concern – EPA/NOAA**
  
- ❑ **PAHs Integration Report** – Mussel Watch, National Status and Trends, Other Regional Assessments