



SETAC North Atlantic Chapter
2011 ANNUAL MEETING
June 8 - 10, 2011
Hilton Garden Inn, Freeport, Maine

PLATFORM SESSION ABSTRACTS

SESSION I: ENDOCRINE DISRUPTORS and EMERGING CONTAMINANTS

ENDOCRINE-ACTIVE PHARMACEUTICALS: AN ENVIRONMENTAL CONCERN? Lesley Mills (mills.lesley@epa.gov), Ruth Gutjahr-Gobell, Doranne Borsay Horowitz, Martha Simoneau, and Gerald Zarogian, US-EPA, Od, NHEERL, Atlantic Ecology Division, Narragansett, RI.

Recently, there has been growing interest in pharmaceuticals that are specifically designed to have endocrine activity, such as the estrogens used in birth control pills, exerting unintended effects on fish and other aquatic organisms. These pharmaceuticals may not be persistent in water, nor present in large quantities, but they are constantly entering the environment in wastewater effluent and are specifically designed to have physiological effects at minute concentrations. For example, tamoxifen, a widely-used treatment for breast cancer and an estrogen receptor ligand, has been detected in high ng/ml concentrations in British waters. Another class of pharmaceuticals used to supplement or replace tamoxifen treatment for breast cancer is aromatase inhibitors. The prospect of aromatase inhibitors entering aquatic environments in wastewater effluent is of concern because aromatase is the enzyme responsible for estrogen biosynthesis in all vertebrates, and is critical to normal reproductive processes. Laboratory experiments were conducted with the marine fish cunner (*Tautoglabrus adspersus*) to evaluate whether these pharmaceuticals have an impact on reproduction or aromatase activity in spawning adults. Cunner were treated with tamoxifen (0, 0.5 or 5 mg/kg) or one of the three aromatase inhibitors (0, 75 or 750 µg/kg) administered by oral gavage on days 0, 4, 8, 12 and 16 of each experiment. Egg production, viability and fertility were determined daily. On day 17, fish were sacrificed, and brain and ovary tissues were flash-frozen for later analysis of aromatase activity. In tamoxifen-treated fish, downward trends in the rate of egg production and the percentage of fertile or viable eggs were not significantly different from controls. Of the aromatase inhibitors, anastrozole and exemestane significantly decreased the rate of egg production in fish treated with the high concentration (750 µg/kg), while letrozole had no effect, although there was a significant decrease in the percentage of fertile and viable eggs in fish treated with letrozole. Female GSI was significantly reduced in anastrozole treatments, significantly increased in 75 µg/kg letrozole treatment, and unaffected by tamoxifen or exemestane treatment. Effects on aromatase activity were variable depending on treatment and tissue (brain or ovary). In fish treated with anastrozole or exemestane, aromatase activity was significantly decreased in brains. Tamoxifen, anastrozole and letrozole treatments significantly increased ovarian aromatase activity. Overall, results indicate these pharmaceuticals can modulate aromatase activity in fish on a chemical and tissue specific basis, and may also adversely impact fish reproduction.

ECOTOXICOGENOMIC APPROACHES TO ENVIRONMENTAL MONITORING OF LEGACY POLLUTANTS AND EMERGING CONTAMINANTS. Helen Poynton (helen.poynton@umb.edu) & William Robinson, UMass, Boston, Boston, MA; James Lazorchak & Chris Impelletteri, US EPA, Cincinnati, OH; Chris Vulpe, UC Berkeley, Berkeley, CA; Maria Sepulveda, Purdue University, West Lafayette, IN; John Colbourne, Indiana University, IN; and Mark Smith, McConnell Group, Cincinnati, OH.

The integration of genomic techniques including DNA microarrays into environmental monitoring has presented exciting possibilities to investigate chemical exposure and probe mechanism of action of pollutants. By profiling thousands of genes simultaneously, microarrays

provide an expression “fingerprint” specific for one chemical. We have developed genomic tools for non-model organisms with relevance to ecotoxicology including the crustaceans *Daphnia magna* and *Hyalella azteca* and mussel, *Mytilus edulis* and illustrated the potential of applying these technologies to environmental monitoring. Recent work has shown that sub-lethal exposures to metal toxicants and PCBs reveal distinct gene expression patterns for each chemical and these “fingerprints” can successfully predict the toxicants present in field collected water samples. In addition, gene expression profiles have provided novel insights into the mode of action of these chemicals and can aid in the establishment of Adverse Outcome Pathways. Our current challenge is to apply this technology to reveal biomarkers which respond specifically to metal-based nanoparticles and can distinguish between exposure to nanoparticles and their corresponding metal ions. These biomarkers will help us understand how environmental factors and nanoparticle characteristics affect the bioavailability of nanomaterials.

EXPOSURE TO POLYBROMINATED DIPHENYL ETHER FLAME RETARDANTS CAUSES CHANGES IN GENE EXPRESSION IN MESENCHYMAL CELL LINES. Deena J. Small (dsmall1@une.edu), Department of Chemistry and Physics, University of New England, Biddeford, ME.

Polybrominated Diphenyl Ether (PBDE) flame retardants are considered a source of emerging environmental contaminants. These chemicals have been used as flame retardants in a majority of household items including carpeting, upholstery and electronics. PBDEs released into the air from these products are subsequently inhaled as dust particles or ingested through food sources. PBDEs are lipid soluble and tend to accumulate within adipose and other fatty tissue within the body including bone marrow. PBDEs are endocrine disrupting chemicals with a structure very similar to thyroid hormones; however the molecular mechanism(s) by which PBDEs modify thyroid hormone function is (are) not defined. The objective of our research was to investigate the effects that PBDE exposure had on the expression of thyroid hormone-response genes in a variety of cultured mesenchymal stem cell lines. Using a combination of quantitative Reverse Transcriptase Polymerase Chain Reaction (qRT-PCR) and immunoblot, we found that PBDE exposure induced significant changes in the expression of genes in adipogenic and osteogenic cells. Changes in gene expression were accompanied by alterations in the differentiation potential of these cells, suggesting that chronic PBDE exposure may contribute to the pathogenesis of disorders linked to metabolic disorders and osteoporosis.

ASSESSING PASSIVE SAMPLERS TO DETERMINE CONCENTRATIONS OF ESTROGENS AND OTHER ENDOCRINE DISRUPTING COMPOUNDS IN NARRAGANSETT BAY. Shifra R. Yonis (sryonis@gso.uri.edu), R. Lohmann, Graduate School of Oceanography at the University of Rhode Island, Narragansett, RI 02882; G. Cornelissen, Norwegian Geotechnical Institute, Postboks 3930 Ullevål Stadion, 0806 Oslo, Norway; and P. Mayer, National Environmental Research Institute, Aarhus University, PO Box 358, 4000 Roskilde, Denmark.

Estrogens (both natural and synthetic) are highly effective endocrine disrupting compounds (EDCs) and have been known to decimate fish populations. Wastewater treatment facilities (WWTFs) are unable to remove 100% of estrogens in their systems. Other factors governing concentrations of EDCs in the water include dilution of WWTF effluents, and direct run off. The main focus of this research is to enable reliable measurements of EDCs such as estradiol, ethynylestradiol, estrone, estriol, bisphenol A, and nonylphenol in natural water, air, and sediment. Traditional methods for determining the concentration of EDCs in the environment rely on active, or one-time snapshot, sampling which gives a biased picture of long-term exposure in a dynamic system. Passive samplers can be used to measure a time-weighted average of freely dissolved concentrations. This is arguably most relevant in assessing accumulative exposure and risk. Polyethylene (PE) is a widely used matrix for passive sampling, but due to its apolarity is not ideal for use with EDCs. Silicone matrix sheets (Si) and polyoxymethylene (POM) samplers potentially can take up EDCs more quickly and to higher amounts than PE. Initial results indicate estrogens are most effectively concentrated in POM.

SESSION II: GENERAL ENVIRONMENTAL TOXICOLOGY and CHEMISTRY

COPPER TOXICITY OF A SEWAGE TREATMENT PLANT WASTEWATER IN AN EFFLUENT DOMINATED STREAM: YEA OR NAY? Barry Mower (barry.f.mower@maine.gov), Maine Department of Environmental Protection, Augusta, ME.

The State of Maine assesses attainment of State of Maine goals of restoring and maintaining biological integrity of state waters via three programs, 1) use of EPA's ambient water quality criteria (AWQC) for toxic pollutants, 2) whole effluent toxicity (WET) testing of effluents, and 3) biological monitoring of benthic communities. Using EPA's Principle of Independent Applicability, any discharge that fails to meet the thresholds of any of these programs is deemed to be causing non-attainment of Maine's Water Quality Standards.

The Paris Utilities District's (PUD) sewage treatment plant's discharge makes up 20% of the Little Androscoggin River at critical low flow. PUD has been unable to meet its copper effluent limit that is based on dilution and EPA's AWQC. Maine Department of Environmental Protection (DEP) rules allow for development of site specific criteria (SSC) following EPA and DEP guidelines. PUD used EPA's new Biotic Ligand Model (BLM) to calculate a SSC for bioavailable copper for the water column. The SSC would allow an increase of total copper to the river and does not address toxicity of copper in the sediments. To address the potential for sediment toxicity, DEP collected sediment samples for analysis of AVS-SEM, sampled the biological community in the sediments, and conducted a fish assemblage study above and below the PUD discharge.

TOXICITY, SUB-LETHAL EFFECTS AND POTENTIAL MODES OF ACTION OF SELECT FUNGICIDES ON FRESHWATER FISH AND INVERTEBRATES. Adria A. Elskus (aelskus@usgs.gov) US Geological Survey, Maine Field Office, University of Maine, Orono, ME.

Fungicides are considered an understudied group with respect to evaluating sub-lethal effects on non-target organisms. Given the basic modes of action through which fungicides exert their toxic effects (e.g. disruption of mitosis, suppressed respiration, altered lipid and protein synthesis), one might expect these chemicals to be potent toxicants for all biological life. Indeed, an increasing number of studies in the peer-reviewed literature report dramatic, and in some cases severe, effects on fish and invertebrates at low, environmentally relevant fungicide concentrations. I will discuss some of the striking findings for fungicide effects on non-target organisms (fish and aquatic invertebrates) and identify sub-lethal effects, sensitive organisms, life-stages, and data gaps. Where sufficient information exists on fungicide biochemical effects in non-target organisms, I will describe examples of fungicide modes of action that may be predictive of modes of action in aquatic vertebrates and invertebrates.

SKIN DAMAGE AND ALTERATION IN LARVAL FISH AS A RESULT OF EXPOSURE TO ULTRAVIOLET RADIATION AND A POLYCYCLIC AROMATIC HYDROCARBON. Amanda K. Gevertz (agevertz@environcorp.com), AJ Tucker, CE Williamson, & JT Oris, ENVIRON International Corporation, Portland, ME.

The purpose of this study was to determine the ways that multiple stressors affect both non-native and native fish species in Lake Tahoe (CA/NV). The stressors included natural ultraviolet radiation (UVR) and fluoranthene (FLU), a phototoxic polycyclic aromatic hydrocarbon (PAH). Responses to these stressors in the native Lahontan redband minnow (*Richardsonius egregius*) and the non-native warm-water bluegill sunfish (*Lepomis macrochirus*) were compared in controlled outdoor exposures. Damage to the epidermis and surrounding tissues was examined with transmission electron and light microscopy, serving as biomarkers of both exposure and effect. Natural defenses against UVR exposure, such as melanocyte and goblet cell formation, were investigated and quantified. Determination of the effects of these two stressors will help determine the invasive success of the bluegill and similar species in Lake Tahoe and other oligotrophic, montane lakes that are susceptible to reduced UVR transparency through habitat alteration or nutrient inputs, and increased PAH exposure as a result of recreational activity. While, the aforementioned study focused on larval freshwater fish in a montane lake, the same principles may be applied to the planktonic stages of larval marine fish inhabiting coastal systems, in which acute PAH and UVR exposure may occur. Such a system

exists in the surface waters along the Gulf of Maine, an area of high shipping activity and larval fish abundance, providing an excellent study system to pursue similar research.

DISCERNING PATTERNS OVER 90 MILES OF DATA: A STUDY OF THE HANFORD REACH IN THE COLUMBIA RIVER. Lisa M. McIntosh (lmcintosh@woodardcurran.com), S. McCarthy, L. Campe, & C. Trapp, Woodard & Curran Inc., Dedham, MA; and L. Hulstrom, Washington Closure Hanford, Richland, WA.

A 90 mile stretch of the Columbia River in Washington State, adjacent to and downstream of the Hanford Site (a largely decommissioned nuclear production facility operated by the United States Department of Energy), has been the subject of environmental investigations for decades. Recently, as part of a remedial investigation, numerous environmental samples, consisting of surface water, sediment, island soils, and several tissue types from six different species of fish, were collected along the 90 mile reach. Analytes included volatile and semi-volatile organic compounds, chlorinated pesticides, PCBs, metals and other inorganics, and radionuclides. The objective of the study reported here is to ascertain patterns in and relationships among environmental media—specifically, sediment and fish tissue-- for a variety of constituents. In particular, PCBs, DDE, mercury and other heavy metals were selected for in-depth multivariate statistical evaluation of the relationship between sediment and fillet concentrations of the individual fish species. The implications of this approach for using sediment data as an indicator of the uptake of these compounds into the fillet portion of different fish species is discussed. The relative contribution to health risks of abiotic and biotic media is also presented.

SESSION III: LOCAL ISSUES

ECOSYSTEM INDICATORS AND TOOLS IN THE GULF OF MAINE. Christine M. Tilburg (ctilburg@seurespeed.us), Gulf of Maine Council, Falmouth, MA, and Kathryn Parlee, Environment Canada, Halifax, NS.

The Gulf of Maine's watershed encompasses more than 170,000 km² and is home to over 6.5 million Canadians and Americans. Despite the long-standing ecological, cultural and economic value of the Gulf, the ecosystem as a whole is not well understood. Recognizing this need, the Gulf of Maine Council (GOMC) developed the EcoSystem Indicator Partnership (ESIP) to look at indicators of ecosystem health for the Region. This partnership, which brings together individuals from more than seventy-five different Canadian and U.S. organizations, is currently focused on identifying and tracking key ecosystem health indicators in seven theme areas (aquatic habitats, aquaculture, climate change, coastal development, contaminants, eutrophication, and fisheries).

At the moment, ESIP is moving ahead with status and trends analysis for over half of these themes: aquaculture, aquatic habitats, climate change, and eutrophication. As the wealth of available data is collected, it is presented through the ESIP Indicator Reporting Tool (www2.gulfofmaine.org/esip/reporting). This web-based Reporting Tool allows managers to locate data in the region and build graphs for the time periods of interest. Snapshots created using the tool can also provide critical information for those faced with making decisions quickly and provide needed baseline information for use with adaptation efforts.

PHOSPHATE SOURCE-SINK DYNAMICS IN ANDROSCOGGIN RIVER SEDIMENTS. Andrew Cardamone (acardamo@bowdoin.edu) and Dharni Vasudevan, Bowdoin College, Chemistry Department, Brunswick, ME.

The Androscoggin River has historically had varying levels of inorganic phosphate (o-P) input from many sources, including pulp and paper mills, agricultural runoff, and wastewater treatment plants. Since the passage of the Clean Water Act, water quality has greatly improved. As the river becomes cleaner, however, questions remain over whether the o-P currently bound to the sediment will reenter the water and adversely affect the ecosystem. To examine this dynamic, several sediment samples were collected at two locations along the river: Gulf Island

Pond (GIP) and Merrymeeting Bay (MMB). Sediments from each site were used in sorption experiments from which the equilibrium phosphorus concentration (EPC) was extrapolated. The EPC value has been extensively used to establish aqueous phosphorus concentrations at which there is no net phosphorus release or uptake by the sediment. At both GIP and MMB, the EPC values indicate an equilibrium between sediment bound phosphate and current pore water and surface water phosphate concentrations. This implies that as phosphate inputs into the river continue to decrease to concentrations less than 0.5 $\mu\text{mol P/L}$ (15 ppb), sediment bound phosphate could be released into the Androscoggin and potentially become a significant new source of phosphate pollution. Furthermore, GIP sediments had higher o-P sorption capacities, surface areas, and extractable iron (ex-Fe) and aluminum (ex-Al) content compared to MMB sediments, indicating the capacity to act as an o-P sink is likely determined by surface area, ex-Fe, and ex-Al content.

TEMPORAL TRENDS AND RECOVERY PROSPECTS FOR MERCURY CONTAMINATED FRESHWATER FISH IN MASSACHUSETTS. Michael S. Hutcheson

(michael.hutcheson@state.ma.us), C. Mark Smith, & Jane Rose, Massachusetts Department of Environmental Protection, Office of Research and Standards, Boston, MA; Carol Batdorf, James Sullivan, & Oscar Pancorbo, Massachusetts Department of Environmental Protection, Wall Experiment Station, Lawrence, MA.

The temporal trends of total mercury concentrations in edible muscle of largemouth bass (*Micropterus salmoides*) and yellow perch (*Perca flavescens*) for a 10-year period are evaluated based upon a data set for approximately 4600 fish from 24 Massachusetts lakes sampled from three to six times. Various regression models are used to describe the shapes of the time series curves for concentrations including linear, exponential, quadratic and linear piecewise where appropriate. The trend curves are primarily downwards and are summarized with annual percent change values compared to values observed elsewhere in North America and will be presented in the context of local, regional and national changes in mercury emissions and atmospheric deposition patterns. Best fit regression curves are used to predict times to reach tissue mercury concentrations used for fish consumption advisory purposes.

SESSION IV: OIL SPILLS AND RESPONSE

WARREN'S EXCELLENT ADVENTURE IN THE GULF. Warren Boothman,

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Following the explosion and sinking of the Deepwater Horizon oil and subsequent release of oil into the Gulf of Mexico at a depth of approximately 1.5 km, a plan was developed to inject dispersant into the subsea release point with the intent to minimize the amount of oil reaching the surface, thereby minimizing risks to shoreline and surface habitats. As part of this plan, BP was directed to implement a water column monitoring program to determine the extent of dispersed subsurface oil. While EPA was not directly involved in implementing the monitoring program, EPA personnel were deployed on ships involved in the monitoring to assess and ensure the validity of the methods and practices involved in the data and sample collection. This presentation will illustrate the conditions and environment during 3 days of sampling around the wellhead in June of 2010, describe the personnel, equipment and procedures involved in the sampling, and give a personal perspective on the operation.

SESSION V: CONTAMINATED SOILS AND SEDIMENTS

MERCURY AND SELENIUM RELATIONSHIPS IN LOCAL FISHERIES. Nichole L. Ares

(nares980@g.rwu.edu) and David L. Taylor, Department of Marine Biology, Roger Williams University, Bristol RI.

Mercury (Hg) is a toxic environmental contaminant that negatively affects human health, and exposure occurs through the consumption of finfish. Selenium (Se) has the potential to directly or indirectly interact with Hg, and in the process, have a mitigating effect on Hg toxicity. Hg levels have been investigated in edible filets of fish, e.g., summer flounder (*Paralichthys dentatus*), black sea bass (*Centropristis striata*), tautog (*Tautoga onitis*), and bluefish (*Pomatomus saltatrix*). Information on the Hg content of other tissues, e.g., brain and liver, however, is lacking. The brain is of particular concern because Hg is a neurotoxin, and the liver due to its role in detoxification. Moreover, the relationship between Hg and Se across these different tissues is largely unknown. This study examined Hg and Se concentrations among four estuarine finfish and their respective tissue-types. The specific objectives of this study were to: (1) examine Hg and Se bioaccumulation within the three target tissues: muscle, brain, and liver, (2) examine the molar ratios of Se:Hg within tissues, and (3) compare Hg/Se differences among finfish as it relates to species-specific life-history characteristics. From June to August 2007-2010, target fish were collected from the Narragansett Bay estuary (RI, USA). Length (cm) was recorded for each fish, and total Hg was determined using a DMA-80 (direct mercury analyzer), which utilizes automated atomic absorption spectroscopy. Total Se was measured using inductively coupled plasma mass spectroscopy. Molar ratios of Se:Hg were calculated to determine the protective quality of Se over Hg toxicity, with a ratio ≥ 1 showing a mitigating effect.

QUANTIFYING THE BIODEGRADATION POTENTIAL OF 8:2 FLUOROTELOMER MONOMERS IN SOIL. Laurel A. Royer (lroyer@exponent.com), Exponent, Maynard, MA.

Much of the scientific literature on perfluorinated alkyl chemicals in the last decade has focused on the fate of fluorotelomer alcohols (FTOHs) in soil, sludge and the atmosphere as well as the identification and quantification of acid metabolites. The FTOH degradation metabolite of greatest interest has been perfluorooctanoic acid (PFOA) due to its apparent persistence, subsequent accumulation, and potential toxicity to wildlife and humans. The hydrolysis of fluorotelomer monomers used as surfactants or in the manufacturing of polymers is one of the most likely, but unconfirmed indirect source of FTOH and ultimately PFOA in the environment. To probe this hypothesis, and to explore structural factors affecting the microbial hydrolysis rates of two fluorotelomer esters, the biotransformation of 8:2 fluorotelomer acrylate (8:2 FTA) and 8:2 fluorotelomer methacrylate (8:2 FTMA) was monitored in aerobic soils for up to 105 days. At each sampling time, triplicate soil microcosms were sacrificed by sampling the headspace for volatile FTOHs followed by sequential extraction of soil for parent compounds, and transient and terminal degradation products. In microbial-active systems, both 8:2 FTA and 8:2 FTMA were hydrolyzed releasing 8:2 FTOH. Observed half-lives for FTA ranged between 3 and 5 days in three different soils. Furthermore, the observed half-lives for 8:2 FTMA in two different soils were determined to be at least three times (15-d) longer. Maximum FTOH levels between 8 and 11 mol % occurred by day 3 in 8:2 FTA microcosms. Subsequently, fluorotelomer carboxylic acids (FTCAs) and perfluorinated carboxylic acids (PFCAs) metabolites were generated consistent with the known biotransformation pathway of 8:2 FTOH. For 8:2 FTMA, the addition of a methyl group to the acrylate moiety adds sufficient bulk to cause some steric hindrances as well as elicit electronic differences that affect microbially-mediated ester cleavage rates. The subsequent aerobic degradation of 8:2 FTOH released from 8:2 FTMA generally followed the same pathway as observed for 8:2 FTA. These biotransformation studies confirm the fluorotelomer esters as indirect sources of PFOA and provide information useful in predicting the biodegradation potential of high molecular weight fluoropolymers applied to a myriad of commercial applications.

SORPTION OF AROMATIC AMINES TO SOILS AND SOIL MINERALS: IMPLICATIONS FOR THE FATE OF EMERGING CONTAMINANTS. Dharni Vasudevan (dvasudev@bowdoin.edu), Teresa Arey, Tina Zhang, and Mark Newman, Bowdoin College, Chemistry Department, 6600 College Station, Brunswick, ME.

Numerous chemicals containing cationic amine functional groups, such as antibiotics, herbicides, and antidepressant drugs, have been detected in surface and ground waters, and some of these pose risks to humans and ecosystems. Understanding and predicting the extent of sorption under a wide range of environmental conditions is key to anticipating potential contamination of groundwater by these chemicals. Cation exchange, the primary mechanism for

cationic amine sorption has been well studied. However, there is a lack of knowledge surrounding potential secondary mechanisms of sorption and the soil characteristics that may facilitate secondary, intermolecular interactions between amines sorbed to the surface and adjacent amines in solution. The presence of secondary interaction mechanism can lead to non-linearities in sorption phenomena. If the equilibrium sorption constant (K_d), a key parameter in contaminant transport models, is not constant over a wide range of solute concentrations, the sorption is considered non-linear. Transport models that assume a constant K_d and do not account for non-linearity will under or over predict contaminant transport and provide ineffective assessments. By studying the sorption of a series of model compounds that represent important sub-structures of antibiotics and pesticides, this study addresses three significant gaps in current understanding of cationic amine fate: (i) *the influence of compound structural criteria on amine cation sorption*, (ii) *secondary interactions mechanisms that contribute to non-linearity in sorption phenomena*, and (iii) *effect of soil properties on sorption linearity and non-linearity*.

EVOLVED POLLUTION TOLERANCE IN THE ESTUARINE FISH, *Fundulus heteroclitus*.

Diane Nacci (nacci.diane@epa.gov), Denise Champlin, & Dina Proestou. US EPA Office of Research and Development, Atlantic Ecology Division, Narragansett, RI.

Wild populations of the killifish *Fundulus heteroclitus* residing in heavily contaminated North American Atlantic coast estuaries have recently and independently evolved dramatic, heritable, and adaptive polychlorinated biphenyl (PCB) tolerance. This presentation will summarize the molecular, toxicological, and ecological approaches that are being employed to reveal the genetic basis for this tolerance, and better understand the realized or potential benefits and costs of this evolutionary response to chemical contamination.

SESSION VI: CHALLENGES AND INNOVATIONS IN ECOLOGICAL RISK ASSESSMENTS

APPLICATION OF MULTIPLE INDEX DEVELOPMENT APPROACHES TO BENTHIC INVERTEBRATE DATA FROM THE VIRGINIAN BIOGEOGRAPHIC PROVINCE.

Marquerite C. Pelletier (pelletier.peg@epa.gov), US EPA, NHEERL, Atlantic Ecology Division, Narragansett, RI; Arthur J. Gold, University of Rhode Island, Department of Natural Resources Science, Kingston, RI; Liliana Gonzalez, University of Rhode Island, Department of Computer Science and Statistics, Kingston, RI; and Candace Oviatt, University of Rhode Island, Graduate School of Oceanography, Narragansett, RI.

Benthic invertebrate indices have commonly been utilized to assess benthic invertebrate communities. These indices have been constructed using different techniques, but have shown different levels of application success. For example, the EMAP Virginian Province Index did not perform well in a smaller estuarine complex. Similarly, the Chesapeake Bay Benthic Index of Biotic Integrity did not perform well outside of Chesapeake Bay, despite multiple metric and good habitat separation. In this study, we assembled multiple variables (metrics) from the literature and applied different methods of index compilation to explore the relative strengths and weaknesses of the indices. Three different approaches were utilized -- two multimetric indices (Chesapeake Bay approach and the Mebane approach) and a logistic regression technique. The data were subdivided by habitat (salinity and grain size) and indices compiled using the same initial group of benthic metrics. Each approach was examined for its classification accuracy for both reference and impaired sites for the entire Virginian Province. The Chesapeake Bay approach did not perform well in this study. In contrast, another multimetric approach, the Mebane approach, performed well, as did the logistic regression approach. Both techniques have promise for index development and could be useful in applying a biological condition gradient to estuaries.

BENTHIC COMMUNITY ASSESSMENT AND IMPROVEMENT IN THE BUFFALO RIVER, NY.

Anne C. Daniel (adaniel@environcorp.com), ENVIRON International Corporation, Portland, Maine; Mary Sorensen, ENVIRON International Corporation, Atlanta, Georgia; Jen Lyndall,

ENVIRON International Corporation, Cleveland, Ohio; Bill Elzinga, MACTEC, St. Louis, Missouri; John Morris, Honeywell International, Morristown, New Jersey; and Victor Magar, ENVIRON International Corporation, Chicago, Illinois.

Benthic invertebrate communities in the Buffalo River area of concern have improved from conditions observed in the 1960s. In 2005, the benthic community was characterized as having low taxonomic richness and diversity, being dominated by pollution-tolerant organisms, and having high incidence of mouthpart deformities in chironomid midges, a condition that can be associated with pollution. To better understand current conditions in the river and to establish expected endpoints for improving beneficial uses, a benthic invertebrate community survey, including a habitat assessment, was conducted in fall 2008. This work was performed as part of the Great Lakes Legacy Act (GLLA) Buffalo River Feasibility Study, in cooperation with the Buffalo River GLLA Project Coordination Team (PCT), which includes the US Environmental Protection Agency Great Lakes National Program Office, the Buffalo Niagara Riverkeeper, New York State Department of Environmental Conservation, United States Army Corps of Engineers, and Honeywell International Inc.

Two reference water bodies were sampled with the Buffalo River to account for its unique orientation on Lake Erie and the frequency/magnitude of seiche effects. Benthic community samples were collected using a sediment grab sampling and Hester-Dendy substrate samplers. Both approaches provided unique insights into the types of organisms present as well as those that can recolonize the river. Multiple benthic community metrics were calculated for the assessment in accordance with accepted approaches developed by USEPA and NYSDEC; metrics included species richness, abundance, EPT richness, HBI, percent model affinity, species diversity, dominance, NCO richness, and chironomid mouthpart deformities. Metric data was compressed into a single index value using USEPA and NYSDEC methods, to determine overall impact. Comparisons were made between sediment grab and Hester-Dendy results for species/family richness and percent dominance/chironomid deformities. Additionally, we evaluated the potential toxicity to benthos of sediment-associated contaminants.

In general, the NYSDEC water quality impact determination for the Buffalo River ranged from moderate to severe, whereas the USEPA approach showed areas are slightly to moderately impacted compared to the reference water bodies. Hester-Dendy samples showed only slight impairment compared to the reference creek; results of the artificial substrate analyses revealed much more diverse fauna than grab samples. The present study confirmed that the river as a whole shows diversity that is not readily apparent by the evaluation of a single method. The habitat assessment was used to inform the need for sediment remediation, which was incorporated into the Buffalo River GLLA Feasibility Study. The assessment also provides baseline conditions to monitor improvements following sediment remediation.

CHEMICAL RANKING AND SCORING SYSTEMS AS GREEN CHEMISTRY TOOLS – APPLICATIONS AND CONSIDERATIONS. [Kim Reynolds Reid](mailto:kreid@gradientcorp.com) (kreid@gradientcorp.com), Tim Verslycke, Sagar Thakali, & Teresa Bowers, Gradient, Cambridge, MA.

The Green Chemistry movement and increasing scrutiny by consumers and regulators have prompted many companies to seek approaches that can be used to effectively and efficiently evaluate their products, with the goal of protecting human health and the environment. Numerous ranking and scoring approaches have been developed to evaluate and assess chemicals and products to help identify 'greener' alternatives. Although the concept of chemical ranking and scoring tools is not necessarily new, approaches have been modified and improved within the past decade such that they are now increasingly applied to chemical ingredients in consumer products. Some of these tools evaluate chemicals via qualitative, hazard-based criteria, while others are used for priority-setting; others seek to "label" consumer products on the basis of human health and ecological risk. We will provide an overview of current approaches to chemical ranking and scoring, discuss in-depth some example systems, describe some of the fundamental attributes of scoring systems, and briefly address other possible applications for chemical ranking systems.

ENVIRONMENTAL RISK-BASED RANKING OF PRODUCT INGREDIENTS. Sagar Thakali (sthakali@gradientcorp.com), Manu Sharma, Tim Verslycke, & Kim Reid, Gradient, Cambridge, MA.

Available environmental scoring and ranking frameworks generally do not explicitly consider potential environmental risk(s) by integrating both hazard and exposure from typical product use. Instead, they focus primarily on inherent environmental hazards (e.g., aquatic toxicity, persistence, bioaccumulation potential, etc.). Using readily available environmental fate/exposure and hazards data, we applied various environmental scoring and ranking frameworks—including those that explicitly consider environmental exposure as well as hazards—to evaluate the relative environmental safety of 38 surfactants widely used in personal care products (PCPs), in household laundry products, in domestic and industrial cleaners, and in a variety of industrial applications. Because most surfactants are typically discharged into the environment through sewage treatment plants, wide-scale use of these surfactants may result in potential environmental impacts. Therefore, a risk-based, rather than a hazard-based, approach to environmental ranking of these surfactants potentially released in the environment may be more relevant. We will present examples of scoring and ranking analyses to demonstrate that consideration of environmental exposure can result in an environmental ranking significantly different than an approach based solely on environmental hazards. Our analyses indicate that a hazard-based environmental ranking of product ingredients may not sufficiently address potential environmental risk(s). Therefore, a risk-based environmental ranking framework, consistent with various environmental risk assessment frameworks, is potentially more reliable and more relevant than hazard-based environmental ranking frameworks for various applications (e.g., to support product stewardship toward "greener" ingredients, identify data gaps and establish priorities, communicate environmental risks and benefits to consumers, and facilitate safe disposal of unused/waste products).

POSTER SESSION ABSTRACTS

SORPTION OF AROMATIC AMINES TO MONTMORILLONITE: ROLE OF CATION- π

INTERACTIONS. Teresa Arey (tarey@bowdoin.edu) and Dharni Vasudevan, Bowdoin College, Chemistry Department, 6600 College Station, Brunswick, ME.

The cationic amine moiety is an important structural feature of many pharmaceuticals and pesticides that are being increasingly released into the environment. The sorption of these chemicals influences their environmental fate as well as the extent of human and ecosystem exposure. Currently, the primary mechanism of cationic amine sorption, cation exchange, is well known, but there is a lack in understanding of secondary sorption mechanisms. As such, this study focused on the sorption of cationic benzylamines to montmorillonite, an important component of many soils systems. The goal was to investigate the effect of the cation- π interaction - a potential secondary sorption mechanism - on the sorption of cationic amines to montmorillonite. The cation- π interaction between 2 aromatic amines is defined as the electrostatic attraction between the π system of one amine and the cationic amine moiety of the other. To investigate the effect of the cation- π interaction, sorption isotherms were obtained for a series of benzylamines with varying electrostatic potentials (electron densities) at the center of the aromatic ring. This study provides new evidence for the importance of cation- π interaction as a secondary mechanism relevant to aromatic amine sorption at the mineral-water interfaces. With an increased understanding of these mechanisms, it will be possible to better predict the environmental fate, and human exposure of more complex amines, such as pesticides and antibiotics in the environment.

ASSESSMENT OF ESTROGENIC ENDOCRINE DISRUPTING CHEMICALS (EDCs) IN THE ASSABET RIVER BASIN.

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The Assabet River located in eastern Massachusetts receives treated wastewater discharges from four major municipal wastewater treatment plants: Westborough, Marlborough, Hudson and Maynard as well as three minor facilities. Up to 95% of the Assabet River is wastewater effluent in periods of low flow. Chemical analyses have shown that municipal wastewaters can contain EDCs. Estrogenic EDCs such as the natural estrogen 17 β -estradiol, the synthetic estrogen 17 α -ethynylestradiol, and estrogen mimics such as nonylphenol can cause feminization in male fish through the induction of vitellogenin (VTG). The purpose of the present research is to assess EDCs in the Assabet River using both a bioassay that measures the induction of VTG in male Japanese Medaka (*Oryzias latipes*) and analytical chemistry to measure the levels of selected compounds.

In the summer of 2010 water samples were collected from five locations along the Assabet River and its tributaries. Male Medaka were exposed to each of the five water samples and VTG induction was measured using quantitative RT-PCR. Concurrently collected samples were analyzed for 40 compounds associated with human activity including several estrogenic EDCs. The bioassay and chemical analysis of limited samples from season one reveal no statistically significant levels of EDCs.

IMPACTS OF CHRONIC EXPOSURES TO C60-STIR AND C60-OH NANOPARTICLES ON *DAPHNIA MAGNA*: RELATING GENE EXPRESSION AND MORTALITY AS A TOOL FOR FUTURE ENVIRONMENTAL IMPACT ASSESSMENTS.

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Fullerene (C60) and hydroxylated fullerene (C60-OH) nanoparticles have a wide range of applications and benefits in industry, consumer goods, and medicine. However, the increasing

manufacturing and production of fullerenes has led to the need for more research to assess the associated environmental impacts. Since chronic exposures are more relevant to the field, this study aims to relate mortality data and Glutathione- S-transferase (GST) and Catalase (CAT) gene expression levels to use genomic data as early warning biomarkers for fullerene exposure. We conducted a 19-day static renewal chronic toxicity assay using *Daphnia magna* as the indicator species. *D. magna* were exposed to 1, 10, and 50 mg/L treatments of C60-stir and C60-OH nanoparticles. At the end of the exposure mRNA was extracted and reverse transcribed into cDNA and Q-PCR was performed for the selected primers and normalized to Actin. The nanoparticles were characterized by TEM and nano Zetasizer. The results of this experiment indicate significant GST and CAT gene expression levels and mortality at 10 and 50 mg/L concentrations. Since it is difficult to quantify the concentration of nanoparticles in aquatic systems, GST and CAT gene expression levels can potentially be used as a threshold to rank and characterize nanoparticle risk in aquatic environments.

RME: EXPLORING THE UPPER BOUNDS OF UPPER-BOUND EXPOSURE PARAMETERS IN DETERMINISTIC HUMAN HEALTH RISK ASSESSMENTS. Diana Chin (diana.chin@arcadis-us.com), P. Anderson, and B. Magee, ARCADIS US, Inc., Chelmsford, MA 01824.

USEPA human health risk assessment guidance defines a reasonable maximum exposure (RME) scenario as “the highest exposure that is reasonably expected to occur at a site,” provided that both quantitative data and professional judgment indicate that the exposure does not exceed the range of possible exposures. High end exposure parameters, chosen “to be conservative” without regard for the core purpose of the RME, result in unrealistic estimates of risk that contribute little to the evaluation of a site. Three considerations concerning the development of realistic RME scenarios are presented here. First, USEPA guidance does not support choosing more than one or two high end exposure parameters for a single RME scenario, particularly if the scenario involves more than one exposure pathway. Next, specific exposure parameters developed for an RME scenario should not be confused with those developed for bounding estimates of risk. Finally, the ability of a site to sustain the chronic high end contact rates used in an RME scenario is an appropriate and necessary consideration for a meaningful human health risk assessment. Real-world examples based on recent risk assessments will be provided to demonstrate each consideration.

ESTIMATING STAGE-SPECIFIC VITAL RATE RESPONSES TO STRESS WITHIN MIXED AGE POPULATIONS OF THE OPOSSUM SHRIMP AMERICAMYSIS BAHIA USING DIGITAL IMAGING. Doranne Borsay Horowitz (borsay.dodi@epa.gov), Jason S. Grear, and Ruth Gutjahr-Gobell, U.S. EPA, Atlantic Ecology Division, Narragansett, RI 02882.

Most observations of stressor effects on marine crustaceans are made on individuals or even-aged cohorts. Results of these studies are difficult to translate into ecological predictions, either because life cycle models are incomplete, or because stressor effects on mixed age populations may differ from those observed in cohort studies. This problem is evident in several important environmental applications of population ecology, including ecological risk assessment of chemicals and futures analyses of ocean acidification. In particular, investigators have acknowledged the need for life cycle approaches in predicting adaptive responses to changing environments. To address this need, we have developed an observational scheme that allows estimation of stage-specific vital rates (e.g., juvenile survival, adult survival, fecundity) from observations of mixed age *Americamysis bahia* populations. Image analysis of video frame captures has enabled us to do reliable temporal in vivo monitoring of test populations. We used this system to examine life cycle responses to four levels of resource limitation (i.e., feeding rates), which is an oft-cited complication in applied population ecology. Based on our analysis, more than 95% of the treatment effect on population growth rate was due to changes in adult survival. However, we also detected complex compensatory responses, such that impairments in one part of the life cycle were partially offset by improvements in other vital rates. This contrasts with our cohort-based results, where resource effects on each vital rate were always positive. Our study suggests that emphasis in stressor-response studies on early life stages and even-aged cohorts may miss important demographic responses and should be augmented by observations of intact populations, especially as methods such as ours become more available.

DEVELOPMENT OF DNA - FREE SEDIMENT FOR ECOLOGICAL ASSAYS WITH GENOMIC ENDPOINTS. (unmanned) Kay T. Ho (ho.kay@epa.gov), Dina Proestou, Lisa M. Portis, Anthony Chariton, Stuart Simpson, & Robert M. Burgess, US EPA, Atlantic Ecology Division, Narragansett, RI.

Recent advances in genomics are currently being exploited to discern ecological changes that have conventionally been measured using laborious counting techniques. For example, next generation sequencing technologies can be used to create DNA libraries from benthic community assemblages living under disparate ecological conditions. The content of the libraries can then be compared, and differences in taxon composition attributed to the ecological factor(s) in question. One challenge in this method is to obtain DNA-free sediment that serves as a control in field and laboratory experiments with genomic endpoints. We tested long-term sediment storage and autoclaving as methods of eliminating DNA in sediments. Our treatments were field-collected sediments that had been stored at 4°C in the dark for 5, 12 and 18 years, and then the same sediments were autoclaved and tested at zero, one and two weeks post autoclave. In addition, a freshly collected sediment sample was included as a positive control. DNA was extracted from all samples in triplicate using a modified method of Power Soil DNA Isolation Kit™ from MoBio. DNA content of each extract was evaluated fluorometrically (nanodrop) and via agarose gel electrophoresis. Results of both the nanodrop assay and electrophoresis indicated sediments stored for prolonged periods of time (up to 18 years) still contained quantifiable concentrations of DNA, whereas subsamples of those same sediments contained no/negligible amounts of DNA after being autoclaved. Neither the storage time (5, 12, 18 years), or holding sediments for up to two weeks after autoclaving affected the DNA concentration. To ensure that extracts obtained from stored, autoclaved sediments are sufficiently 'clean' enough for use in future ecological genomics studies, they will be subjected to PCR analysis.

SPATIAL DISTRIBUTION OF TRICLOSAN IN SEDIMENTS AND WATER OF AN URBANIZED ESTUARINE EMBAYMENT. David Katz (Katz.David@epa.gov), Mark Cantwell, Julia Sullivan, Monique Perron, Mike Charpentier, & Robert Burgess, US EPA, Atlantic Ecology Division, Narragansett, RI.

Triclosan (TCS) is a broad spectrum anti-microbial compound found in many consumer and personal care products. TCS enters water bodies primarily through wastewater treatment plant (WWTP) effluent and may also be introduced by combined sewer overflows or surface water runoff. TCS undergoes photodegradation in estuarine waters and has a half life of approximately 10 days in surface waters. However, TCS also has a high K_{ow} and adsorbs onto particles where it is protected from photodegradation and can be preserved for long periods of time after deposition to sediments. The fate and transport of TCS in marine ecosystems are the subjects of this research. Sample locations were chosen from a statistically randomized hexagonal grid design of Greenwich Bay, which is located in Narragansett Bay, Rhode Island. Sediments were obtained from Van-Veen grab and water samples collected were passed through 1 μ m glass fiber filter media. After extraction, samples were derivatized and analyzed by GC/MS-ESI. Preliminary results show a high sediment concentration of TCS in Greenwich Cove which receives effluent from the local WWTP, designating it as major source of TCS to the area. Dissolved water concentrations are spatially variable, suggesting there may be other discrete sources of TCS to Greenwich Bay. Finally, a sediment core collected from the center of the bay shows a sustained decline from 1990 to the present, indicating an overall decrease in TCS release to the bay over time.

MERCURY BIOACCUMULATION IN ELASMOBRANCHS. Nicholas Kutil (nkutil553@g.rwu.edu), Roger Williams University, Bristol, RI.

Mercury (Hg) is a toxic environmental contaminant that bioaccumulates in the tissues of fish, including numerous marine species. Cartilaginous fish of the subclass Elasmobranchii are important ecological constituents of marine ecosystems, yet the fate of Hg contaminants in their

body tissues is largely unknown. In this study, four species of elasmobranchs: little skate (*Raja erinacea*), winter skate (*R. ocellata*), smooth dogfish (*Mustelus canis*), and spiny dogfish, (*Squalus acanthias*) were collected from the Rhode Island/Block Island Sound, and the Hg content (ppm wet wt) of white muscle tissue was analyzed using automated combustion atomic absorption spectrometry. Diet and feeding habits for each species were also assessed by stomach content and stable isotope analyses. Mean Hg concentrations differed significantly among species, with highest levels measured in smooth dogfish (mean Hg = 0.768 ± 0.154 ppm, $n = 10$), followed by spiny dogfish (mean Hg = 0.324 ± 0.049 ppm, $n = 23$) and skates (mean Hg = 0.100 ± 0.012 ppm, $n = 36$ and 0.064 ± 0.005 ppm, $n = 23$ for little and winter skate, respectively). The Hg concentration of skate muscle tissue did not vary by body weight, suggesting that Hg does not bioaccumulate in these species. Conversely, smooth and spiny dogfish both bioaccumulate Hg with respect to body size, although smooth dogfish have a higher Hg burden relative to spiny dogfish. Carbon and nitrogen isotope signatures are presented for dogfish (mean $\delta^{13}\text{C} = -16.68 \pm 0.415$ and -21.98 ± 0.824 , mean $\delta^{15}\text{N} = 13.55 \pm 0.810$ and 11.93 ± 0.576 for smooth and spiny dogfish, respectively) and skates (mean $\delta^{13}\text{C} = -16.39 \pm 0.347$ and -17.69 ± 0.418 , mean $\delta^{15}\text{N} = 12.43 \pm 0.590$ and 12.71 ± 0.830 for little and winter skate, respectively). Crustacea and osteichthyes were essential to the diet of the smooth dogfish, whereas squid was the major diet item of spiny dogfish. Shrimp was an important component to the little skate diet, and crustacea were important to the winter skate diet. Future work includes researching the effect of age, habitat use, and Hg of prey, to better understand bioaccumulation patterns in these species.

HABITAT EFFECTS ON MERCURY BIOACCUMULATION IN BLACK SEA BASS

(*Centropristis striata*). Garrett LeBlanc (Gleblanc756@g.rwu.edu), Carissa Gervasi, & David L. Taylor, Roger Williams University, Department of Marine Biology, Bristol, RI.

Mercury (Hg) is a widespread environmental contaminant that bioaccumulates in fish muscle tissue, and therefore poses a risk to human consumers. Understanding the human risk from Hg exposure requires insight into: (1) species-specific Hg concentrations and (2) variability in fish Hg content as a function of life history (e.g., habitat use and diet). In this study, an important recreational fish, the black sea bass (*Centropristis striata*) was collected from inshore (Narragansett Bay Estuary) and offshore (Rhode Island/BIS Sound) habitats using trawls and hook & line. The white muscle tissue of black sea bass ($n = 36$) was analyzed for total Hg and results were evaluated relative to fish age and habitat use (inshore vs. offshore). The otoliths of the inshore sea bass population were analyzed for strontium (Sr) concentrations to detect evidence of a salinity signature, and thus, a verification of site fidelity in the Bay. Visual analysis of stomach contents was also performed to assess variation in diet across habitats, which could account for geographic differences in sea bass Hg contamination. Irrespective of habitat-type, the Hg content of black sea bass muscle tissue was positively correlated with fish age, indicating the bioaccumulation of Hg. Black sea bass collected from inshore habitats, however, had higher Hg levels at a given age than conspecifics from offshore locations. Further, within the inshore habitat, individuals with a lower Sr concentration (lower salinity signature) had higher Hg levels. The cumulative results indicate that Hg concentrations in black sea bass vary significantly over relatively small spatial scales (5 km), and site-specific sea bass Hg levels are correlated with the anthropogenic contaminant sources in the Narragansett Bay. Finally, the diet of the inshore sea bass population was dominated by crabs (50% frequency of occurrence, *FO*), whereas offshore conspecifics fed on crabs (28% *FO*), shrimp (24% *FO*), and algae (16% *FO*). Future work will include the analysis of black sea bass stable isotope signatures and otolith microchemistry (for offshore fish), as well as examining the Hg content of sea bass preferred prey across habitats.

EFFECTS OF POLYBROMINATED DIPHENYL ETHER FLAME RETARDANTS ON CELL CYCLE PROGRESSION AND SURVIVAL IN MESENCHYMAL CELL LINES.

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Polybrominated Diphenyl Ethers (PBDEs) are a synthetic class of flame retardants used in numerous common objects. They are present in carpets, upholstery, small appliances, and many other household items. PBDEs seep out from the objects they are manufactured into and

spread into their immediate environment. Through inhalation and consumption of contaminated foods, humans will accumulate PBDEs in their bodies. Although little research has been focused on the effects of PBDE on adipose and bone tissue specifically, research in the Small Lab has found that PBDE exposure has a negative effect on the differentiation potential and production of metabolic hormones in rodent adipogenic cells and tissue. In addition, PBDE exposure also alters the expression of genes important for bone cell development. Since mesenchymal stem cells need to exit the cell cycle before they differentiate, it is possible that PBDE's exert these effects by promoting cell cycle progression and uncontrolled proliferation. To test this hypothesis, adipogenic and osteogenic cell populations exposed to PBDEs were assayed for cell growth and markers of cell cycle progression. The results from these studies may provide important information regarding the contribution that these emerging environmental contaminants have on chronic human disease including metabolic syndrome, osteoporosis and cancer.

MONITORING ORGANIC CONTAMINANT FLUXES FOLLOWING DAM REMOVAL UTILIZING PASSIVE SAMPLER TECHNOLOGY. Monique Perron (monique_perron@brown.edu), David Katz, Julia Sullivan, Robert Burgess, & Mark Cantwell, US EPA, NHEERL, Atlantic Ecology Division, 27 Tarzwell Drive, Narragansett, RI

Restoration of riverine habitats and their associated ecosystems is a growing priority for government agencies (e.g., USEPA, NOAA, USDA), as well as non-profit conservation organizations (e.g., American Rivers). Dam removal is a major component of many restoration projects credited with reintroducing fish species, improving water and habitat quality, and increasing recreation potential. Many locations being considered for restoration, however, have been previously impacted by discharges of chemical pollutants and the potential exists for re-release of these contaminants following dam removal or other restoration activities. To date, few if any restoration projects which involve dam removal have measured changes in the transport of contaminants during and after dam removal. In this study we plan to measure changes in the fluxes of several classes of organic contaminants (e.g. PAHs, PCBs) in an urbanized river scheduled for restoration by removal of an existing dam. Passive samplers along with sediment traps will be employed to measure changes in the flux of dissolved and particulate contaminants. Data from preliminary deployments of passive samplers in this river indicate that this technology can be successfully applied to evaluate changes in contaminant fluxes over time. Results from this study will be used to evaluate the passive sampler approach and improve our ability to evaluate the short and long-term impact of ecological restoration activities.

ECOSYSTEM INDICATORS AND TOOLS IN THE GULF OF MAINE: AN INTERACTIVE POSTER. Christine M. Tilburg (ctilburg@securispeed.us), Gulf of Maine Council, Falmouth, MA, and Kathryn Parlee, Environment Canada, Halifax, NS.

The Gulf of Maine's watershed encompasses more than 170,000 km² and is home to over 6.5 million Canadians and Americans. Despite the long-standing ecological, cultural and economic value of the Gulf, the ecosystem as a whole is not well understood. Recognizing this need, the Gulf of Maine Council (GOMC) developed the EcoSystem Indicator Partnership (ESIP) to look at indicators of ecosystem health for the Region. This partnership, which brings together individuals from more than seventy-five different Canadian and U.S. organizations, is currently focused on identifying and tracking key ecosystem health indicators in seven theme areas (aquatic habitats, aquaculture, climate change, coastal development, contaminants, eutrophication, and fisheries).

At the moment, ESIP is moving ahead with status and trends analysis for over half of these themes: aquaculture, aquatic habitats, climate change, and eutrophication. As the wealth of available data is collected, it is presented through the ESIP Indicator Reporting Tool (www2.gulfofmaine.org/esip/reporting). This web-based Reporting Tool allows managers to locate data in the region and build graphs for the time periods of interest. Snapshots created using the tool can also provide critical information for those faced with making decisions quickly and provide needed baseline information for use with adaptation efforts.