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SESSION 1: **ENVIRONMENTAL CONCERNS: PAHs** (Susan Kane-Driscoll, Chair)

EVALUATING THE ECOLOGICAL RISK OF PAHS IN SEDIMENTS: A REGULATORY PERSPECTIVE. N. Bettinger, G. Braun, L. Thompson, and Tom Angus (Thomas.Angus@state.ma.us), Massachusetts Department of Environmental Protection, Office of Research and Standards, One Winter Street, Boston, MA 02108.

The USEPA equilibrium partitioning sediment benchmark (ESB) approach for PAHs is a useful line of evidence for evaluating ecological risk to benthic organisms and generally provides an appropriate degree of protectiveness. The ESB approach assumes that the partitioning of the chemical between sediment organic carbon and pore water is in equilibrium and that organisms receive equivalent exposure from water-only exposures or from any equilibrated phase. It is important to use the ESB approach correctly and to consider conditions under which it may be underprotective. The risk assessor must consider environmental conditions, the presence of other chemicals, and the nature of the petroleum present when determining whether the ESB approach is protective. A recent presentation at the National SETAC Conference argued that the ESB approach is overprotective based on solid-phase microextraction (SPME) analysis and co-located sediment toxicity testing. SPME may represent a useful tool for evaluating the bioavailable fraction of PAHs in pore water, but caution should be used in interpreting SPME data for a site-specific risk assessment. Finally, the regulations of the Massachusetts Contingency Plan define certain conditions related to petroleum contamination as significant risk that are not evaluated under the ESB approach.

PAHS AND PARKING LOTS: A FIELD STUDY ON PAHS EXPORTED FROM SEALED AND UNSEALED PARKING LOTS AT THE UNH STORMWATER CENTER. Alison Watts (alison.watts@unh.edu), Robert Roseen, Tom Ballestero, James Houle, and Tim Puls, Environmental Research Group, University of New Hampshire, Durham, NH.

Recent studies have suggested that coal tar based sealcoat may be a significant source of polycyclic aromatic hydrocarbons (PAHs) in the environment. The University of New Hampshire Stormwater Center is conducting a field experiment to quantify the mass of PAHs released from parking lots in cold climates. In October 2007, coal tar and asphalt-based sealcoat was applied to separate areas of a University parking lot. Runoff from the two sealcoated sections and an unsealed control lot is collected and monitored with automated ISCO samplers. Initial unfiltered runoff samples from the coal tar-sealed lot and the asphalt-sealed lot contained 5,800ug/l total PAHs, and 640ug/l total PAHs, respectively. Concentrations from the sealed lots decreased rapidly after the first month, but remain higher than concentrations from the unsealed lot. PAH concentrations in swale sediments downstream of the coal-tar sealed lot increased from several ug/kg to over 90 ug/kg in the year after sealant was applied. A second phase of this project is currently monitoring PAH concentrations in air, dust, and surface soil at each of the lots.

SUBSURFACE OIL PERSISTENCE AND SHORELINE TYPE IN THE EXXON VALDEZ SPILL ZONE OF PRINCE WILLIAM SOUND, ALASKA. Dave S. Page (dpage@bowdoin.edu) Chemistry Department, Bowdoin College, 6600 College Station, Brunswick, ME 04011; P. D. Boehm and J. S. Brown, Exponent, 3 Clock Tower Place, Suite 205, Maynard, MA 01754; and J. M. Neff, Neff & Associates, LLC., 20 Templewood Dr., Duxbury, MA 02332.

This paper synthesizes the results of 1990-2007 shoreline surveys of the Exxon Valdez spill zone in Prince William Sound, Alaska, to show the relationship between shoreline type and persistence of subsurface oil (SSO) residues. SSO deposits mapped after 2000 occur primarily at specific exposed

boulder/cobble and sheltered boulder/cobble/gravel locations that represent a minute fraction of the original spill zone. Over 78% of the total heavy and moderate SSO deposits mapped in 2001 by NOAA occur at exposed boulder/cobble shoreline sites, with 70% at 6 locations. Patchy SSO residues persist at these sites because they are sequestered in low porosity finer-grained sediments between subsurface boulders and cobbles and are protected by the surface boulder/cobble armor. These are physical features that inhibit tidal flushing needed to promote natural oil loss and exposure to wildlife. The survey results show that SSO deposits persist primarily at locations associated with specific shoreline types, consistent with findings from other major oil spills.

IMPLEMENTING AN OIL TOXICITY FIELD GUIDE FOR SPILL RESPONSE. Troy L. Baker, NOAA Assessment and Restoration Division (ARD), Baton Rouge, LA; Joseph Cunningham, Coastal Response Research Center (CRRC), University of New Hampshire, Durham, NH; Ken Finkelstein (Ken.Finkelstein@NOAA.gov), NOAA Assessment and Restoration Division, Boston, MA; and Tyler Crowe, Coastal Response Research Center (CRRC), UNH, Durham, NH.

An Oil Toxicity Field Guide for Aquatic Habitats displays toxicity information associated with polycyclic aromatic hydrocarbons (PAH) in a consistent format that is easy to interpret during an oil spill. This field guide, co-developed by the Coastal Response Research Center (CRRC) and the National Oceanographic and Atmospheric Administration's Office of Response and Restoration (NOAA OR&R), is designed to fulfill OR&R's need to compile PAH concentrations against effects for on-site responders. The field guide has been used for recent oil spills in North America because it enabled the responder to rapidly query median lethal effect concentrations (LC_{50}) for affected animals. Responders are able to make rapid assessments of PAH toxicity levels using the guide.

The field guide is derived from a toxicity database structured so that users can query individual PAH data for animals in freshwater and saltwater. All data in the guide were converted into common units (µg/l) for easier interpretation. Aromatic compounds found in the toxicity database and field guide include nine parent PAHs and benzene. Forty-two plots were constructed for the guide that displays median lethal effect concentrations of individual PAHs at 24, 48, 72, and 96 hour intervals. The field guide also contains PAH compositions of three source oils, an assessment example for the user, a glossary, and selected interpretive information about PAHs and oil spills. A companion CD that contains all raw data, source literature, and templates for user-defined graphs and queries is part of the guide.

The field guide is not limited to use by on-site responders. It also could be useful in the following situations: communication of synthesized toxicity information to a variety of stakeholders; injury determination for use in natural resource damage assessments; training responders, modelers, scientists, and natural resource damage specialists on the acute effects of PAHs to aquatic species; informing stakeholders about the need to collect or analyze water samples or other field data in a timely manner; and rapid evaluation of PAH toxicity thresholds in freshwater and saltwater for individual species or species groups.

The field guide in its current form uses literature-derived toxicity data including recent PAH research sponsored by CRRC. The data presented in the field guide is currently more suitable for North American spill situations. However, additional toxicity data and oil types will be added in the near future to broaden the applicability of the field guide.

USE AND VALIDATION OF A BIOLOGICAL EFFECTS MODEL FOR OIL SPILLS. D. French McCay, Jill J. Rowe (jrowe@asascience.com). Applied Science Associates, 55 Village Square Drive, South Kingstown, RI 02879.

In the event of an oil spill, we apply our oil spill model, SIMAP, to simulate physical fate and biological effects that could result from the oil being released into the environment. The physical fates and biological effects submodels in SIMAP estimate exposure and impact on each habitat and species (or species group) in the area of the spill. An evaluation of 14 spill case studies, including major spills such as the *Exxon Valdez*, was performed using SIMAP to compare model predictions of biological impacts to

those based on field observations after the spill. Observational data on biological impacts of spills are primarily of birds and other wildlife oiled, although in some cases, quantitative data on impacts to fish and invertebrates were also available (i.e., *North Cape* oil spill). Since it is typically not possible or cost-effective to evaluate spill impacts completely with field data, modeling allows quantification of spill impacts using as much site-specific data as available for input, calibration of model results, or a combined field-based and modeling approach. Needed information to improve the accuracy of modeling and combined approaches includes field observations of pre-spill abundance (in advance of oil or in nearby areas), error estimation on abundance and oiled bird observations, and explicit reporting of the details of field observations and subsequent calculations.

SESSION 2: **ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY TOPICS** (Adria Elskus, Chair)

FISH SCALES AND GILLS: POSSIBLE NON-LETHAL BIOMARKERS FOR WATERBORNE ORGANIC CONTAMINANTS. Jennifer C. Meyers (JenCMeyers@gmail.com), School of Marine Sciences, University of Maine, Orono, ME 04469; and A.A. Elskus, U.S. Geological Survey, University of Maine, Orono, ME 04469.

Hepatic cytochrome P4501A (CYP1A) enzyme expression is a well-established, lethal biomarker for organic contaminant exposure; however, non-lethal methods are needed for endangered species. My hypothesis is that gill and scale CYP1A activities (measured as ethoxyresorufin-*o*-deethylase, EROD) provide reliable, sensitive, non-lethal biomarkers of waterborne organic contaminant exposure. Atlantic salmon (*Salmo salar*) parr were statically exposed to two aqueous concentrations of the potent CYP1A inducer 3,3',4,4',5-pentachlorobiphenyl (PCB-126, 0.01 & 0.001 µM), acetone (32.25 ppm, vehicle), or untreated water for 24 h before transfer to clean water. During and post-exposure we collected gill filaments and scales (non-lethally) and livers (lethally). Gill EROD activities in PCB-126 treated fish showed maximum fold induction (relative to controls) at 24 h during exposure (108 & 415 fold induction for 0.001 & 0.01 µM PCB-126, respectively), scale EROD activities were maximally induced at 34 d post-exposure (9 & 17 fold, respectively) and liver EROD activities were maximally induced at 2 d post-exposure (35 & 49 fold, respectively). These data indicate that tissue sensitivity of CYP1A activity ranks as gills≥livers≥scales. All fish sampled non-lethally and held over 34 d showed 100% survival. Gill and scale EROD protocols show great promise as non-lethal biomarkers of contaminant exposure. Funded by USGS and the Senator George J. Mitchell Center for Environmental and Watershed Research 06HQGR0089.

RESPONSE OF FISH POPULATIONS AND CAGED MUSSELS TO PULP AND PAPER MILL EFFLUENT AND MUNICIPAL SEWAGE TREATMENT PLANT EFFLUENT IN MAINE RIVERS. Barry F. Mower (barry.f.mower@maine.gov), Maine Department of Environmental Protection, Augusta, Maine; Kelly R. Munkittrick, Canadian Rivers Institute, University of New Brunswick, Saint John, New Brunswick, Canada; Rebecca J. Van Beneden, University of Maine, Orono, Maine.

Adverse effects of pulp and paper mill discharges to fish populations observed in Sweden and Canada have been reduced by recent mill process changes. Studies of white sucker (Catostomus commersoni) from the Androscoggin River in Maine in 2001-2003 demonstrated that endocrine disruption, first measured in 1994, was undetected after three large bleached kraft pulp and paper mills changed to ECF bleaching in the late 1990s. In 2003, ancillary studies of dioxin contamination documented induction of vitellin, a female reproductive protein, in male caged mussels (Elliptio complanata) below a large bleached kraft pulp and paper mill on the Kennebec River. Consequently, caged mussel studies were conducted during 2004-2006 in the Kennebec River and Penobscot River along with studies of white sucker and smallmouth bass (Micropterus dolomieu) populations. There was little evidence of endocrine disruption for either fish or mussels below the bleached kraft mills. White sucker however, exhibited reduced gonad and liver size, and abnormally low vitellogenin levels at the reference station below two non-kraft pulp and paper mills and municipal discharges to the Penobscot River in Millinockett, indicating potential endocrine disruption. The data suggest that both rivers, especially the Penobscot, have undergone eutrophication.

BRINGING GULF OF MAINE ECOSYSTEM INDICATORS TO THE USERS. Christine M. Tilburg (ctilburg@securespeed.us), Gulf of Maine Council on the Marine Environment, Falmouth, ME 04105; Susan Russell-Robinson, US Department of the Interior, Reston, VA 20192; and Kathryn Parlee, Environment Canada, Dartmouth, NS B2Y2N6.

In 2006 the Gulf of Maine Council on the Marine Environment's Ecosystem Indicator Partnership (ESIP) began the complex process of delivering ecosystem indicators for the Gulf of Maine. Indicator selection has been accomplished by the dedication of over one hundred volunteer Canadian and U.S. scientists and managers working in six subcommittees focused on aquatic habitats, climate change, contaminants, coastal development, eutrophication, and fisheries & aquaculture. Initial priority indicators (three to four) have been determined for the six themes. Concurrent with this effort, ESIP engaged in a broad user needs assessment and development of an Indicator Reporting Tool. The creation of the tool relied upon a thorough data discovery process and innovative efforts with respect to the data aggregator and database. The Indicator Reporting Tool is a novel web application that allows users to look at data for the proposed indicators both geospatially and in graphical form. Currently, users can access point-source information, extent of seagrasses and salt marsh, and mussel tissue contamination (www.gulfofmaine.org/esip). In allowing the user to access data from a variety of data providers, ESIP further accomplishes its goal of providing baseline data for the assessment of ecosystem conditions and trends. This collaborative process has been based on sound science, engagement of end-users, and the strength of the extensive transboundary working partnership.

GELLYFISH: AN IN-SITU EQUILIBRIUM-BASED SAMPLER FOR DETERMINGING MULTIPLE FREE METAL ION CONCENTRATIONS IN AQUATIC SYSTEMS. Zhao Dong (zdong@hsph.harvard.edu), C. G. Lewis, J. P. Shine. Exposure, Epidemiology and Risk Program, Department of Environmental Health, Harvard School of Public Health, 401 Park Drive, Boston, MA 02215.

The ‘Gellyfish’, an in-situ equilibrium-based sampling tool for determining multiple free metal ion concentrations in aquatic systems was developed and refined under laboratory conditions. Determination of free ion concentrations was based on equilibrium partitioning between free metal ions in the surrounding solution and iminodiacetate binding groups within the gel matrix of the sampler. Ninety percent equilibration was achieved in 25.9 hours. Apparent stability constants were measured for the binding products involving five metals: Cu, Zn, Pb, Ni, Cd. An accompanying computer model was developed to account for intra-metal competitions during uptake into the sampler. Subsequent laboratory experiments were performed to validate the computer model. Results suggested that the use of Gellyfish sampler in conjunction with the model we developed was a useful approach for monitoring the free ion levels in metal mixtures. Compared to other sampling methods for free metal ions, Gellyfish was inexpensive, rapid, recyclable, easy to use, and had the potential advantage of sampling multiple metals simultaneously.

ANALYSIS OF PCB IN SEAFOOD TISSUE: A CASE STUDY FROM NEW BEDFORD HARBOR. Paul E. Craffey, (paul.craffey@state.ma.us), MassDEP, Bureau of Waste Site Cleanup, Boston, MA 02108; Jayme P. Connolly, MACTEC Engineering and Consulting, Inc., Portland, ME, 04101; Maura K. Surprenant, Alpha Analytical, Mansfield, MA 02048; and James Occhialini, Alpha Analytical, Mansfield, MA 02048.

Bioaccumulation of polychlorinated biphenyls (PCBs) in biota may pose unacceptable risks to humans and the environment. An ongoing seafood monitoring program at the New Bedford Harbor Superfund Site has shown evidence of bioaccumulation of PCBs in finfish and shellfish species. This monitoring program has collected samples of several fish and shellfish species annually since 2002. Results have shown a general correlation between the PCB concentrations detected in the sediments and those detected in the fish. Some degree of correlation between the Aroclor and congener concentrations was observed for all species with high to moderate levels of PCBs. This presentation will discuss the lessons learned in using PCB congener and Aroclor tissue data as a method to measure the success of the remedial action.

INTERACTIVE SESSION 3: **CAUSAL ANALYSIS AND BEYOND** (Charlie Menzie)

APPLIED CAUSAL ANALYSIS APPROACHES: ILLUSTRATIONED THROUGH CASE STUDIES.
Charlie Menzies (camenzie@exponent.com), Exponent, Alexandria, VA and Susan Cormier (Cormier.Susan@epamail.epa.gov), NCEA, US EPA, Cincinnati, OH.

People's brains have evolved to seek patterns and to make connections among potential causes and effects. Most of these analyses occur at the subconscious level and only a tiny fraction involves the deliberate choice to analyze information in a structured or scientific way. In both conscious and subconscious attribution of causation, these mental connections reflect an individual's experience, perceptions, and even values. As issues become more complex and are associated with decisions that can affect several parties, there is increasing need for explicit formalized approaches of causal analysis. This discussion will describe general explicit approaches that have proven effective for causal analysis. These can be applied to a variety of problems. Illustrations are provided for three different environmental case studies: 1. Causes of damage to plants and farms in the Yemen desert, 2. Sources of contamination at a complex environmental site, and 3. Predicting conditions related to beach closures.

This session will be an interactive session with Dr. Susan Cormier, US EPA, also contributing. Susan is the instructor for our preceding short course, Causal Analysis/Stressor Identification (Wednesday, June 10). We will provide for and encourage opportunities for audience discussion and participation.

SESSION 4: **CONTAMINATED SEDIMENTS** (Peg Pelletier, Chair)

AN INTRODUCTION TO THE RADIOMETRIC DATING OF SEDIMENTS. Darryl L. Luce
(luce.darryl@epa.gov), U.S. Environmental Protection Agency, Region 1, Boston 02114.

Sediments provide an insight into the history of a water body and may record the events in a watershed over time. As such, sediments are an important tool in environmental forensics, sometimes being the only "record" of an event. However, sediments are not tree rings where definitive horizons can provide a reliable chronology. Instead, another type of "clock" that can accurately measure time is required. Because most environmental forensics work focuses on events during the industrial age that began in the 1850's, a dating tool that can accurately span such a period is required. Radiometric dating may provide accurate, definitive dates over the past 125 years. The techniques, methods and limitations of gamma spectroscopy in determining the ages of horizons of sediments will be discussed. The talk will focus primarily on the radioisotopes ^{210}Pb, ^{137}Cs and ^{7}Be; however, the utility of other radioisotopes will also be discussed. The primary example will taken from two sediment cores obtained from the Upper Charles River Watershed, Echo Lake and Box Pond.

TEMPORAL TRENDS OF TRICLOSAN IN DATED SEDIMENT CORES FROM FOUR URBANIZED ESTUARIES: EVIDENCE OF PRESERVATION AND ACCUMULATION. Mark Cantwell
(cantwell.mark@epa.gov), R. Burgess, USEPA Atlantic Ecology Division, Narragansett, RI; B. Wilson, J. Zhu, G. Wallace, C. Olsen, University of Massachusetts, Boston; J. King, University of Rhode Island; and J. Smith, U.S. Naval Research Laboratory.

Triclosan is an antimicrobial agent present in a wide array of consumer based goods such as soaps, skin creams and dental care products. It has also been incorporated into textiles and plastics due to its effectiveness as a biocide in solid material. It is introduced into municipal sewer systems where it is partially removed during wastewater treatment with the balance entering receiving waters via effluent discharge. The fate and effects of triclosan are poorly understood, particularly in estuarine environments. In this study, triclosan was measured in dated sediment cores from Boston Harbor, Narragansett Bay, New York Harbor and Chesapeake Bay in order to reconstruct the spatial and temporal trends of accumulation. Triclosan first appeared in each of the sediment cores near 1964, which corresponds with the U.S. patent issuance date of triclosan. The presence of triclosan at each of the study sites at or near the patent date indicates that long-term preservation is occurring in estuarine sediments. As

concentrations of triclosan increase above background, temporal trends at each location are unique, reflecting between site variability. In Narragansett Bay, concentrations climbed to as high as 400 ng g^{-1}, due in part to local, commercial production of triclosan. Overall, results indicate that temporal trends of triclosan in the sediments of these estuaries do not reflect the reported increasing domestic usage of this compound over time.

BIOAVAILABILITY ASSESSMENT OF A CONTAMINATED FIELD SEDIMENT FROM PATRICK BAYOU, TEXAS: TIE AND EQUILIBRIUM PARTITIONING. Monique M. Perron (mperron@post.harvard.edu), J.P. Shine, Harvard School of Public Health, Boston, MA 02115; R.M. Burgess, K.T. Ho, M.C. Pelletier, M.G. Cantwell, U.S. EPA AED, Narragansett, RI.

Contaminated sediments are commonly found in urbanized harbors. Remediation is often necessary and diagnosing the cause of sediment toxicity becomes imperative. In the present study, sediments from Patrick Bayou, Texas were subjected to initial toxicity testing. All sediments were found to be toxic to the amphipod, *Ampelisca abdita*, while sites PB4A, PB6A and PB9 were the only sites found to be toxic to the mysid, *Americamysis bahia*. Due to its toxicity to both test organisms, site PB6A was chosen for a marine whole sediment Phase I toxicity identification evaluation (TIE). Based on the TIE results, toxicity to amphipods was found to be caused primarily due to nonionic organic contaminants (NOCs), rather than cationic metals or ammonia. Causes of mysid toxicity were less clear. An assessment of metal bioavailability using equilibrium partitioning (EqP) approaches supported the results of the TIE that cationic metals were not responsible for observed sediment toxicity in PB6A. Toxic units (TU) calculated on measured concentrations of PAHs and PCBs in the sediment yielded a total TU of 1.25, indicating these contaminants are contributing to the observed sediment toxicity. Using a combination of TIE and EqP assessment tools, this investigation found NOCs are the likely class of contaminants causing acute toxicity to amphipods exposed to Patrick Bayou sediment. The cause of mysid toxicity was not definitively determined, but unmeasured NOCs are suspected.

FIELD VALIDATION OF MOLYBDENUM ACCUMULATION IN SEDIMENTS AS AN INDICATOR OF HYPOXIC WATER CONDITIONS. Warren S. Boothman (boothman.warren@epamail.epa.gov), National Health and Environmental Effects Research Laboratory, U.S. Environmental Protection Agency, Narragansett, RI 02882.

Accumulation of authigenic molybdenum (Mo) in marine sediments has often been used as qualitative indicator of periods of hypoxic bottom water, but rarely, if ever, used quantitatively. Laboratory experiments have shown that the accumulation rate of Mo may serve as a quantitative surrogate for direct measurement of hypoxic conditions in overlying waters, with Mo accumulation in the top 1 cm of sediment linearly related to the period of exposure to dissolved oxygen (DO) concentrations below ~3 mg/L. To determine if these laboratory results can be applied to field settings, accumulation rates of Mo in sediments from Narragansett Bay (RI, USA) were related to the frequency of hypoxia in bottom waters. Sediment cores were collected from 6 sites encompassing a range of hypoxic exposures. The frequency of bottom-water hypoxia was determined from RI Dept. of Environmental Management monitoring data for the years 2003-2007. Pb-210 dating of selected core sections at each site established sedimentation rates. Total Mo concentrations were determined in surficial sediments by HF digestion and ICP-MS analysis. Lithogenic contributions were estimated by multiplying measured Al concentrations by a mean crustal Mo:Al ratio, and the lithogenic portion subtracted from total Mo to estimate concentrations of authigenic Mo. Authigenic Mo concentrations and sedimentation rates were combined to yield authigenic Mo accumulation rates. The calculated accumulation rates determined from field samples did not correlate well with the frequency of hypoxia. The highest calculated rate corresponded with the highest frequency of hypoxia, but there was significant scatter among sites with less frequent hypoxia. There was strong correlation, however, between concentrations of Mo in the sediments and the mean frequency of hypoxia in overlying bottom waters, such that concentration of Mo in sediments may be a better indicator of the frequency of hypoxia than accumulation rate.

SESSION 5: **EMERGING CONTAMINANTS** (Jimmy Hauri, Chair)

GREEN PHARMACY: STRATEGIES FOR REDUCING THE PHARMACEUTICAL FOOTPRINT. Nick Anastas (mnanastas@comcast.net), Poseidon's Trident, Milton, MA 02186.

The presence of Pharmaceuticals and Personal Care Products (PPCPs) in the environment has recently received increasing attention in both the popular and scientific press. Improved analytical detection techniques have led to the identification of prescription and "over-the-counter (OTC) drugs, fragrances, personal care products and compounds that can adversely impact the endocrine system. The consequences of these compounds on the environment and the potential impact on human health have not yet been fully investigated.

Each point along the lifecycle of a pharmaceutical or personal care product can be examined for the possibility of reducing the potential environmental risks. Benign-by-design is an approach for applying the principles of green chemical design build molecule from scratch that are less hazardous. Feedstock should ideally come from renewable feedstocks, materials for manufacturing and distribution must be recyclable.

Physicians must be judicious in their prescribing practices to ensure that a three month supply of medicine is not prescribed for a seven day rash. Flushing medications into the domestic sewer systems or into septic systems are no longer acceptable practices. Medicines need to be recycled efficiently through return programs or complete mineralization practices, *i.e*., combustion/incineration.

Current wastewater and drinking water treatment systems are not designed to efficiently remove these inherently water-soluble environmental pollutants. Treatment practices must be altered to reflect this new challenge. This talk will present the driver and barriers to reduce the environmental load of PPCPs to the environment through the application of Green Pharmacy.

POLYBROMINATED DIPHENYL ETHERS (PBDES): PROMOTERS OF SWEET PREFERENCE, OVEREATING, AND WEIGHT GAIN IN MALE RATS. Stephen R. Hennigar (stephen.hennigar@unh.edu), A.M. Ronan, A.C. Mirando, & A.R. Tagliaferro, University of New Hampshire, Durham, NH 03824.

Sugar-sweetened beverage consumption has increased significantly and is associated with weight gain and obesity. Prenatal exposure of male rats to PBDEs increases preference for saccharin-sweetened solutions. The present study aimed to determine whether: 1) the observed sweet preference is specific to saccharin; 2) exposure to PBDEs and sucrose leads to an increased caloric consumption and weight gain; and 3) prenatal exposure is necessary to induce sweet preference. Rats treated pre- and postnatally with PBDEs (18 mg/kg-bwt) or corn oil by gavage, were given access to three water bottles containing: water, a sucralose-water solution, and a saccharin-water solution at three different ages for two weeks. In a second study, 28-day old rats were treated with PBDEs or corn oil. At 42-days of age, the animals were given access to an 11% sucrose-water solution or water for nine weeks. Male and female PBDE-treated animals consumed 70% and 30% more ($p<0.05$) sucralose, respectively, compared to controls. PBDE-treated animals consumed 16% more sucrose and 11% more ($p<0.05$) total calories compared to controls. Male PBDE-treated animals gained more weight than control animals; no differences were seen in female animals. PBDE treatment induces a behavioral preference for sweetness that translates to a significant increase in total dietary calories and weight gain in male rats.

THE EFFECT OF DIET AND POLYBROMINATED DIPHENYL ETHER (PBDE) EXPOSURE ON ADIPOCYTE AND WHOLE BODY METABOLISM IN MALE WISTAR RATS. Erin Allgood (Elallgood@gmail.com), G.Carey, University of New Hampshire, Durham, NH 03824.

PBDEs are lipophilic flame-retardant chemicals found in many consumer products and are considered to be endocrine-disrupting compounds (EDCs) with potential obesogenic properties. This study sought to determine if chronic PBDE exposure plus a high-fat/high-sugar diet promotes obesity in rats. Twenty-

eight male Wistar rats were fed either a control (C) or high-fat/high-sugar diet (HF), and gavaged with either 18 mg/kg PBDEs (+) or corn oil (-) daily for 4 weeks (n=6-7 per group). Body weight and food intake were measured 3x per week. At 3 weeks, 24-hr whole-body metabolism was measured. At 4 weeks, blood was sampled for thyroid hormone (T_4) and insulin concentrations, epididymal fat pads were removed and weighed, and adipocytes were isolated. Lipolytic response to varying concentrations of isoproterenol over 90 minutes was measured. PBDE administration significantly increased weight gain, decreased T_4 levels by 83% ($P<0.05$) and tended to increase glucose disappearance ($P=0.062$), increase energy production ($P=0.081$) and decrease insulin levels ($P=0.075$). HF rats consumed 7.7% more kcals than C over 4 weeks ($P=0.053$) and had significantly decreased metabolic efficiency (ME). A diet x PBDE treatment interaction ($P\leq0.081$) was noted for ME, protein disappearance, epididymal fat pad weight, and insulin level. We conclude that, in rats, PBDEs disrupt macronutrient metabolism and energy balance, and that the obesogenicity of PBDEs can be modulated by diet.

SESSION 6: **LOCAL AND REGIONAL ISSUES** (Allison Dunn, Chair)

PRELIMINARY RESULTS OF THE EXAMINATION OF THERMAL IMPACTS FROM STORMWATER BMPs. Robert M. Roseen, Nicholas DiGennaro (ntj5@unh.edu), Alison Watts, Thomas P. Ballestero, and James Houle, UNH Stormwater Center, Department of Civil Engineering, University of New Hampshire, Durham, NH.

The preliminary results to examine the 4 years of monitoring of runoff temperature for a range of stormwater management BMPs and the affects on stormwater runoff temperatures in relation to established environmental indicators are presented for a study in Durham, NH. Research indicates that thermal impacts are not limited to summer months but include other times important for life-cycle considerations. The research products will be tools that are useful for determining if a BMP will affect runoff temperatures and ultimately the health of the receiving streams. Stormwater BMPs examined include conventional, Low Impact Development, and manufactured treatment designs. The statistical distributions of event mean temperatures (EMTs) were examined to assess thermal influences. Surface systems that are exposed to direct sunlight have been shown to increase already elevated runoff temperatures, while other systems that provide treatment by infiltration and filtration can reduce runoff temperatures by thermal exchange with cool subsurface materials. Results indicate there is an increase in the thermal mass of runoff from a storm sewer system draining an area of asphalt pavement with a 97% impervious cover. For the storm sewer system, the mean EMT value of 53.1^{o}F (± 12.1^{o}F), which is greater than the mean groundwater temperature, which resembles the mean daily average annual air temperature, of 47^{o}F that feed coldwater streams (NCDC 2005). The examination of stormwater BMPs indicates that the larger surface systems will see greater thermal variations and the larger subsurface systems will see greater thermal buffering. The large surface system, the Pond, with a mean value of 51.5^{o}F (± 13.4^{o}F), was susceptible to greater thermal variations than the large subsurface system, the Gravel Wetland, whose mean value of 48.0^{o}F (± 9.5^{o}F), would indicate a greater thermal buffering. The Runoff, the Pond, and the Gravel Wetland calculated maximum and minimum values of event mean temperatures of 71.9^{o}F and 33.4^{o}F, 79.3^{o}F and 32.4^{o}F, 62.6^{o}F and 33.0^{o}F respectively. These temperatures are important to note when considering lethality indices of aquatic species. The optimum zone for aquatic species is between 45 ^{o}F and 65 ^{o}F, above 65 ^{o}F the aquatic species become stressed and will die when the temperature reaches 80 ^{o}F. These values are known as the lower and upper optimum limits and the lethal limit respectively. Another indicator of the health of a system that has been utilized by environmental monitoring programs is the mean July temperature of the stream under investigation. The mean July temperatures calculated from the preliminary data set of the Runoff, Pond, and Gravel Wetland are 66.7^{o}F, 73.1^{o}F, and 60.2^{o}F respectively.

IMPACTS OF CULVERTS AND IMPERVIOUS AREAS ON WATER TEMPERATURES IN SOUTHERN NH STREAMS. Gary Lemay, Jr. (gsj2@cisunix.unh.edu), Department of Civil Engineering, University of New Hampshire, Durham, NH 03824.

Water temperature plays an important role in the composition and density of species present in a small stream. Coldwater fish, such as the Eastern Brook Trout, require cooler temperatures to grow, survive,

and reproduce. Because water temperature has increased in basins throughout the Northeast, their habitat has become increasingly sparse and fragmented. The research examines the role of the development and urbanization within the stream's watershed on stream water temperature changes. Experimental results show that temperature increases downstream of urbanization during baseflow conditions and that those differences are greater during summer rainfall events. Recently developed methods and models for quantifying and modeling the stream temperature in an urban environment are also presented.

INTEGRATION OF GEOSPATIAL AND RISK-BASED ANALYSES TO PRIORITIZE SEDIMENT MANAGEMENT ACTIONS FOR THE ST.CLAIR RIVER AREA OF CONCERN

Allison Glessner (aglessner@environcorp.com), M. Henning, and M. Bock. ENVIRON International Corporation, Portland, ME.

The St. Clair River flows 64 km from Lake Huron to Lake St. Clair and forms the border between the state of Michigan (U.S.A.) and the province of Ontario (Canada). Designated as an Area of Concern (AOC) in 1985 under the Great Lakes Water Quality Initiative, the St. Clair River has been the focus of remedial measures targeting contaminated sediment. However, risks from mercury biomagnification remain a concern for fish. To delineate zones of risk within the most impacted reach of the AOC, areas of maximum exposure to fish were defined based on measured invertebrate tissue concentrations. Co-located tissue residue data for fish and invertebrates allowed calculation of a range of invertebrate-to-fish biomagnification factors (BMFs). To calculate a range of target methylmercury invertebrate tissue concentrations protective of fish, the "safe" fish tissue concentration was divided by minimum and maximum BMFs. The spatially weighted average concentration (SWAC) of methylmercury in invertebrate tissue was calculated based on the anisotropic interpolation of invertebrate methylmercury concentrations. Given that the SWAC of methylmercury was greater than the target invertebrate tissue concentration, risk reduction actions were recommended. Hot spots of methylmercury in invertebrates were iteratively removed from the dataset (to simulate hot spot remediation), until the target invertebrate tissue concentrations based on minimum and maximum BMFs were attained. This spatially explicit analysis helped to prioritize remediation decisions to yield a cost-effective recommendation for the AOC.

SIXTEEN YEARS OF CONTAMINANT MONITORING IN THE GULF OF MAINE AND BAY OF FUNDY BY CANADA AND THE UNITED STATES; 1993 TO 2006.

The Gulfwatch Contaminants Monitoring Program for the Gulf of Maine Council. Barbara Arter[1], Jamie Aube[2], Cynthia Bourbonnaise-Boyce[3] Guy Brun[2], Gareth Harding[3], Peter Hennigar[4], Christian Krahforst[5], David Page[6], Stephen Jones[7], Susan Shaw[8], James Stahlnecker[9], Jack Schwartz[10] (Jack.Schwartz@state.ma.us), Darrell Taylor[11], Bruce Thorpe[12], Peter Vass[3], and Peter Wells[4] .

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Contaminant monitoring of blue mussel tissues has been conducted as an international effort since 1993 by the Gulfwatch Program for the Gulf of Maine Council. A network of mussel sampling stations was established to get a comprehensive coverage of the entire region. In general, contaminant levels mirrored human population density, where mussel tissue concentrations were highest at certain sampling locations in the southwestern gulf. However, local "hotspots" were found for individual contaminants at various locations around the gulf. While there is considerable temporal variability in the concentrations of contaminants measured at some sites, the findings suggest a decline with some contaminants over the span of the program for some of the most contaminated localities. Future plans may include expanding to look at contaminants of emerging concern, such as other industrial compounds and pharmaceuticals.

SESSION 7: **NANOMATERIALS: ENVIRONMENTAL IMPLICATIONS AND APPLICATIONS** (Stephen Clough, Chair)

BIG CONCERNS WITH THE VERY SMALL: THE EMERGENCE OF NANOTOXICOLOGY. Emily Monosson (emonosson@verizon.net), Montague, MA.

The field of nanotoxicology is in its infancy, yet is ever expanding as newly created nanomaterials require assessment of potential health and environmental impacts. Nanomaterials are now used in over 800 consumer products, and growing. Yet there is no consensus as to how best to evaluate the potential human or environmental impacts of these new chemical entities. The body of literature on nanoparticles provides some insight into both the priorities and the rapid growth of nanoparticle research. An ISI Web of Science search for "nanotoxicology" limited to 2005, for example, identified five articles, while a search limited to 2008 resulted in 55 articles. A broader search for nano and toxic resulted in 3 articles in 1990, 76 articles in 2000 and over 1000 articles in 2008. However, this rapid expansion in research does not imply any coordination of research techniques or data reporting, and in fact, such rapid an expansion might be indicative of haphazard approaches as health and environmental scientists try to keep pace with nanotechnology. Following a brief introduction to nanoparticles, and summary of a recent literature review focused on one particular type of nanoparticle, the quantum dot, I will discuss some of basic concerns of toxicologists working with nanomaterials, leaving enough time, for discussion of this fascinating topic.

SESSION 8: **METALS IN THE ENVIRONMENT** (David Taylor, Chair)

EFFECTS OF IN VITRO EXPOSURE OF AMERICAN WOODCOCK SPLENOCYTES TO CADMIUM CHLORIDE. Brian J. Hiller (brian.hiller@uconn.edu), Wildlife Conservation Research Center, Department of Natural Resources and the Environment, University of Connecticut, Box U-4087, Storrs, CT; B. Morsey, M. Levin, & S. DeGuise, Department of Pathobiology, University of Connecticut, Storrs, CT; and J.S. Barclay, Wildlife Conservation Research Center, Department of Natural Resources and the Environment, Box U-4087, Storrs, CT 06269.

Cadmium, which is immunotoxic in several species, was found at high concentrations in tissues from wild collected woodcock. We cultured splenocytes with concanavalin A (ConA) at 0.5μg/mL, then exposed the cells in vitro to $CdCl_2$ (0.5, 1, 2.5, 5, 10, and 15 ppm) and evaluated proliferative response and viability compared to an unexposed control. We found a statistically significant reduction in proliferation at 2.5 and 5 ppm; there was no corresponding change in viability (>10% cells dead) at these concentrations. Proliferation was also significantly reduced at 10 and 15 ppm; and at those cadmium concentrations there was a corresponding change in viability: 65% and 95% of cells dead, respectively. This suggests the possibility that woodcock exposed to Cd concentrations equal to or above those levels tested in-vitro may experience compromised immune function resulting in individuals that may be more susceptible to disease or infection.

INFLUENCE OF METAL CONTAMINATION SOURCE AND SOIL PROPERTIES ON METAL BIOACCUMULATION BY PLANTS. Laurel A. Schaider (lschaide@hsph.harvard.edu) and J.P. Shine, Harvard School of Public Health, Boston, MA, 02215; R.E. Moran, University of California, Davis, CA, 95616; and B.E. Sample, CH2MHILL, Sacramento, CA, 95833.

Metal accumulation by plants is an important consideration for both ecological and human health risk assessment, and accurate predictions of metal concentrations in plants are useful for conducting risk assessments of soil-bound contaminants. While metal speciation and bioavailability are known to be affected by contamination source (e.g., metals in mining waste tend to have low bioavailability), the impact of contamination source on phytoavailability is poorly understood. We performed a meta-analysis of published plant and soil metal concentration data to investigate the influence of contamination source and soil parameters on phytoaccumulation of 8 metals/metalloids. We categorized each sample

according to contamination source, including mining, smelting, industrial/urban, sludge, as well as artificially contaminated soils and soils with no known contamination source. Uptake factors ($[metal]_{plant}/[metal]_{soil}$) decreased in the following order: Se>Cd>Zn≈Hg>Cu≈Ni>Pb≈As. Variation within a metal's uptake factor was reduced by accounting for contaminant source, with metals associated with mining and smelting having lower uptake factors and artificially-contaminated soils having the highest uptake factors. However, simple uptake factors are dependent on soil metal concentration, making direct comparisons difficult to interpret. The data were also used to create multivariate regression models that account for both metal source and soil characteristics. These models improve the ability to predict metal uptake by plants relative to older approaches that rely on a single uptake factor.

ESTUARINE INVERTEBRATES AND FORAGE FINFISH AS BIO-INDICATORS OF ENVIRONMENTAL MERCURY LEVELS. Jennifer C.Linehan (jlinehan371@hawks.rwu.edu), D.L.Taylor, Roger Williams University, Department of Marine Biology, Bristol, RI 02809.
Estuarine environments are susceptible to anthropogenic perturbations, including the deposition and mobilization of a variety of contaminants in the sediment. Environmental mercury (Hg) contamination is of particular concern because Hg bioaccumulates in aquatic food webs and exposure has deleterious effects on biota, including humans. The potential health risks associated with Hg exposure justifies the development of monitoring programs that link environmental and biological Hg contamination. In this study, we assessed the utility of estuarine invertebrates and forage finfish as bio-indicators of environmental Hg pollution. Specifically, surface sediments (0-2 cm; 54 sites) and biota (finfish, macrocrustaceans, bivalves, polychaetes, and zooplankton; 83 sites) were collected from the Narragansett Bay (Rhode Island), and analyzed for total Hg concentration using atomic absorption spectroscopy. Spatial relationships between sediment and biota Hg concentrations were then statistically compared using Geographic Information System and least-squares linear regression models. There was a significant positive correlation between sediment Hg levels and the Hg content of bivalves (R^2 =0.389; p < 0.0006) and zooplankton (R^2 = 0.2613; p < 0.005). Conversely, polychaete, macrocrustacean, and finfish Hg body burdens were not significantly related to environmental Hg levels (R^2 = 0.091, 0.322, 0.012; p = 0.2746, 0.1463, 0.5236, respectively). Preliminary results therefore indicate that the effectiveness of estuarine biota as bio-indicators of environmental Hg contamination is taxon-specific, and is likely influenced by feeding ecology, longevity, and site fidelity.

QUALITY ASSURANCE IS NOT A GUARANTEE: FALSE POSITIVES AND NEGATIVES FOR METALS DATA USED IN QUANTITATIVE RISK ASSESSMENT. Leonard Pitts (lpitts@alphalab.com) Alpha Analytical, 320 Forbes Blvd, Mansfield, MA 02048; Susan Chapnick (s.chapnick@comcast.net) and N. Rothman (nrothman_neh@comcast.net) New Environmental Horizons, Inc., 2 Farmers Circle, Arlington, MA 02474.

Laboratory Quality Control Programs are implemented to assure that data produced is precise, accurate and defensible; however, false positive, false negative or biased results can be generated due to sample matrix effects even when quality control results are within acceptance criteria. Decisions concerning environmental and/or human health risk assessments and remediation efforts based on data of this nature may be flawed. The majority of trace metals data for environmental studies is generated using the inductively coupled plasma by methods such as EPA Method 6010/200.7 (ICP-AES) and EPA Method 6020/200.8 (ICP-MS). Inter-element correction factors for ICP-AES and isobaric corrections for ICP-MS are used to minimize bias but the accuracy of these corrections is highly dependent on the sample matrix. Elements such as arsenic, selenium, and thallium are highly subject to interferences by either technique. Results for these metals that are risk-drivers at a site should be verified by an alternative analytical technique. This presentation will demonstrate how matrix effects can influence metals results in environmental samples and discuss case studies where initial results were checked by alternative methods to change decisions concerning risk/remediation efforts at a Superfund Site in MA, a state-led site in MA, and a site in NYC.

METAL BIOAVAILABILITY AND TROPHIC TRANSFER IN INTERTIDAL FOOD WEBS. Celia Y. Chen (celia.chen@dartmouth.edu), J. Williams, Dartmouth College, Hanover, NH 03755, and N.S. Fisher, Stony Brook University, Stony Brook, NY 11794.

Metals in estuarine environments are deposited readily in the mixing zones of intertidal zones where communities of potentially exposed fauna include benthic and pelagic organisms of different functional feeding groups. We conducted a study of metal bioavailability and bioaccumulation in intertidal food webs at sites in the Gulf of Maine and Narragansett Bay. Across five sites, we sampled sediments and biota including benthic infauna and epifuana and pelagic organisms. We measured metal concentrations (Hg, Cd, As, and Pb), SEM-AVS, and total organic carbon (TOC) in sediments, and metal concentrations and stable isotope signatures in biotic tissues. We found that sediment concentrations are poor predictors of metal in biota. Moreover, bioaccumulation measured as a Benthic-Sediment Concentration Factor (BSCF) was strongly related to sediment TOC but not SEM-AVS for all four metals. Food source measured as delta ^{13}C was predictive of MeHg and Hg bioaccumulation but not other metals. These results show that bioavailability of metals is more dependent on biogeochemical and ecological factors then sediment concentrations alone.

POSTER SESSION ABSTRACTS (Patti Reilly, Chair)

FLUORESCENCE SPECTROSCOPY AS A RAPID, COST-EFFECTIVE METHOD TO MONITOR AND ANALYZE LOW LEVELS OF PHARMACEUTICALS AND PERSONAL CARE PRODUCTS IN ENVIRONMENTAL WATER SAMPLES. James Killarney (james_killarney@umit.maine.edu) and H. Patterson, Department of Chemistry, University of Maine, Orono, ME 04469.

Pharmaceutical and personal care product (PPCP) compounds are contaminants of emerging concern in U.S. water supplies. Although individual concentrations may be low, the number of PPCP compounds detected is large. The effects of chronic PPCP exposure on humans and ecosystems are poorly understood. To support modeling and exposure assessment, new analytical technologies are needed that can detect PPCPs quickly at very low environmental concentrations. This study evaluates the use of synchronous scan fluorescence spectroscopy (SFS) to identify mixtures of PPCPs in natural water samples. SFS involves scanning the excitation and emission sides of the fluorometer simultaneously at an experimentally determined wavelength offset. This technique has been used successfully to identify mixtures of petroleum hydrocarbons in soil and water samples. We have demonstrated that SFS can identify components of a mixture of 17α-ethynylestradiol, triclosan and caffeine in spiked natural water samples. In laboratory samples, these compounds, along with bisphenol A, have been identified as individual components of a mixture at 1×10^{-11}M concentrations. Added benefits of this technique are that water samples need no preparation prior to analysis and compounds can be analyzed in mixtures. Results from environmental samples collected from the Penobscot River (Maine) will be presented to demonstrate these techniques. Funding provided by the Department of the Interior, U.S. Geological Survey and the Senator George J. Mitchell Center for Environmental and Watershed Research at the University of Maine, under Award No. 06HQGR0089.

INFLUENCES OF WATER SAMPLING METHODOLOGIES ON PESTICIDE DETECTION AND DATA INTERPRETATION. Lien Chow (chowl@agr.gc.ca) & Zisheng Xing, Potato Research Centre, 850 Lincoln Road, P.O. Box 20280, Fredericton, New Brunswick, Canada, E3B 4Z7; Bill Ernst & Clair Murphy, Environment Canada, Environmental Protection and Operations Directorate, Charlottetown, Prince Edward Island, Canada; and Mark Hewitt, Aquatic Ecosystem Protection Research Branch, National Water Research Institute, Burlington, Ontario, Canada.

Pesticide contamination in surface water under intensive potato production has become a highlighted research focus globally. Accurately detecting the contamination was highly influenced by sampling methodologies because of the complexity of pesticide transport and retention in the environment. A

research was done to investigate the differences between traditional sampling (TS, grab sampling) and a time-sequentially sampling (TSS, sampling during and immediately after major rainfall-runoff events) with two datasets concurrently collected in a long-term (2003-2008) pesticide residual tracking project in the Atlantic region of Canada. With the datasets the presentation displays the problems related to the TS method and demonstrates significant improvements of the TSS method in detecting pesticide residual, representing the real-time spatial variations of pesticide contamination, and providing more detailed information for event-based modelling of the pesticide concentration in stream water. Some detections of pesticide in excess of available water quality guidelines for aquatic life have been detected using TSS although these concentrations were well below drinking water quality guidelines and would not represent any risk to human health. However, these exceeding cases were not fully detected using TS. The TSS method can also be used to determine the impacts of land management on the pesticide residual translocation in the environment, which is hard to proceed using the TS.

HISTOPATHOLOGIC EFFECTS OF ESTROGENS OR AN AROMATASE INHIBITOR ON MARINE FISHES. G. Zaroogian, Doranne Borsay Horowitz (borsay.dodi@epa.gov), R. Gutjahr-Gobell, L. Mills, U.S. EPA, NHEERL, Atlantic Ecology Division, Narragansett, RI 02882; and J. Fournie, U.S. EPA, NHEERL, Gulf Ecology Division, Gulf Breeze, FL.

Endocrine-disrupting chemicals (EDCs), such as estrogens estradiol (E_2) and ethinylestradiol (EE_2) and aromatase inhibitor androstatrienedione (ATD) have been reported to affect fish reproduction. This study histologically compared and evaluated effects of EDCs in two species of treated fish. Juvenile male summer flounder (*Paralichthys dentatus*) and cunner (*Tautogolabrus adspersus*) were treated in the laboratory with E_2, EE_2 or ATD through injected slow-release implant systems. Cunner reproductive endpoints (egg production, fertility, viability) were monitored daily for 14 days post-implantation when tissues were sampled for histopathological evaluation. Excessive hyaline material accumulated in livers, kidneys, and testes treated with E_2 in both species. Accumulations resulted in hepatocyte hypertrophy, disruption of spermatogenesis, and obstruction of renal glomeruli. Immunochemical staining was conducted on flounder tissues for presence of vitellogenin (VtG). Staining was positive for VtG in hyaline material and negative in control treatments. Inhibition of testicular growth with atrophy and clusters of dead germ cells were prevalent in flounders at highest E_2 treatments. Hepatocyte nuclei and nucleoli were enlarged and accumulations of hyaline material observed in treated fish. Hepatocyte hypertrophy was common in these areas and mortalities occurred in the highest doses. All E_2 treated flounders displayed VtG accumulation in testes tissue sections. Cunner treated with E_2 or EE_2 showed significantly lower egg production and egg fertility (EE_2 only). Gonadal somatic index (GSI) was significantly lower in male and female cunner and plasma VtG was significantly higher in both sexes. Some of E_2 and EE_2 treated male cunner had hemorrhaging testes in addition to VtG accumulation in renal tubules and glomeruli; one with extensive hepatocellular necrosis, hemorrhage, and hemosiderin accumulation. In cunner treated with ATD, significantly lower egg production, fertility and viability were observed; yet no notable histopathological abnormalities were found. Male cunner GSI was lower. In females, GSI was higher and VtG concentration was lower. Overall, histopathological changes in liver, testicular, and renal glomeruli tissues appear similar in both species of fish and relate to excessive accumulation of VtG.

EVALUATION OF THE EFFECTIVENESS OF IN-SITU PCB AND DDT REMEDIATION WITH ENGINEERED AMENDMENT AGENTS. Scott Cloutier (scottcloutier@me.com) and K.H. Gardner, University of New Hampshire, Environmental Research Group, Durham, NH 03824.

Wetlands owned by the Department of Defense (DoD) often act as sinks for contaminants including persistent, bioaccumulative, and toxic (PBT) compounds [e.g., Dichloro-Diphenyl-Trichloroethane (DDT) and Polychlorinated Biphenyls (PCBs)]. Remediation of contaminated wetlands traditionally has involved excavation of hydric soils and off-site transport of excavated materials for treatment and disposal. This type of remediation is both destructive and expensive. Wetland restoration efforts following excavation can be expensive and successful restoration is challenging at best. Alternative remedial approaches that would allow targeted *in situ* remediation of wetlands would result in tremendous cost savings with the added benefit of minimizing impacts on ecosystem components. Validated *in situ* technologies for addressing and mitigating hydric soil contamination would be applicable to many wetland areas requiring

active remedial responses, reserving excavation, dredging and other more extreme response actions for only the most highly contaminated areas where actionable risks are readily apparent. The objectives of the study are to determine the most effective amendment agent(s) to be used for field demonstration. Effectiveness will be based upon pre and post treatment contaminant concentrations (for amendments aimed at mass reduction) and reduction in porewater contaminant concentration. This will include evaluation of several sequestration agents and delivery systems to determine which combination(s) provides the most cost-effective and environmentally protective solution(s). Monitoring will be conducted following the demonstration to validate project success.

EVALUATION OF SOLID PHASE MICRO EXTRACTION TO ASSESS PAH UPTAKE OF IN-SITU SEDIMENT AND BENTHIC ORGANISMS. Rebecca Damberg-Mauser (ram37@unh.edu) and K.H. Gardner, University of New Hampshire, Environmental Research Group, Durham, NH 03824.

Current procedures for evaluating risk assessment of hydrophobic organic chemicals in soils and sediments can lead to unnecessary remediation. Specific sites containing high concentrations of Polycyclic Aromatic Hydrocarbons (PAH) can be analyzed using bioassays yet alternative methods such as Semipermeable Membrane Devices (SPMDs) and Solid Phase Microextraction (SPME) prove to be straightforward and cost effective. Traditionally, SPME is used to determine aqueous phase concentrations but has recently been proven to measure in situ pore water concentrations. The objectives of this study are to measure in situ PAH in sediment including total mass, porewater, TOC, and black carbon. Laboratory testing will provide an equilibrium partitioning model to calculate theoretical porewater concentrations to be compared to in situ measurements. This study will also include a series of laboratory diffusion tests using SPME to measure the rate of PCB release into overlying water with different capping methods (reactive mat, mat with sand, no cap). This will also include body burden measurements of PAH in field organisms, both collected for benthic community analysis and in situ deployed caged organisms. Testing will be conducted in the laboratory and in situ to better evaluate PAH uptake using SPME.

DOES DEVELOPMENTAL EXPOSURE TO FLAME RETARDANTS PROMOTE OBESITY AND DIABETES IN RATS? Amy G. Taetzsch (aga3@unh.edu), G.B. Carey, Department of Molecular, Cellular and Biomedical Sciences, University of New Hampshire, Kendall Hall, Durham NH 03824.

Obesity and diabetes are attributed to poor eating habits, a sedentary lifestyle, and genetics, although environmental chemicals may also contribute. One class of environmental chemicals is polybrominated diphenyl ethers (PBDEs), synthetic flame retardants that bioaccumulate in fat tissue, breast milk, and cross the placenta. To evaluate the possibility that developmental exposure to PBDEs could promote obesity and diabetes in offspring, six pregnant rats were daily administered 0,1.8, 18 mg/kg PBDEs (DE-71) during gestation and lactation. Each dam nursed 4 male pups, and at weaning, pups were fed either a control or a high fat high sugar diet (HFHS) diet. Body weight and food intake were measured thrice weekly. At 68-72 days of age pups were euthanized, epididymal fat pads removed, and fat cells isolated for sizing, counting, and glucose transport measurement. The study found that food intake was significantly increased in pups consuming a HFHS diet compared to control diet. Glucose transported into fat cells decreased in pups fed a HFHS diet compared to a control diet. Metabolic efficiency of pups decreases with a HFHS diet compared to a control diet. Weight gain in pups tended to be affected by both drug and diet with pups from the 0 and 1.8mg/kg dose of PBDEs gained more weight when fed the HFHS diet, while pups exposed to 18mg/kg dose of PBDEs gained more weight when fed the control diet. We conclude that developmental exposure of rats to flame retardants can interact with the diet of the offspring to influence weight gain.

OSTEOBLAST CELL DEVELOPMENT IN THE PRESENCE OF POLYBROMINATED DIPHENYL ETHERS (PBDES) - A CHEMICAL FLAME RETARDANT. David Cocozziello (dmw25@cisunix.unh.edu), University of New Hampshire, Durham, NH 03824.

PBDEs are a type of chemical flame retardant seeded into large amounts of household and other common objects including upholstery, electronics, plastics, carpets, and motor vehicles. PBDEs that leak

into the environment are introduced into the body through the inhalation of dust or food via ingestion. Once *in vivo,* PBDEs have a tendency to accumulate in fat tissues where they alter adipocyte development and insulin sensitivity. It is known that osteoblast cells originate from the same lineage as adipocyte cell types, but the effect of PBDEs on osteoblast differentiation and development remain unknown. To address this question, we exposed ST2 mesenchymal stem cells to varying dosages of PBDEs and monitored their ability to become osteoblasts. We found that PBDE exposure decreased the expression of the osteogenic cell marker osteocalcin and reduced the formation of nodule-like structures. These studies suggest that PBDE exposure may contribute to the development of osteoporosis and other bone disorders.

CONCENTRATIONS IN ESTUARINE FISHES. M.N. Piraino and David L. Taylor (dtaylor@rwu.edu), Roger Williams University, Department of Marine Biology, Bristol, RI 02809.

Assessing mercury (Hg) concentrations in fish typically involves sacrificing specimens in an effort to analyze contaminants in muscle tissue. To this end, the development of nonlethal sampling techniques to predict muscle Hg content may be beneficial to continue or expand current monitoring programs. In this study, the relationship between total Hg concentration in white muscle tissue, caudal fin clips, and dorsolateral scales was analyzed for five species of marine finfish collected from the Narragansett Bay (Rhode Island, USA), including bluefish (*Pomatomus saltatrix*), striped bass (*Morone saxatilis*), tautog (*Tautoga onitis*), summer flounder (*Paralichthys dentatus*), and winter flounder (*Pseudopleuronectes americanus*). Moreover, a subsample of fins and scales was subjected to a cleaning treatment (Ivory soap and distilled water, 1g/L) in order to improve the predictive ability of these nonlethal techniques. The cleaning treatment had no effect on fin/scale Hg content, however, and subsequent analyses were made on full data sets (untreated and clean fins and scales). Results of linear regression models indicated that the Hg concentration of fish muscle tissue was positively correlated with the fins and scales of bluefish (fin: R^2 = 0.730, n = 21; scale: R^2 = 0.457, n = 33), striped bass (fin: R^2 = 0.482, n = 21; scale: R^2 = 0.152, n = 26), and tautog (fin: R^2 = 0.741, n = 16; scale: R^2 = 0.319, n = 18). Conversely, no correlations were observed between the Hg content of flounder muscle tissue and their respective fins and scales (summer flounder: R^2 = 0.041-0.054, n = 23-34; winter flounder: R^2 = 0.001-0.064; n = 15-24). These results suggest that analysis of caudal fin clips and scales may be a useful nonlethal method for predicting Hg contamination for select species, but is not recommended as a broadly-applied monitoring strategy.

RECOVERY FROM MERCURY CONTAMINATION IN THR.EE NORTH AMERICA LAKES. Jody A. Kubitz (jkubtiz@entrix.com), Entrix, Barrington, IL 60010.

Fish mercury concentrations in Deer Lake (Michigan), Clay Lake (Ontario) and Ball Lake (Ontario) have decreased following remedial actions. Long-term monitoring data for northern pike, a piscivorous predator, are used to assess recovery from industrial mercury contamination in all three of these north-temperate reservoirs. Despite differences in mercury sources, loading rates, initial fish concentrations, and other factors, the recovery rates for these three water bodies are quite similar. The results from this study suggest that recovery from mercury contamination, as determined by methylmercury concentrations in predatory fish, can be forecasted.

A COMPREHENSIVE REVIEW COMPARING THE AQUATIC TOXICOLOGY OF COMMON NANOMATERIALS REVEALS A LOW POTENTIAL FOR ENVIRONMENTAL RISK. Stephen R. Clough (Sclough@haleyaldrich.com), Haley & Aldrich, Boston, MA.

It has been predicted that nanotechnology will be the “Industrial Revolution” of the 21st century. The media has stated that at least one nanomaterial is patented per day, and that nanoscale technologies will be worth billions of dollars as we move into the next decade. This, of course, this has revived the “risk vs. benefit” or the “double-edged sword” arguments, and even coined new terms such as the “Trojan Horse effect”, whereby seemingly beneficial nanomaterials (such as potential quantum dots used in medical applications), once inside a cell, will disassemble and cause severe toxic effects. For conventional

(macroscale) compounds, a rich database of toxicity data is available from many federal agencies for hundreds of aquatic species on which thousands of commercial compounds have been tested. This comprehensive review presents species sensitivity profiles (primarily for fish and invertebrates) utilizing several toxicity endpoints (e.g. NOECs, LOECs, LC_{50}'s) of at least six common nanomaterials used in commerce to ranges of toxicity endpoints typically seen for conventional pollutants. Several common themes emerge from this review, indicating that, to date, the vast majority of nanomaterials currently used in commerce will pose a negligible risk to aquatic organisms if released to the general environment (e.g. wastewater treatment discharges to rivers and streams).

DIFFERENTIAL BODY BURDENS OF VARIOUS METALS AND ORGANIC COMPOUNDS IN CO-OCCURRING MARINE BIVALVES: IMPLICATIONS FOR ECOLOGICAL AND HUMAN HEALTH RISK ASSESSMENT. Jerome Cura (jjcura@sciencecollaborative.com), The Science Collaborative, Winchester, MA 01890.

Research over the past ten years has demonstrated that bioaccumulation of chemicals depends variously on the chemical properties, the species of organism, temporal differences, environmental conditions, and the exposure history of an organism (Luoma and Rainbow, 2005). There is ample evidence that under field and laboratory conditions, contaminant concentrations in tissue are often species-specific. For example, investigators have observed species differences in bioaccumulation of: zinc (summarized in Luoma and Rainbow, 2005) between two filter feeding co-located epibenthic organisms (mussels and barnacles); PCBs between a deposit feeding and a filter feeding bivalve in laboratory uptake experiments (Burgess and McKinney, 1998); various metals and PCBs between mussels and oysters observed in long term regional monitoring data (San Francisco Estuary Institute, 1997); cadmium and copper among grass shrimp, mussels, and quahogs in controlled muti-element laboratory exposures (Rule and Alden, 1996); and PAHs among various benthic species (as reviewed in Rust et al., 2004). These authors comment upon the implications of differential uptake and accumulation when selecting organisms for toxicity testing, bioaccumulation testing, or monitoring.

These differences pose an uncertainty of generally unknown magnitude in ecological and human health risk assessments which often depend upon a small number of representative species. Risk assessors commonly select representative species to represent various trophic levels or vulnerabilities (ecological risk assessors) or ingested food types (human health risk assessors) with uncertain knowledge regarding the range of differences in bioaccumulation that may occur even among species of the same feeding type or taxonomic family. This work measures the range of tissue concentrations for various metals and organic chemicals among co-located bivalves that are both prey for local animal species and a regular food source for recreational shell fishers. We discuss the implications for selecting representative species in ecological risk assessment and selection of recreationally caught species in human health risk assessment.

INSULIN SIGNALLING IN ADIPOCYTES EXPOSED TO PBDEs. Bradley R.Best (best_bradley@hotmail.com) and D.J. Small, University of New Hampshire, Durham, NH 03824.

PBDEs (Polybrominated Diphenyl Ethers) are a class of lipid-soluble chemicals used in the production of plastics and flame-retardants. Because they are lipid soluble, PBDEs easily localize in adipocytes. They are hypothesized to be endocrine disruptors which impair proper hormone regulation in various metabolic pathways. One such pathway - the insulin signaling pathway - is very important for regulation of the breakdown of glucose and storage of glycogen and fat. PBDEs have been found to disrupt insulin signaling in adipocytes, although the molecular mechanism is not well known. If PBDEs are disrupting hormone responses that are paramount to proper energy storage in adipocytes, their presence in common-place consumer products could be one cause of obesity. In this study, we found a dose-dependent response to the expression levels of various genes relevant to the insulin signaling pathway in adipocytes treated with different concentrations of PBDEs. In addition, immunoblot analysis revealed an unexpected increase in the activity of downstream effectors of the insulin pathway. These studies suggest that low doses of PBDEs may alter the duration or rate of insulin signaling in PBDE exposed adipocytes.

USING PASSIVE SAMPLERS TO EXAMINE THE FATE AND TRANSPORT OF DIOXINS AND FURANS IN NEWARK BAY, NEW JERSEY. Carey L. Friedman (cfriedman@gso.uri.edu), and R. Lohmann. University of Rhode Island Graduate School of Oceanography, Narragansett, RI 02882.

Newark Bay is an estuary in New Jersey (USA) that connects four rivers: the Passaic and the Hackensack to the north, and the Kill Van Kull and Arthur Kill to the south. In the 1950s and 60s, the Passaic River was contaminated with, among other compounds, polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/Fs) by the Diamond Alkali Co., a pesticide manufacturer. High PCDD/F levels in the Passaic were discovered in the mid-1980s, and since then, sampling in Newark Bay has revealed high concentrations there as well.

During the summer of 2008, we deployed passive polyethylene (PE) samplers at five sites in Newark Bay: in the mid-bay, and at the convergences of the Bay with each of the four surrounding rivers. At each site, PE samplers were deployed at both the bottom and the surface of the water column, as well as directly above the water column in the air. PE samplers absorb contaminants via diffusion so their concentrations reflect the non-particulate contaminant concentrations in the media to which they were exposed. After 16 weeks deployment, samplers were retrieved and analyzed for PCDD/Fs. The average gaseous (atmospheric) or dissolved (water) PCDD/F concentrations samplers had been exposed to during their deployment were calculated with PE-water or PE-air partition coefficients corrected for temperature and salinity effects. Performance reference compounds impregnated in the samplers were used to assess PCDD/F uptake equilibrium status. Our results indicate that at all sites where samplers were recovered, surface water was a source of PCDD/Fs to the atmosphere and surface water was more contaminated than bottom water. Differences in concentrations between sites varied with PCDD/F congener. The 2,7-dichloroDD congener was present in the greatest concentrations (10^{-5} μg/L range) in all surface and bottom water, while 2-chloroDD and 2,7-dichloroDD were present in the greatest concentrations in the air (10^{-9} mg/m^3 range). These results imply that the Passaic is still a major source of PCDD/Fs to Newark Bay and surrounding areas, since surface waters enter the Bay from the north end, while bottom waters are tidal and enter the Bay from the Kills at the southern end.

EFFECTS OF POLYBROMINATED DIPHENYL ETHERS ON BONE DENSITY. Casey Doucette (crk7@unh.edu) University of New Hampshire, 53 Albany Street Extension, South Portland, ME.

Polybrominated Diphenyl Ethers (PBDEs) are lipid-soluble compounds that are abundant in our environment; they are used as flame-retardants and are incorporated into a number of products including carpets, electronics, and upholstery. PBDEs are similar in structure to thyroid hormones and are thought to act as antagonists of thyroid hormone receptor function. Interestingly, bone development is regulated by thyroid hormone signaling, but the effects of PBDE on bone density have not been reported. To address this question, we evaluated the effects that PBDE exposure had on bone density in developing and adult rats using microtomography (MicroCT) and PIXImus dual-energy x-ray absorptiometry (DEXA) technologies. We found that PBDE treatment changed some, but not all parameters of bone density in adult and adolescent rats. These results suggest that PBDE exposure may impact bone health.

DEMONSTRATION OF DATA PORTAL FOR MASSACHUSETTS FRESHWATER FISH TISSUE MERCURY DATABASE. Michael S. Hutcheson (michael.hutcheson@state.ma.us) and Jane Rose**,** Massachusetts Department of Environmental Protection, Office of Research and Standards, Boston, MA.

Massachusetts has developed a web-based data portal for accessing its research database containing edible fish tissue mercury concentration data, associated lake water quality data and lake surficial sediment geochemical data. This application allows data selection using either a GIS-based interface or a text search capability for selecting data on the basis of multiple classification variables. Selected data can be downloaded into Excel worksheets by users of the application. The database currently contains data from 1994 and 1999 and newer data will be added from time to time. The display will include a computer for hands-on demonstration of the application on the MassDEP website.

KEYNOTE ADDRESS

SCIENCE TO INFORM DECISION MAKING. Susan M. Cormier, PhD (Cormier.Susan@epa.gov), Senior Scientist, National Center for Environmental Assessment, USEPA, Cincinnati, Ohio.

Scientists have access to information that others need. Not only do we have a grasp of facts that others do not have, but we have the ability to make those facts relevant. How do we develop and share useful information while also being scientifically rigorous and maintaining our reputation as objective witnesses? First we must continue to be skeptics, but in a productive way. We must be willing to go beyond providing raw facts and associated uncertainties. We need to use a wider array of information and learn to consider the value of that information. We need to show how the facts fit together and suggest options for a course of action. As scientists it is our responsibility to remain open to possibility. We need to be aware of where and how we can make a difference and then provide the information at the right time and in the right way so that good science will guide or even compel right actions. We need to know that what we do matters and that it makes a difference. To that end, I will share with you a way to connect scientific investigations and assessments to resolve environmental problems. To make it interesting, I will share a few stories of how integrated assessments have made a difference in the real world of environmental protection.