SETAC-CHESAPEAKE/POTOMAC REGIONAL CHAPTER
2010 SPRING MEETING

Towson University, Maryland
Date: April 19, 2010

AGENDA

7:30 - 8:30		Registration (Continental Breakfast)
8:30 - 8:50		Welcome & Opening Remarks – Judi Durda, CPRC President
		Platform Session 1 – Toxicology & Chemistry
8:50 - 9:10	#1	Dietary uptake and toxicity of coal ash and selenium to larval grey tree frogs (*Hyla versicolor*) – Lockard
9:10 - 9:30	#2	Comparative toxicity of diphacinone to Northern Bobwhite (*Colinus viriginaus*) and American Kestrels (*Falco sparverius*) – Rattner
9:30 - 9:50	#3	Energetic and glutathione antioxidant responses in crustacean hepatopancreas following chronic triclosan exposure – Stueckle
9:50 - 10:10	#4	Factors affecting thio-arsenic speciation in sulfidic sediment pore water – Elliott
10:10 - 10:30		**Poster Break (Refreshments)**
10:40 - 11:00		SETAC North America Presentation – Bill Goodfellow
11:00 - 11:40		Keynote Presentation – Sujay Kaushal
		• *Influence of Land Use, Climate Change, and Watershed Restoration on Contaminant Dynamics*
11:40 - 1:00		Lunch/Posters/Networking
		Platform Session 2 – Exposure & Risk Assessment
1:00 - 1:20	#5	Improvement, verification, and refinement of spatially explicit exposure models in risk assessment – Johnson
1:20 - 1:40	#6	Integrative approach to assessing wildlife population risk from wind turbine development – Behum

1:40 - 2:00	#7	Recent advances on information useful in the risk assessment of RDX- Williams
2:00 - 2:20	#8	Application of a stable isotope tracer to estimate the soil Zn pool available to *Lumbricus terrestris* (L.) across a salinization gradient – Rodgers
2:20 - 3:00		Chapter Meeting
3:00 - 3:20		**Poster Break (Refreshments)**
		Platform Session 3 – Monitoring & Management
3:20 - 3:40	#9	Identification of a model watershed for field investigation of consumer product ingredient safety – DeLeo
3:40 - 4:00	#10	Investigating the storage and transport of roadway salt to surface waters in a second order suburban watershed, Owings Mills, Maryland – Flora
4:00 - 4:20	#11	Assessing the distribution and abundance of seasonal pools in Maryland – Franks
4:20 - 4:40	#12	Carbon footprints and turf management: Carbon emissions and sequestration for golf courses – Cohen
4:40 - 5:00		Awards
5:00		**Adjourn**

DIRECTIONS to TOWSON:

- **From I-95 (northbound and southbound):** Take the Baltimore Beltway I-695 west (toward Towson). Take exit 25 (Charles Street) south. Proceed 1.7 miles. Turn left on Towsontown Boulevard and proceed to the first stoplight on Osler Drive. Turn right on Osler Drive, proceed for 0.4 miles and turn right onto Auburn Drive. Lot 14 will be on your right.
- **From I-83 (northbound and southbound):** Take the Baltimore Beltway I-695 east (toward Towson). Take exit 25 (Charles Street) south. Proceed 1.7 miles. Turn left on Towsontown Boulevard and proceed to the first stoplight on Osler Drive. Turn right on Osler Drive, proceed for 0.4 miles and turn right onto Auburn Drive. Lot 14 will be on your right.
- **From I-70 (eastbound):** Take the Baltimore Beltway I-695 north (toward Towson). Take exit 25 (Charles Street) south. Proceed 1.7 miles. Turn left on Towsontown Boulevard and proceed to the first stoplight on Osler Drive. Turn right on Osler Drive, proceed for 0.4 miles and turn right onto Auburn Drive. Lot 14 will be on your right.
- **From Baltimore (Penn Station):** Proceed north on Charles Street for five miles. Turn right on Towsontown Boulevard and proceed to the first stoplight on Osler Drive. Turn right on Osler Drive, proceed for 0.4 miles and turn right onto Auburn Drive. Lot 14 will be on your right.

From Lot 14 (http://www.towson.edu/main/maps/index.asp?id=L14) you have two options to get to the University Union (http://www.towson.edu/main/maps/index.asp?id=UU):

- Option 1 - campus shuttle; pickup times are 7:06, 7:36, 8:06, 8:36, 9:06 and so on. Take it four stops to Osler Dr. and then walk down to the Union.
- Option 2 - walk from Lot 14 to the Union. This is a 10-15 minute walk past the Center for the Arts. Return buses are on the hour and half-hour.

HOTELS:

- On-Campus Hotels - **Burkshire Marriott Conference Hotel** (www.burkshiremarriott.com); 10 West Burke Ave., Towson (1-800-435-5986)
- Other Area Hotels (based on their proximity to the university) -
    - **Sheraton Baltimore North** (www.sheratonbaltimorenorth.com); 903 Dulaney Valley Road, Towson (1-888-627-7147)
    - **Towson Place Hotel & Suites** (www.towsoninn.com); 1100 Cromwell Bridge Road, Towson (1-410-823-4410)
    - Comfort Inn (www.ComfortInn.com); 8801 Loch Raven Blvd., Towson (1-410-882-0900)
- Hotels Within a 15-Minute Drive –
    - **Courtyard by Marriott** (www.marriott.com); Hunt Valley 221 International Circle, Hunt Valley (1-410-584-7070)
    - **Crowne Plaza Hotel** (www.CrownePlaza.com); Timonium 2004 Greenspring Drive, Timonium (1-410-252-7373)
    - **Hunt Valley Marriott** (www.marriotthuntvalley.com/); 245 Shawan Road, Hunt Valley (1-410-785-7000)
    - **Hampton Inn–Hunt Valley** (HamptonInn.Hilton.com); 11200 York Road, Hunt Valley (1-410-527-1500)
    - **Residence Inn by Marriott** (Marriott.com/ResidenceInn); 45 Schilling Road, Hunt Valley (1-410-527-2333)

SETAC CPRC SPRING 2010

PLATFORM ABSTRACTS

Matthew Behum
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Integrative approach to assessing wildlife population risk from wind turbine development.

The United States Department of Energy projects to have 20% of American energy production resulting from wind power sources by 2030. This lofty goal necessitates a total of 3.0×10^5 MW of power generated from wind power, and currently the nation is only one-tenth of the way there. Even though the United States now has the largest wind power capacity in the world, various factors may prevent the siting and successful development of specific wind energy facilities, including potential interference with military and aviation radar, community rejection based on perceived acoustic, visual, and property value impacts, and potential adverse effects on wildlife. The potential impacts of wind turbine development on wildlife are mainly associated with habitat disruption and mortality of birds and bats due to turbine strikes. Impacts on wildlife are almost exclusively quantified as strike numbers over time, and the significance of mortality and habitat effects on the distribution, abundance, and persistence of wildlife populations has generally not been addressed. We propose a multi-faceted approach to quantifying population-level effects on birds and bats utilizing population modeling combined with wildlife-turbine encounter modeling based on geospatial analysis, field observations, and habitat assessment. Population modeling can be used to extrapolate mortality and reproductive data to key population-level endpoints including estimates of risk of population decline. We estimate risk more reliably with the addition of GIS modeling through habitat patch analysis and encounter modeling aimed at quantifying preferred receptor habitat and affected areas in a three-dimensional format. GIS can also be used in conjunction with graph theory techniques in a landscape connectivity framework to characterize relationships among habitat patches over various spatial scales for determinations of habitat value and vulnerability. The integration of these tools can more reliably estimate true population risks from wind turbine development for birds, bats, and other mammals because they transcend simple field observations and extrapolate typically available data to the population level. These tools can assist in land management decisions and community outreach by providing both concrete risk estimates and visual presentation materials that resonate with the general public.

Stuart Z. Cohen, N. LaJan Barnes, Aaron Harding, and Kenneth Ingram
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Carbon footprints and turf management: Carbon emissions and sequestration for golf courses.

Regardless of uncertainties in global warming climate modeling, carbon footprint reduction is a good thing: it helps reduce our overall ecological footprint, and it works toward the goal of energy independence. Golf course facilities provide many opportunities to reduce C emissions and increase C sequestration. Pesticides and fertilizer production emits C, and these products are used on >>99% of all US golf courses. Substitution of 'natural'/'organic' fertilizers for some of the synthetic products is an option that results in reduced C emissions. Some data on C emissions for pesticide production are available, but more are needed. The greatest source of golf course C *emissions* is electricity use due to the clubhouse>maintenance facility>irrigation/well pumps. C *sequestration* is significant, and declines in the order trees>shrubs>greens/tees/fairways>native grasslands. Golf course facilities, including the clubhouses, seem to be net significant carbon emitters, but the golf courses themselves seem to be close to carbon neutral, and may achieve net sequestration. Many opportunities exist for improving their C footprints.

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Identification of a model watershed for field investigation of consumer product ingredient safety.

Many formulated consumer products such as cosmetics and cleaning products are disposed of 'down the drain' following use. In developed countries, most wastewater is delivered to wastewater treatment plants (WWTPs) where constituents are removed prior to discharge. However, some residues will be discharged and eventually make their way to aquatic environments.

The consumer product industry has been engaged in investigations of the fate and effects of consumer product ingredient residues in the environment for many decades. Many such ingredients are used in high volumes (millions of pounds per year) in products that are sold across the US. As part of a current effort to investigate the environmental safety of a particular class of chemicals, fatty alcohols, a field investigation was developed. This investigation was driven by the fact that fatty alcohols in the environment may come from anthropogenic sources (consumer product residues) or natural sources (bacteria and plants). The objective was to estimate the relative contribution of natural and synthetic (petrochemical) sources of fatty alcohols for the purpose of apportioning sources of risk.

An investigation in a freshwater catchment in the United States was initiated. An evaluation and screening of a database of more than 10,000 WWTPs in the US yielded a set of 300 candidates for further investigation. A number of geographic and land use criteria were evaluated to arrive at a short list for follow-up with local water quality managers. This presentation will discuss the process of screening the WWTPs and evaluating the catchments. This methodology will be contrasted to selection of sites used in previous studies with effluent-dominated streams in highly urbanized environments.

Charles B. Elliott and Edward J. Bouwer

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Factors affecting thio-arsenic speciation in sulfidic sediment pore water.

The sediment system of the Baltimore Harbor has been shown to exhibit toxicity to benthic macroinvertebrates, but efforts to identify the contaminants responsible for that toxicity have so far been unsuccessful. Arsenic (As) is a contaminant of concern as it is present throughout the harbor sediment and has been shown to result in toxicity to humans and other organisms at sufficiently high concentrations. The mere presence of a contaminant is an unreliable predictor of toxicity, however. The form that a contaminant takes under environmental conditions and the characteristics of the organism determine the availability of the contaminant to interact with the organism and cause toxicity. Studies of sulfidic surface waters in several locations have identified the presence of soluble thioarsenic species as significant arsenic containing species, but little work has been done to determine the speciation of arsenic in sulfate reducing sediments. Ion chromatography (IC) allows for separation of arsenic species by oxidation state, into organic and inorganic forms, and into several different thioarsenic species. Simultaneous detection by inductively coupled mass spectrometry (ICP-MS) allows for quantification of arsenic and associated sulfur at the low μg/L level. This research seeks to identify the predominant arsenic containing species in Baltimore Harbor sediment pore water and the significant factors that contribute to the formation of thioarsenic species.

R. Flora[1], S.M. Lev[1], R.E. Casey[1], E.R. Landa[2], and J.W. Snodgrass[1]

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Investigating the storage and transport of roadway salt to surface waters in a second order suburban watershed, Owings Mills, Maryland.

Urbanized watersheds of the mid-Atlantic U.S. are receiving large quantities of road salt entering into the hydrologic system via stormwater basins. The Red Run watershed, located in Baltimore

County, MD, contains more than 200 retention basins and is an ideal location to investigate the impact of road salt on surface water and groundwater in an urban system. This investigation examined the chloride contribution of road salt, particularly sodium chloride, from two ponds which discharge into a 12,000m^2 flood plain of a second order stream in the Red Run Watershed. A network of wells was installed to sample phreatic groundwater beneath the flood plain and stormwater ponds and discharge to associated streams was quantified. Groundwater in the flood plain remains elevated (> 10mS/cm) for most of the year suggesting a slow discharge of salt to groundwater year round. At the study site, discharge in the second order tributary downstream of input from the stormwater retention basins is generally 2.5 times higher and chloride levels are 5 times higher than an upstream reference site. This corresponds to chloride loading from the two retention ponds where concentrations of 6,735 mg/L have been observed in ground water samples. Winter chloride concentrations are 3x the pre-salting concentrations, with an average of 3,075mg/L, and remain approximately 2x pre-salting concentrations through June. A slow moving road salt derived chloride plume has been identified moving towards the stream peaking in November. Groundwater samples in the center of the flood plain have been observed as high as 2,100 mg/L in June. Data from winter 2010 indicates a large volume of chloride stored within groundwater beneath stormwater retention ponds; moving towards the stream. This continuing road salt enriched plume may also be changing the distribution of cations bound to flood plain soils, significantly altering the chemical properties of these soils.

M.S. Johnson[1], W.T. Wickwire[2], I. Linkov[3], R.C. Porter[4], K. von Stackelberg[5], D.J. Barclift[6], A. Meyer[7], and M. Greenberg[8]

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Improvement, verification, and refinement of spatially explicit exposure models in risk assessment.

Compounds at installations, particularly ranges, are often found in heterogeneous distributions in the environment. Additionally, valued wildlife species use the environment in very biased ways that are linked to the habitat requirements for each species. Recently, two spatially explicit exposure models that include spatial aspects of chemical distributions in the environment have been developed within the Army Environmental Quality Technology program. Both models incorporate virtual movements for a population of individuals in the environment that include habitat preferences and produce a probabilistic estimate of risk. The Spatially Explicit Exposure

Model (SEEM) is a model that calculates exposure and risk for terrestrial wildlife species and FishRand calculates tissue concentrations for fish. The SEEM has been tested at two small arms sites for songbirds and was shown to be predictive within a factor of three, whereas the conventional deterministic model was between 10-500 fold off of field observations. A recent workshop discussed the roles and values of these models in risk assessment and discussed a range of applications and recommended improvements. Further work involves refinement of these models and to test SEEM for its utility in predicting risk for small mammals and FishRand to predict body burdens of chemicals in fish. Field verification of results will be based on blood lead toxicity reference values for mammals and fish concentrations of persistent organic substances for fish. Additionally, phenotypic biomarkers for effect will be investigated.

Laura A. Lockard[1], Chris Rowe[1], and Andrew Heyes[1]

[1] University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Solomons, MD (lockard@umces.edu)

Dietary uptake and toxicity of coal ash and selenium to larval grey tree frogs (*Hyla versicolor*).

Coal ash (CA) releases into aquatic systems have increased awareness of potential effects of complex contaminant mixtures on vulnerable amphibian species. Selenium (Se) is a labile trace element leached from aquatic CA deposits, which can be incorporated into aquatic food webs and potentially biotransformed into forms of varied toxicity. We conducted two parallel feeding studies to determine the uptake and toxicological effects of CA and two Se compounds to larval grey tree frogs (*Hyla versicolor*). Study A contrasted toxicological effects of an inorganic Se compound, selenium dioxide (SeO_2), with an organic Se compound, selenomethionine (SeMet). Study B contrasted toxicological effects of CA with SeMet, but also integrated food limitation as a possible co-stressor. Each Se compound was added to the diet in nominal concentrations of 5 ppm and 50 ppm.

Many individuals exposed to 50 ppm SeMet displayed abnormal coloration and symptoms of edema beginning 24 hrs. after study initiation. All individuals from these exposures died early in development. Both SeMet concentrations in Study B significantly reduced individual standard metabolic rates compared to control or CA exposed animals. Severe rear leg deformities were observed in 14 of the 41 metamorphosing individuals from 5 ppm SeMet exposures in. 34% of those did not survive through metamorphosis. SeMet toxicity appeared to outweigh any influence of food limitation. In CA and control treatments, however, food limitation may have contributed to a slight, although not significant, increase in mortality. Time to metamorphosis for surviving individuals did not differ significantly between exposures in either study. Contrary to expectation, larvae exposed to CA did not exhibit noticeable physical malformations, altered metabolic rates, or decreased survival to, and mass at, metamorphosis in comparison to control animals, regardless of food provision.

Barnett A. Rattner[1], and Katherine E. Horak[2]

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Comparative toxicity of diphacinone to Northern bobwhite (*Colinus viriginaus*) and American kestrels (*Falco sparverius*).

A risk assessment by the U.S. EPA identified several rodenticides (brodifacoum, difenthialone, bromadiolone, difenacoum) that pose a significant risk to birds and non-target mammals, and subsequently some restrictions were placed on their sale, distribution and packaging. This action may be offset by expanded use of other anticoagulant rodenticides (e.g., diphacinone) for which there are limited toxicological data in raptors. Based on acute oral toxicity studies, we found diphacinone to be about 20 times more toxic to American kestrels (LD_{50} 97 mg/kg) than to northern bobwhite (LD_{50} 2014 mg/kg). Several precise and sensitive clotting assays (prothrombin time, Russell's Viper venom time, thrombin clotting time) were adapted to measure the inhibitory effects of diphacinone on blood coagulation. Oral administration of diphacinone over a range of doses (sublethal to LD_{15}) evoked behavioral changes and prolonged clotting time within 24 to 48 hrs post-exposure. Prolongation of clotting time reflects impaired coagulation complex activity, and was detected before or at the onset of overt signs of toxicity and lethality. Prolonged clotting time could affect survival of free-ranging birds. Measurement of clotting time has applicability as both a rodenticide exposure and effect biomarker in laboratory and field studies. Overall findings suggest that extrapolation of diphacinone toxicity from commonly used wildlife test species (bobwhite, Order Galliformes; mallards, Order Anseriformes) to other avian Orders (e.g., Falconiformes, Strigiformes) may be dubious, and protection of raptors may require substantial safety factors. These data will assist in the development of a pharmacodynamic model to assess and predict rodenticide toxicity to non-target avian species.

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Application of a stable isotope tracer to estimate the soil Zn pool available to *Lumbricus terrestris* (L.) across a salinization gradient.

This experiment evaluated Zn bioavailability to *Lumbricus terrestris* (L.) as a function of soil cation distribution. We modified stormwater pond soils using two treatment regimes whereby porewater Zn was varied either by different amendments of $ZnCl_2$ or by a constant amendment of $ZnCl_2$ followed by varying the soil cation distribution through salt amendments ($NaCl/CaCl_2$). We used the elimination of a stable isotope tracer, ^{68}Zn, to assess the magnitude of Zn entering earthworms from the soil. Earthworms previously incubated in ^{68}Zn-spiked soil were introduced

to experimental soils, and after two days, removed for analysis of isotopic ratios in specific tissues. There was a significant ($P = 0.018$) interaction between the method of manipulating porewater Zn and Zn concentration in the anterior organs. Despite a wide range of porewater Zn values produced by the salt treatments (0.007 – 24.3 mg kg^{-1}), we did not observe a significant relationship between Zn turnover rate in earthworm tissues and porewater Zn in the salt-treated soils. Rather, turnover rate better correlated with Zn present in broader pools, such as that extracted by 6M HNO_3. The bioavailability of trace metals to earthworms may be poorly characterized by loosely bound fractions such as the porewater. We propose that the turnover rate of ^{68}Zn in anterior organ tissues was directly proportional to the size of the bioavailable soil Zn pool.

Mark Southerland, Ph.D.[1], and Elizabeth Franks[1]

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Assessing the distribution and abundance of seasonal pools in Maryland.

Seasonal (vernal) pools are important and declining resources nationwide, but especially throughout the Northeastern U.S, including Maryland. Beginning in 2007, the Maryland Biological Stream Survey (MBSS) added the identification of seasonal pools to their statewide monitoring program. However, the proportion of seasonal pools that can be captured by sampling only in stream corridors is not known. A survey of statewide seasonal pool inventories in Massachusetts and New Jersey indicated that seasonal pools are widely distributed across the landscape and are not disproportionately present within stream corridors (i.e., within the 100-year floodplain or within 50 meters of streams). We determined that the densities of potential seasonal pools in New Jersey were similar in the 100-m wide riparian area (0.45 per km^2) versus upland area (0.54 per km^2). Sampling in Maryland from 2007-2009 found that the density of seasonal pools was greater in Coastal Plain stream corridors (65% of seasonal pools per stream mile) than in the Piedmont (41%) or Highlands (4%). Approximately 3,000 seasonal pools are estimated to be in Maryland stream corridors, including 23% that had amphibians present and 11% that had obligate species present (i.e., wood frog, mole salamanders, fairy shrimp).

The conservation of seasonal pools in Maryland requires that we determine what proportion of seasonal pools is found in the stream corridor, as well as this proportion varies by region or landscape type. Using MBSS seasonal pool data, we have formulated hypotheses about how seasonal pools are distributed across the landscape, including what proportion of pools occur in upland areas versus riparian areas, and how seasonal pool distributions differ among geographic regions (i.e., Coastal Plain, Piedmont, and Highlands). To test these hypotheses, we propose a study that uses color infrared (CIR) photo-interpretation, LIDAR, and ground-truthing to identify seasonal pools throughout entire watersheds. These data will be compared with seasonal pool data obtained through MBSS sampling to paint a more complete picture of the distribution and abundance of seasonal pools in Maryland.

Todd Stueckle[1], Rebecca Cumberland[2], and Zach Wright[2]

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Energetic and glutathione antioxidant responses in crustacean hepatopancreas following chronic triclosan exposure.

Growing concern with exposure to personal care products and their associated antimicrobial compounds has centered on potential long-term effects in aquatic organisms. A widely used antimicrobial, triclosan, is released into aquatic systems after wastewater treatment and accumulates in organic sludge and sediments. Triclosan (TCS) residues in coastal sediments is an emerging concern due to its structural similarities to persistant organochlorines. Risk assessment research estimates that sediment pore water concentrations (0.26-383 ◎g/L) pose a threat to sensitive crustacean taxa. Although recent research has shown that acute toxicity occurs above environmental levels, very few studies have evaluated sensitive marine crustacean chronic TCS toxicity. The main objective for this study was to evaluate 7-day chronic toxicity of TCS on marsh fiddler crabs (*Uca pugnax*) by evaluating hepatopancreas health indices, nutrient content and changes in glutathione antioxidant status. We hypothesized that as TCS concentration increased, hepatopancreas health and nutrient content would decrease while glutathione status would be altered indicating a risk for oxidative stress. TCS (0.03 to 3000 μg/L) was not chronically toxic to *U. pugnax,* however, total lipids, HSI and HCI significantly decreased at 300 - 3,000 μg/L. Furthermore, the highest concentration of TCS caused an increase in total protein concentration. Evaluation of glutathione S-transferase, glutathione reductase and GSG:GSSG ratio resulted in no significant change compared to controls. Our results suggest that TCS exposure induced energetic stress in crab hepatopancreas tissues thus increasing lipid consumption and decreasing HSI. Furthermore, increased protein content indicates changes in protein expression. Absence of changes in GST activity and glutathione antioxidant cycling suggests that *U. pugnax* hepatopancreas detoxification and anti-oxidant defenses are sufficient to deal with chronic TCS exposure. Future research should focus on TCS's impacts on crustacean growth, reproduction and detoxification since the hepatopancreas plays a major role in these energetically demanding physiological functions.

L.R. Williams[1], G. Reddy[1], and M.S. Johnson[1]

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Recent advances on information useful in the risk assessment of RDX.

The explosive 1,3,5-trinitrohexahydro-1,3,5-triazine (RDX) has widespread application as a component in propellants, detonators, grenades, bombs and a variety of other military ordnance. Consequently, inadvertent environmental contamination in soil has resulted in concentrations detected in groundwater. Current regulatory values are based on toxicity data which are dated

and incomplete. To assist regulatory entities in the reevaluation of safe thresholds, specific studies were conducted to aid in this effort. Histology of neoplasms found in female mice were reassessed by a team of pathologists to determine incidence of cancer using current criteria. Subchronic studies in rats were conducted to determine the maximum tolerated dose and to replicate effects reported from previous studies. To aid in interspecies extrapolation, experimental data were collected to refine physiologically-based, pharmakinetic (PBPK) models as well as in vitro toxicodynamic assays. Other work involves investigations focused on understanding the mode of action of RDX-induced seizure neurotoxic effects, and reassessment of the relative source contribution of RDX in groundwater. Together, these data are intended to be useful in more accurate extrapolation of animal data to the potential for adverse effects in exposed human populations.

POSTER ABSTRACTS

M.E. Barton Bohannon[1], K. Dean, K. Davani, and M.A. Ottinger
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Induction of cytochrome P450 ethoxyresorufin-o-dealkylase (EROD) activity in hatchling tree swallows: Comparison of PCB-dosed and environmentally exposed hatchlings.

Ethoxyresorufin-O-dealkylase (EROD) and other cytochrome P450-associated monooxygenases are well documented biomarkers of exposure to toxicants and often show a dose-dependent response with exposure. Tree swallow eggs from three reference sites, Patuxent Research Refuge (PRR) in MD, Greater Sacandaga Lake (GSL) in NY, and Cobleskill Reservoir (CR) in NY, were dosed with environmentally relevant levels of PCB congeners. In 2006, eggs from PRR and GSL were dosed with PCB 126. In 2007, eggs from PRR and CR were dosed with a 58-congener PCB mixture. Untreated eggs from a contaminated site of the Upper Hudson River were collected. Eggs were collected, allowed to hatch, and livers were collected within 24 hours of hatching. EROD activity was measured using an enzyme activity assay that had been optimized and validated for tree swallows, using ethoxyresorufin as the substrate. Activity was variable within and between sites and years, often with dose-dependent results. Contaminant analysis is also being performed in these eggs, which will help inform these EROD activity data. The conclusions and opinions presented here are those of the authors, they do not represent the official position of any of the funding agencies, the Hudson River Trustees or the United States.

Barbara Beckingham
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Assessing the partitioning of PCBs to artificially weathered microplastics.

Microscopic plastic particles and fibers have been found to be widespread in pelagic and sediment environments since the 1970's, and many different classes of aquatic organisms have been shown in field or laboratory observations to ingest micro-debris (< 1mm), including deposit- and filter-feeding invertebrates. Hydrophobic organic contaminants can sorb to polymer materials, and recent research has illustrated a potential hazard to aquatic ecosystems from the transport and exposure of toxic chemicals associated with plastic debris to organisms that inadvertently ingest these materials. If marine plastic debris constitutes a relevant exposure pathway for toxic chemicals to marine life, future conservation efforts will need to monitor and address this hazard. Solid-water partitioning coefficients provide a measure of the tendency for organic chemicals to be associated with a certain medium, and this information can be used to explore the potential for plastics to sorb or to release contaminants with the surroundings which will impact the local environment for marine organisms. In the present study, we measure the

partitioning of PCBs to artificially-weathered polypropylene and also measure the contaminant load on plastic pellets collected from a beach on Chesapeake Bay.

Kenneth T. Belt[1], Sujay S. Kaushal[2], Chris M. Swan[3], Richard V. Pouyat[4], and Peter M. Groffman[5]

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Dissolved organic carbon in streams: The effect of hydrologic state and stormwater runoff on concentrations and fluxes along an urban stream continuum.

Urban streams have often been viewed as simple extensions of stormwater networks. They are, rather, very complex catchment-wide hydrologic ecosystems. Of great importance is the degree of connectivity between civil infrastructure and receiving streams, including pathways for the routing of stormflow, augmentation of baseflow by potable water networks, "upland riparian" sources, and riparian interactions with sanitary sewers.

Storm and baseflow sampling at a forested reference and urban streams of the BES Long Term Ecological Research network will be discussed in terms of DOC concentrations & fluxes in urban stormwater systems. Biweekly sampling revealed that both impervious cover (ISC) and hydrologic state were important drivers, with DOC concentrations at the urban sites were higher than the forested reference site. Stormwater sampling showed that within stormwater hydrographs

While dry weather exports of DOC are similar for both forested and urban streams, ISC and its attendant network of drainage infrastructure (and strong terrestrial-aquatic linkages) may be greatly modifying wet weather related DOC fluxes, resulting in much higher exports for more urbanized catchments. This may have significant implications for eutrophy of downstream aquatic ecosystems, pollutant transport, and disinfection by-product formation during drinking water treatment processes in urbanizing catchments.

M.G. Brown[1], E.K. Dobbs[2], J.W. Snodgrass[3], and D.R. Ownby[3]

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Combined effects of sodium chloride and copper to the amphibian species, Cope's Gray tree frog (*Hylan chrysoscelis*) and green frog (*Rana clamitans*).

Metal ions in the water cause toxicity by blocking cation pumps on the organism. In freshwater fish this process is reported as an inhibition of the sodium/ potassium adenosine triphosphatase (Na^+/ K^+ ATPase) on the gill surface. This results in the inability to ionoregulate. With the addition of cations to the system, the effect is altered. The data available for this process is limited to freshwater fish and daphnia and can be modeled with the Biotic Ligand Model. To test if a similar effect can be observed in amphibians, Cope's Gray Tree Frog (*Hyla chrysoscelis*) and Green Frogs (*Rana clamitans*) were tested for the combined effects of sodium chloride and copper. Triplicate exposures containing all 49 possible combinations of six sodium chloride and six copper concentrations and single compound controls were performed. . The eggs were placed in exposure chambers less than 24 h after fertilization and exposed through Gosner stage 25. NaCl 96 h LC50 for Green Frogs was 3890 mg/L and Gray Tree Frogs was 1383 mg/L. Gray Tree Frog copper 96 h LC50 was 91 µg/L, this value increased to over 150 µg/L after addition of 200 mg/L NaCl. A similar effect was seen for Green Frogs with LC50s ranging from 155 to >463 µg/L as NaCl increased from 58 to 800 mg/L. For both frogs, an ameliorative effect on copper toxicity was observed when sublethal concentrations of NaCl were present. This effect is hypothesized to be observed because the sodium ions in the water outcompete the copper ions for binding sites on the organism.

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Methoprene and multiple stressor impacts on the energetic status of post-molt *Uca pugnax*.

Pesticides such as methoprene, an insect juvenile hormone mimic, and permethrin, a neurotoxin, are applied in coastal regions to control mosquito populations. While both pesticides have short half lives in water, slow release methoprene briquettes and pyrethroid sediment accumulation result in potential chronic, low dose mixture exposures in urban and residential coastal waterways. Recent research has shown that both methoprene and organochlorine xenobiotics act as 'invisible' endocrine disruptors in crustaceans by primarily influencing normal molting processes through either ecdysteroid or hyperglycemic hormone disruption which alters energetic status. The purpose of this study was to examine single compound and mixture effects of these contaminants on the energetic status of post-molt fiddler crabs (*U. pugnax*). First, male and female crabs were subjected to a molting and limb regeneration challenge while exposed to environmental levels of methoprene. A subsequent molting challenge study was conducted using a fractionated factorial design to evaluate impacts due to multiple stressor exposure of

methoprene, permethrin and salinity. Nutrient assays of post-molt epithelial and hepatopancreas tissues were run to determine the amount of protein, protein-bound carbohydrate, free carbohydrate, and lipids. Initial published results indicated that male crabs experienced greater sensitivity to both exposures by displaying alterations in exoskeleton protein content, increased deformed limb frequency and decreased growth capacity. Cellular energy allocation (CEA) can be calculated by determining nutrient content and using available respiration data. This study will lend further insight to how chronic exposure to environmental levels of endocrine disruptors and multiple stressors impact sensitive and energy demanding growth and development processes in marine invertebrate taxa.

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Polychlorinated biphenyls (PCBs) are a class of synthetic organic chemicals that are highly stable, persistent, bioaccumulative in the environment, and have been classified as a possible human carcinogen. They are lipophilic and transfer through the food chain from benthic biota, to fish, wildlife and eventually humans through bioaccumulation. Emerging research has shown that contaminant transport pathways can be interrupted by modifying and enhancing the binding capacity of natural sediments using strong adsorbents. Activated carbon has been shown to reduce bioavailability for low to moderate levels of PCBs in freshwater and marine sediments. In-situ treatment with low-impact delivery of activated carbon can be especially attractive for PCB-impacted vegetated areas and sensitive wetlands. This study was performed at a vegetated wetland and creek that flows into the James River in Virginia. This pilot-scale study is aimed to develop the in-situ remediation technology and address the critical barriers in the advancement of the technology. Control and treatment sites were 15meters by 15meters, half within the channel segment and half in the bordering marsh. The treatment was deployed in the summer of 2009. Samples were collected and examined before treatment and two months after treatment. A bioaccumulation study using *Leptocheirus plumulosus* as well as aqueous concentration measurement using a passive sampler showed reductions in PCBs at the treatment sites just two months after deployment. The presentation will include recent findings of this pilot-scale demonstration.

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Is environmental remediation static or dynamic: Case studies.

Presently, environmental remediation (ER) of the impacted soil and groundwater has become a top priority among the scientists and engineers. Therefore, innovative remediation technologies are emerging for impacted site remediation. Data obtained from the three ER cases at three sites in Washington, DC were evaluated through four key parameters (site conditions, chemical of

concerns (COCs), regulatory requirements, and site safety) to find out the answer of the title. Soil and groundwater of the sites were impacted with benzene, toluene, ethylbenzene, total xylenes (BTEX), methyl tert-butyl ether (MTBE), total petroleum hydrocarbon-gasoline range organics (TPH-GRO), and total petroleum hydrocarbons-diesel range organics (TPH-DRO). Previous consultant's approaches to remediate two of the above mentioned sites were not considered feasible. Therefore, Kleinfelder received those sites for further investigations and remediation. Based on the site history, soil and groundwater analytical data, and site safety, in-situ chemical oxidation (ISCO) using sodium persulfate, oxygen releasing compound (ORC), and bioventing and biosparging remediation systems were selected, designed, and implemented at the above mentioned sites for remediation. The data analysis from pre and post injection of ISCO and ORC at two sites showed BTEX, MTBE, TPH-GRO, and TPH-DRO mass reduction of 75 to 95%. The bioventing/biosparging pilot test is scheduled for April 2010 and will be discussed. Having similar COCs at the Washington sites, why different remediation approaches were considered either among the sites or between the consultants? This study was focused on those key parameters that would help to deliver the projects successfully, safely, and develop good relationship with the clients.

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Using the trident probe to characterize chloride contamination at the groundwater-surface water interface (GSI).

Historical investigations at an industrial facility in the Midwest identified elevated total dissolved solids (TDS) and chloride concentrations in site groundwater. On- and offshore cone penetrometer testing (CPT)/electrical conductivity (EC) logging and groundwater sampling data collected in 2006 suggested that chloride might be venting into an adjacent freshwater lake at concentrations exceeding the state ecotoxicological benchmark. Although specific conductance probes showed indirect chloride concentration measurements in the lake, at the groundwater-surface water interface (GSI) and biologically active zone (0 to 12 inches of sediment), were lower than concentrations measured in deep grab samples, no direct chloride measurements in shallow pore water had previously been collected. In April 2008, potential venting zones were surveyed and sampled using the Trident Probe, a direct-push, integrated temperature sensor, conductivity sensor and pore water sampler developed to screen sites with potential GSI zones. The Trident Probe was configured with two temperature/conductivity sensors and three pore water sample probes. Each pore water probe consisted of a 6-inch sand-pack pre-filter to minimize potential clogging from fine-grained sediment, and attached to peristaltic pumps to facilitate low-flow sampling techniques. The midpoint of the three pore water probes were set to penetrate to depths of 4, 16 and 29 inches below the sediment surface, with temperature/conductivity sensors set to

collect measurements within the shallowest and deepest depth ranges. In addition to temperature and conductivity, drawn surface water and pore water was further analyzed ex situ for conductivity and temperature as well as other basic water quality parameters (pH, ORP, TDS). Split samples were submitted to a laboratory for analysis of chloride. The water quality and analytical results were used to identify venting zones and compare chloride concentrations to the state ecotoxicological benchmark so potential risks to ecological receptor could be characterized. This presentation presents the Trident Probe methods employed and summarizes the field-collected data and conclusions generated from the study.

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Assessing the influence of storm water BMPs on surface water chemistry in the Red Run Watershed, Maryland.

Salt is widely used as a road-deicing agent in the Northeastern and Mid-Atlantic US. A general increase in impervious surfaces within urban and suburban watersheds has led to an increase in salt loading in these watersheds. Chloride derived from road salt behaves conservatively and is readily transported to surface and ground waters, while the cations associated with road salt tend to bind to soil particle surfaces and may not be transported to streams as readily as chloride. In this investigation we examined the surface water chemistry of 28 sites across a gradient of land use, storm water BMPs, and salt application practices throughout the urbanizing Red Run watershed in order to evaluate the impact of these factors on road salt derived cation and anion chemistry of local streams.

Surface water samples were collected monthly from December to April to determine seasonal trends in the flux of ions to streams. At the time of sampling, specific conductance, temperature, and pH were measured in the field and samples were returned to the laboratory for ion analysis. Cation and anion concentrations (Na^+, K^+ ,Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-} , and NO^{3-}) of water samples were determined using a Dionex Ion Chromatograph in the Urban Environmental Biogeochemistry Laboratory (UEBL) at Towson University.

Surface waters of Red Run had elevated Mg^{2+} (up to 33 mg L^-) and Na^+ (up to 118 mg L^-) levels year round in several areas and Cl^- levels varied seasonal throughout the watershed. Concentrations of Mg^{2+}, Na^+, and Cl^- were well above typical baseline ion concentrations for surface waters in undeveloped watersheds within the Piedmont, indicating widespread contamination of streams by road salts. While Cl^- levels are clearly related to road salt application, the distribution of elevated cation levels seems to be closely related to the distribution of storm water BMPs and privately maintained paved surfaces within the watershed.

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Development and implementation of Masonville Dredged Material Containment Facility, Masonville Cove Environmental Education Center, and associated mitigation package.

The Masonville Dredged Material Containment Facility (DMCF) was constructed to address long-term dredged material placement capacity needs for the Port of Baltimore. Sediment dredged from Baltimore Harbor is statutorily required to be placed within a confined disposal facility. Beginning in 2010, there is a placement capacity shortfall for this material. The DMCF will provide approximately 15.4 million cubic yards of future placement capacity. The innovative design used onsite borrow material and beneficially reused material from another Baltimore Harbor dredging project to construct the DMCF. This reduced the needed dredged material placement capacity for the Seagirt Marine Terminal (SMT) project and increased the DMCF capacity by excavating construction material from the site footprint. Use of material from the SMT project reduced regional emissions associated with dredged material disposal and provided $10 million in cost-savings to the Maryland Port Administration (MPA).

The MPA developed a compensatory mitigation package that centered on the restoration of adjacent Masonville Cove, a Baltimore City-designated habitat protection area. The Cove restoration will improve aquatic and shoreline habitat within the Chesapeake Bay watershed through wetland creation/enhancement, substrate enhancement, debris removal, and contaminated soil remediation. An additional enhancement associated with the package is the development of a community environmental education center. Community participation in the development of the restoration plan for Masonville Cove resulted in overwhelming support for the project. To justify the mitigation package, a project-specific Habitat Conditions Analysis (HCA) was developed to compare habitat functions lost within the footprint of the DCMF to habitat functions gained by the implementation of the mitigation package proposed for Masonville Cove. This analysis developed relative values for the functions gained and lost by the project and associated mitigation. The HCA was presented to and approved by federal, state, and local resource agencies and partners.

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Using stable isotopes of carbon (^{13}C) and hydrogen (^{2}H) to determine the contribution and fate of detergent fatty alcohols in the environment.

Fatty alcohols are used in cosmetics and other cleaning products as sulphates or polyethoxylates. Those products are disposed of 'down the drain' with most constituents removed prior to discharge. However, fatty alcohol residues may eventually make their way to freshwater or marine environments, and be transported to sediments. Fatty alcohols also are produced naturally by a wide range of organisms.

Detergent range alcohols (C_{12} – C_{18}) may be sourced from oleochemicals or petroleum for consumer products, but also are produced by animals and plants in the environment. As such, simple techniques such as chromatographic signature analysis based on the profile of compounds do not unambiguously allocate source to environmental concentrations. The most appropriate method for source identification of fatty alcohols may be compound specific stable isotope analyses because enzymatic and chemical reactions that compounds undergo during synthesis can lead to preferential incorporation of isotopes. As such, the final compounds have stable isotope ratios that differentiate between the sources.

The consumer product industry has been engaged in the investigation of source contribution of fatty alcohols in several environments. Carbon and hydrogen isotopes were chosen for investigation. Environmental samples were collected at various points throughout a model watershed and its associated wastewater treatment plant. Formulated consumer products sold within the catchment were purchased for analysis and comparison of the stable isotope signatures to the environmental samples. Results from a site in the United Kingdom will be presented with comparison of anthropogenic and natural sources of fatty alcohols, together with source apportionment based on the two stable isotopes.

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Influence of activated carbon on the accumulation and elimination of PCBs from unsaturated soil.

Cleanup strategies for contaminated soils follow a risk based approach that takes into account several exposure pathways linking sources to potential receptors. Typical exposure pathways for terrestrial environments include contaminant leaching from soil to ground or surface water, contaminant release from soil due to volatilization, ingestion of contaminated soil or food that has accumulated contaminants from soil.

Past research has demonstrated the feasibility of PCB bioavailability reduction in water-saturated sediments through the amendment of activated carbon. This research is evaluating the effect of

activated carbon on PCB exposure from unsaturated soils through bioaccumulation in the earthworm, *Eisenia fetida*. Earthworms are representative organisms at the base of the terrestrial food chain and live in close contact with soil where they may be exposed directly to bioaccumulative chemicals. In this research the accumulation and elimination of PCBs from an artificially contaminated soil was studied with and without amendment with activated carbon (80-325 mesh). A 28-day soil exposure study demonstrated 95% reduction in the bioaccumulation of PCBs when activated carbon was mixed in the soil and 68% reduction when activated carbon was layered on top of the soil. Rapid elimination of dichlorobiphenyls was observed in the activated carbon amended soil as compared to clean artificial soil. The elimination process of tri and tetrachlorobiphenyls were fast for the first three days and then slowed down. Overall a greater elimination of PCBs was observed in activated carbon amended soil.

Results from this study indicate that treatment of the biologically active layer of contaminated soil with activated carbon may be a promising in-situ stabilization method for reducing the bioavailability of PCBs and other hydrophobic organic compounds in a terrestrial environment.

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Sources of chlordane in the Anacostia River Watershed.

The Anacostia River (DC and MD) is one of three Areas of Concern of the Chesapeake Bay from toxic pollution. The Anacostia has a fishing advisory due to PCBs and chlordane in fish tissue, also high sediment toxicity and tumors in over 60% percent of resident fish. Using active biomonitoring with the local Asiatic clam (*Corbicula fluminea*). students and I examined 68 sites in the 176 square mile Anacostia watershed for 65 EPA Priority Pollutants plus seven metals. Chlordane was 80% of all pesticides. Chlordane is a toxic Persistent Organic Pollutant that is slow to degrade and bioaccumulates up the food chain. Chlordane use was banned in 1988 due to its toxicity, especially for fish. As chlordane was once widely used for termite control we did not expect to find localized sources. However clams placed in some Anacostia streams accumulated very high levels of chlordane, plus heptachlor epoxide which is produced by chlordane degradation. Those streams may be associated with old chlordane dump sites. They included Riverdale East a small stream entering the Northeast Branch, upper Sligo Creek Main Branch which enters the Northwest Branch, upper Lower Beaverdam Creek, Still Creek and near Stickfoot Sewer at the the lower tidal Anacostia. The Anacostia has a PCB TMDL (Total Maximum Daily Load) requirement and possible PCB sources are being examined by the Maryland Department of the Environment. However there is as yet no Anacostia chlordane TMDL or restoration plan that includes chlordane source remediation.

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The use of Brown Bullhead otolith chemistry to evaulate home range and river fidelity in fish populations from the South and Choptank Rivers, MD.

Otoliths, the calcified structures found in the inner ear of teleost fish, are typically composed of alternating layers of aragonite and protein, which, are thought to be deposited annually. These layers provide a temporal record of the growth history of the fish and potentially a record of the environmental conditions the fish has been exposed to over the course of its life. Elements such as Ba^{2+}, Sr^{2+}, Mg^{2+}, Zn^{2+} and Mn^{2+}, can substitute for Ca^{2+} in the aragonite portion of the otolith and can be used as indicators of health and environmental conditions over the life span of the organism. Otolith growth bands are typically 50-100 mm wide and characterization of their elemental composition therefore requires a high-resolution direct sampling approach like Laser Ablation. Using LA-ICP-MS, we determined the trace element composition of otoliths from brown bullhead catfish (*Ameiurus nebulosus*) collected from two locations in the Chesapeake Bay watershed. This study is the first investigation to characterize the otolith chemistry of the brown bullhead catfish and, evaluate the potential to use the otolith trace element fingerprint as a marker of home range and river fidelity.

Catfish used in this investigation were collected from the South and Choptank rivers which represent potential end members in the study region. A standard preparation method consisting of, embedding the otolith in epoxy resin; grinding and polishing to expose the core of the otolith was used. Otoliths were analyzed from core to rim with LA-ICP-MS for trace elements. The Sr/Ca ratio record from otoliths in both rivers, suggest exposure to a range of salinities over the lifetime of each fish. Other potential relationships exist for elements such as Cu, Zn and Pb but additional data collection is required to confirm the observed patterns.

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Preliminary results of an avian two-generation toxicity test in Japanese quail using endosulfan as a model endocrine disrupting chemical.

A two-generation avian assay using Japanese quail (*Coturnix japonica*) is part of a battery of Tier 2 tests that the U.S. Environmental Protection Agency is implementing in their Endocrine Disruptor Screening Program. This avian two-generation assay serves to evaluate potential population effects of endocrine modulating compounds on myriad avian species, and represents

terrestrial, oviparous wildlife species in general. A previous study demonstrated the test method in one generation of Northern bobwhite; the current study will assess the practicality of the two-generation assay and the potential value added over the existing one-generation OPPTS avian reproduction test guideline. In this study, endosulfan was used as a model estrogenic endocrine disrupting chemical. The parental generation was exposed to endosulfan in feed from week five of age until completion, the F1 generation was exposed *in ovo* and in feed throughout their lifetime, and the F2 generation was exposed only embryonically. Reproductive measures include male copulatory behavior, sperm concentration and motility, onset to sexual maturation, sperm digestion of the perivitelline layer, and fertility. Additional measures include growth, concentration of endosulfan deposited in yolk by hens, eggshell strength and thickness, serum estradiol, testosterone, and thyroid hormone concentrations, and assessment of the cell-mediated and humoral responses.

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An urban waterfront case study: Landscape connectivity modeling applied to regional restoration planning In the Delaware Estuary.

Regional restoration planning is emerging nationally as a means to promote better coordination among restoration practitioners, planners and project decision-makers to ensure that the most meaningful ecological outcomes are realized. The goal of the Partnership for the Delaware Estuary's new Regional Restoration Initiative (RRI) is to provide a science-based decision-support system that proactively guides restoration activities to ensure that outcomes: 1) are tailored to maximize ecological needs for specific sub-watershed regions and 2) minimize short-term loss of opportunity and maximize long-term "bang-for the-buck". Initially, the RRI is focusing on four case studies for developing restoration ecosystem service tools: urban waterfronts, tidal wetlands, bivalve shellfish and headwaters.

Integral Consulting completed modeling for the urban waterfronts case study to provide the relative ecological value, with respect to the landscape connectivity, of six potential restoration plots along the Philadelphia waterfront for regional bird species of concern. Landscape connectivity refers to the relative value that habitat patches (including candidate restoration sites) provide in terms of allowing populations of species of interest to successfully move and flourish across a broader regional scale. The landscape connectivity insights from the modeling will serve as one line of evidence in a matrix of site characteristics for a prioritized project registry of restoration opportunities across the Delaware Estuary.

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Modeling wetland plant, cattail (*Typha spp.)* and softstem bulrush (*Scirpus validus*), trace metal accumulation in an urban constructed.

The treatment of wastewaters with constructed wetlands has received a great deal of study due to the ability of wetlands to immobilize trace metals amongst other pollutants. Constructed wetlands are becoming an increasingly integrated feature of newly developed areas due to their ability to capture sediment, metals, and nutrients as well as decrease runoff velocity. The stormwater runoff of urban areas typically contains elevated levels of Zn and Cu as well as road salt, pesticides, and nutrients. This project was designed to intensively characterize Cu, Zn, and Na levels within the sediments and plants of a constructed wetland in order to develop a model that predicts metal accumulation in plants. A summer 2009 survey of pond sediments found total metal concentrations ranged from 115-1023 mg/kg for Zn (n=47), 37-147 mg/kg for Cu (n=47), and Na concentrations ranged from 3-717 mg/kg (n=46). Plant root, rhizome, and seed samples were collected from *Typha spp.* and *Scirpus validus* in order to evaluate the potential for plant metal accumulation and the magnitude of this route for trophic transfer of metals. Models for the relationship between sediment and plant metal concentrations were evaluated. Due to the competitive nature of these cations for soil binding sites, the relationship between salt levels and metal accumulation was examined as well. It was found that the distribution of metals within the sampling area was highly variable and relationships were not easily characterized. Finally, acid-extractable concentrations of metals were compared to consensus-based sediment quality guidelines established by MacDonald et al. (2000). For both Cu and Zn 95% of the samples exceeded the threshold effect concentration; none of the samples analyzed exceeded the Cu probable effect concentration, but 61% of the samples exceeded the Zn probable effect concentration.

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Maryland fish consumption risk due to PCBs.

The work presented is an effort to assess human health risks associated with carcinogenic chemicals found in fish caught in Maryland. The Maryland Department of the Environment (MDE) collects fish samples from Maryland waters annually. This study has targeted 2 years of sampling collected in 2008 and 2009. In the first year of study, polychlorinated biphenyl (PCB) congeners were measured in 35 composite fish tissue samples, from 13 fish species-collected from major Maryland waters in 2008 fall. PCB concentrations in fish tissues were compared across geographical regions and to Maryland fish consumption advisory levels. Most samples have concentrations of PCBs<313ng/g (wet weight) which is Maryland's "no consumption" threshold. The greatest PCB concentrations were measured in white perch from the Patapsco River

(368.59ng/g), which exceeded the MDE "no consumption" concentration level. The PCB congener concentrations in fish are used to track PCB transport and bioaccumulation patterns throughout Maryland waters. Fish consumption advisories and analysis of contaminants in fish are used to protect human and ecological receptors. The advisories usually recommend limiting or avoiding consumption of certain fish from specific water bodies. The data presented here are being used to help develop and update fish consumption advisories for Maryland waters.

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A "pumped up" pouch: Quantification of steroid hormones in *Syngnathus fuscus* and *Syngnathus floridae.*

The fish family, Syngnathidae, which includes pipefish, seahorses and sea dragons, are known for paternal incubation of embryos within a specialized brood pouch. The role and function of the brood pouch are still being determined, especially pertaining to paternal protection, nourishment, osmoregulation and steroid contribution. Previous studies have determined that the brood pouch is extensively vascularized and that paternally-dervied nutrients are taken up by embryos. The aim of this study is to quantify levels of steroids present in blood, pouch fluid and embryos of *Syngnathus fuscus* and *Syngnathus floridae* to investigate potential paternal contribution and intrerspecific differences. We have developed a capillary electrophoretic pH-mediated sample stacking method that is capable of separating 7 steroid hormones in under 5 minutes. Moreover, these steroids can be quantified in samples as small as 5-10μl. Preliminary results indicate detectable levels of 17β-estradiol, α,β-dihydroxyprogesterone, and 11-ketotestosterone in embryos and pouch fluid. This study aims to gain a greater understanding on the role of the paternal brood pouch and the evolution of this parental care.. Moreover, sex determination in Syngnathid fishes has yet to be elucidated; Quantification of steroid hormones during the stages of embryonic development may indicate whether this is a factor, as well as forecast the influence of environmental factors, including endocrine disruptors, on offspring sex ratios.