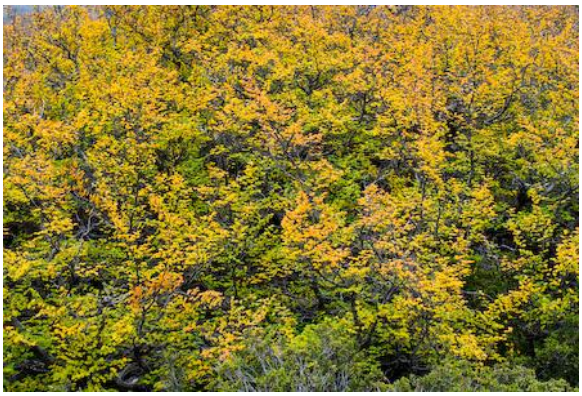
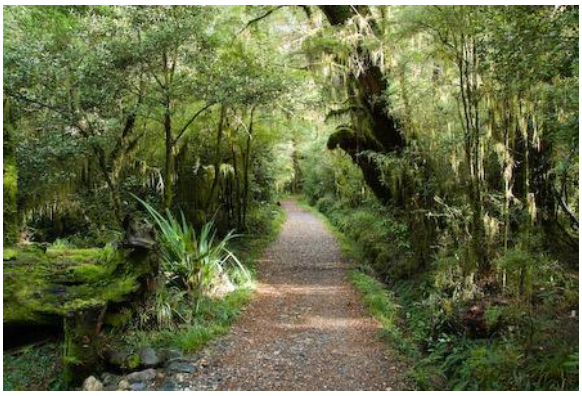
22nd Annual Meeting of the Northern California Regional Chapter of the

Society of
Environmental
Toxicology
And
Chemistry

Seeing the Forest Through the Trees: Integrated Science, Informed Policy

May 2-3, 2012
University of California, Berkeley
Clark Kerr Campus





Northern California Regional Chapter

Society of Environmental Toxicology and Chemistry
2451 Estand Way, Pleasant Hill, CA 94523
Tel: (866) 251-5169 x1108
Email: norcalsetac@onebox.com; http://www.norcalsetac.org

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Ari Halberstadt
Independent Consultant ari@arihalberstadt.com

Charlie Huang
California Department of Fish and Game, OSPR chuang@ospr.dfg.ca.gov

Thomas Jabusch
San Francisco Estuary Institute thomasj@sfei.org

Eugenia McNaughton
U.S. Environmental Protection Agency mcnaughton.eugenia@epa.gov

David Ostrach
Ostrach Consulting djostrach@gmail.com

Katie Siegler
University of California Davis csiegler@ucdavis.edu

***Leona D. Scanlan,* Student Representative**
U.C. Berkeley Molecular Toxicology Graduate Group lds@berkeley.edu

***Vanessa De La Rosa,* Student Representative**
U.C. Berkeley Molecular Toxicology Graduate Group vydelarosa@berkeley.edu

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SCHEDULE

22nd Annual Meeting of the Northern California Regional Chapter of the Society of Environmental Toxicology and Chemistry

May 2-3, 2012
University of California, Berkeley
Clark Kerr Campus

Wednesday, May 2, 2012
Day One – Short Courses

Time	Description	Instructor	Location: Room
8:00-8:30	Registration		Krutch Theatre Entry
8:30-12:00	Ecological Risk Assessment and Management – Process and Applications, Module 1	Bridgette DeShields, ARCADIS; Ned Black, United States Environmental Protection Agency ; Kimberley Walsh, ARCADIS; Mala Pattanayek, ARCADIS,	Room 102
12:00-13:00	Lunch Break / Registration		Room 102/TBD
13:00-16:30	Ecological Risk Assessment and Management – Process and Applications, Module 2	Bridgette DeShields, ARCADIS; Ned Black, United States Environmental Protection Agency ; Kimberley Walsh, ARCADIS; Mala Pattanayek, ARCADIS,	Room 102

- **Box lunches will be provided to short course and meeting attendees each day.**
- **Parking is available for purchase on-site each day for $12 per day.**

SCHEDULE

Thursday, May 3, 2012
Day Two – Conference

Time	Description	Speaker(s)	Location: Room
8:00-12:00	Registration	NA	Krutch Theatre Entry
9:00-9:10	Welcoming Address	Angela Perez, NorCal SETAC President	Krutch Theatre
9:10-9:20	SETAC N.A. Address	Mary Reiley and Bridgette DeShields	Krutch Theatre
	Introduction of Plenary Speakers	Angela Perez, NorCal SETAC	Krutch Theatre
9:20-9:45	Plenary Speech: Valuing Nature's Benefits to Society	Guy Ziv , Ph.D., Stanford University	Krutch Theatre
9:50-10:15	Plenary Speech: Talk to the People Who Live There: Using the Dynamics of Environmental Discrimination to Assess Cumulative Impacts	Rachel Morello-Frosch , Ph.D., University of California, Berkeley	Krutch Theatre
10:20-10:45	Plenary Speech: An Overview of the Natural Resource Damage Assessment Process and the Role of Large Integrated Datasets	Jennifer Holder, Ph.D., ERM	Krutch Theatre
10:45-11:00	Panel Discussion, Audience Q&A	Moderator: Angela Perez	Krutch Theatre
11:00-12:00	**POSTER SESSION AND BREAK**		Garden Room
11:30-13:00	Registration, Box Lunch Pick-up		Krutch Theatre Entry; Building 14 Hallway
12:00-13:00	Student -Mentor Lunch	Students, Sustaining Members, Speakers and NorCal SETAC BOD	Garden Room
13:00-14:40	Session 1: Toxicity Testing and Modeling	Session Chair: David Ostrach	Krutch Theatre
13:00-14:40	Session 2: Contaminant Fate and Transport	Session Chair: Katie Henry	Room 102
13:00-14:40	Session 3: Advances in Toxicogenomics	Session Chair: Eugenia McNaughton	Room 104
14:40-15:00	**BREAK**		
15:00-16:40	Session 4: Issues in Human Health Risk	Session Chair: David Ostrach	Krutch Theatre
15:00-16:40	Session 5: Monitoring Contaminants in the Environment	Session Chair: Charlie Huang	Room 102
16:40-17:00	**POSTER SESSION AND BREAK**		Garden Room
17:00-17:15	Members Meeting	All	Garden Room
17:15-18:00	Social Reception and Student Awards	All	Garden Room

SCHEDULE

PLATFORM SESSIONS

Sessions 1, 2 and 3 (13:00 – 14:40)

Time	Session 1: Toxicity Testing and Modeling Chair: David Ostrach Room: Krutch Theatre	Session 2: Contaminant Fate and Transport Chair: Katie Henry Room: 102	Session 3: Advances in Toxicogenomics Chair: Eugenia McNaughton Room: 104
13:00-13:20	**Beckon W, U.S. Fish and Wildlife Service, Sacramento, CA:** *Toxicity of Selenium to White and Green Sturgeon*	**Jones R,** Bayer CropScience**, Stilwell, KS:** *Important Pathways for Residential Runoff Transport of Pyrethroids*	**Page K, UC Berkeley, Berkeley, CA:** *Metallostasis Genes Regulate in vivo Aluminium Levels and Sensitivity to Aluminium Exposure in Caenorhabditis elegans*
13:20-13:40	**Clark S, Pacific EcoRisk, Fairfield, CA**: *Reproduction Toxicity with Ceriodaphnia dubia: "False Positives" Due to Epibionts*	**deBerry B, URS, Oakland, CA:** *Mercury Erosion Control and TMDL Implementation at Former Mercury Mine*	***Gaytan B, UC Berkeley, Berkeley, CA:**.*Using Yeast Functional Toxicogenomics to Decipher the Toxicity of Organochlorinated Pesticides*
13:40-14:00	***Callinan K, University of California Davis, CA:** *The Toxicity and Interactions among Common Aquatic Contaminants in Binary Mixtures*	**Phillips B, University of California, Davis, CA:** *Optimization of an Integrated Vegetated Treatment System and Evaluation of Landguard A900 Enzyme: Reduction of Water Toxicity Caused by Organophosphate and Pyrethroid Pesticides*	***Hasenbein M, Technische Universität München, Freising, Germany:** *Genomic Assessments in Delta Smelt (Hypomesus Transpacificus) Exposed to River Water Downstream of the Sacramento Regional Waste Water Treatment Plant*
14:00-14:20	***Hasenbein S, University of California Davis, CA:** *Effect Assessment of Tertiary Pesticide Mixtures on the Amphipod Hyalella Azteca and the Midge Chironomus Tentans*	***Jasper J, University of California, Berkeley, CA:** *Fate of Trace Organic Contaminants in Unit Process Treatment Wetlands*	***Scanlan L, UC Berkeley, Berkeley, CA:**. *Toxicity of silver nanowires on Daphnia magna*
14:20-14:40	**Panel Q & A**	**Panel Q & A**	**Panel Q & A**

SCHEDULE

PLATFORM SESSIONS

Sessions 4, 5 and 6 (15:00 – 16:40)

Time	Session 4: Issues in Human Health Risk Chair: David Ostrach Room: Krutch Theatre	Session 5: Monitoring Contaminants in the Environment Chair: Charlie Huang Room: 102
15:00-15:20	**Brown F, Department of Toxic Substances Control, Berkeley, CA:** *Levels of Halogenated Flame Retardants (HFRs) in House Dust from Northern California Homes*	**Siegler K, University of California Davis, CA:** *The Stream Pollution Trends (SPoT) Program: Evaluating Trends in Stream Contaminants and Toxicity in California*
15:20-15:40	***Li X, University of California, Berkeley, CA:** *Pulmonary Toxicity and Biodistribution of Therapeutic Nanomachines*	**Mckenzie E, University of California Davis, CA**: *A powerful technique for the analysis of metal complexation by macro-molecules – a case study of storm event distributions*
15:40-16:00	***Roegner A, University of California, Davis, CA:** *Microscale Hepatocyte Aggregate Culture (MHAC) and Microcystins (MCs): A potential novel in vitro tool for evaluating congener hepatotoxicity*	***Houtz E, University of California, Berkeley, CA:** *Oxidative Detection of Precursors of Perfluorinated Acids in Aqueous Film Forming Foams (AFFF) and AFFF-impacted groundwater*
16:00-16:20	**Panel Q & A**	**Clark S, Pacific EcoRisk, Fairfield, CA**: *A comprehensive study of pyrethroids in the American River: Information Learned to Date*
16:20-16:40	**Panel Q & A**	**Panel Q & A**

*** Student presentation – please remember to fill out an evaluation if you view this presentation**

Members Meeting - Students and Non-Members Welcome in Garden Room

Social Reception and Student Awards in Garden Room

Plenary Speakers

Guy Ziv , Ph.D., Scientific Development Lead, Natural Capital Project, Stanford University (guyziv@stanford.edu)

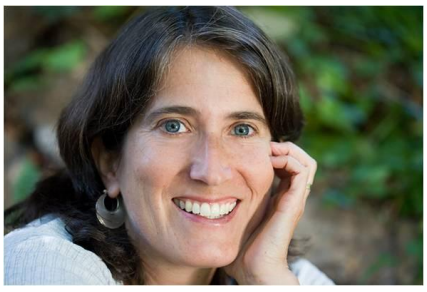
"Valuing Nature's Benefits to Society"

Ecosystems provide numerous benefits to society, including water, food, and climate regulation. While we usually account for expected gains due to land management decisions, more often than not we ignore the detrimental impacts of our actions on other aspects. Getting qualitative and quantitative about those trade-offs is the goal of the Natural Capital Project, and the toolset we produce, InVEST - Integrated Valuation of Ecosystem Services and Trade-Offs. In this talk I will present InVEST, and demonstrate how this approach has been successfully applied in multiple locations, with varying policy-contexts including land management decisions, optimal conservation planning and marine spatial planning.

Guy Ziv is leading the development of terrestrial and freshwater environmental services within InVEST. He is a physicist experienced in modeling natural and artificial complex systems. His past projects include analyzing trade-offs between hydropower dams construction and fish biodiversity and productivity in the Mekong River Basin, and quantifying bird communities resilience to agricultural intensification in Costa-Rica. His research interest is the interplay between policy, land management decisions and land use change impacts on Environmental Services. He holds a Ph.D. in Physics from the Weizmann Institute of Science, and was a Research Associate at Princeton University before joining the Natural Capital Project.

Rachel Morello-Frosch , Ph.D., Associate Professor of Environmental Science, Policy and Management and the School of Public Health, University of California, Berkeley (rmf@berkeley.edu).

"Talk to the People Who Live There: Using the Dynamics of Environmental Discrimination to Assess Cumulative Impacts"



Although research has generally demonstrated a pattern of disproportionate exposures to toxics among communities of color and the poor, with racial differences often persisting across economic strata, most previous analyses are limited to illustrating how inequities in hazard exposures are spread across the landscape, shedding little light on their origins, the reasons for their persistence, and the cumulative impacts of environmental and psycho-social stressors. Environmental justice advocates have pushed researchers and policy makers to “move upstream”

to address and prevent the cumulative impacts of chemical and non-chemical stressors on disadvantaged communities. A new environmental justice screening method (EJSM) can inform regulatory decision-making and environmental health policy. The method assumes that community engagement in research on causes and development of new screening approaches is essential to ensuring the rigor, relevance and reach of the emerging science on cumulative impacts.

Dr. Morello-Frosch examines race and class determinants of environmental health among diverse communities in the United States. Along with academic and regulatory colleagues, she has developed scientifically valid and transparent tools for assessing the cumulative impacts of chemical and non-chemical stressors to inform regulatory decision-making and environmental policy, advancing environmental justice goals and addressing the disparate impacts of chemical and non-chemical stressors in vulnerable communities.

Jennifer Holder, Ph.D., Lead of the Sediment and Watershed Integrated Management (SWiM) practice at ERM, (jennifer.holder@erm.com).

"An Overview of the Natural Resource Damage Assessment Process and the Role of Large Integrated Datasets"

Natural resource damage assessments (NRDA) focus on the restoration of natural resource services lost to the public (ecological as well as recreational) as a result of hazardous substance or oil releases. NRDAs encompass the evaluation of small spills in a limited area, through complex river systems, to large regions such as the Gulf of Mexico. Historical data sets, as well as data collected specifically for the NRDA, are integral to the process of estimating the size of the injury and defining the amount of restoration necessary to offset the losses. This presentation will provide an overview of the NRDA process, discuss the types of datasets generally used, and discuss challenges with the use and management of disparate datasets.

Jennifer Holder, PhD is a partner and lead of the Sediment and Watershed Integrated Management (SWiM) practice at ERM. Dr. Holder has over 20 years of environmental industry experience and has conducted ecological assessments in aquatic, sediment, and terrestrial habitats, including National Priority List, RCRA and NRD sites. Her strong experience in evaluating the impacts of contaminants on the environment has resulted in her key role in assessing injuries and supporting damage assessments for a number of Natural Resource Damage Assessments (NRDAs). Her background in ecology also adds to her ability to evaluate and/or implement potential restoration alternatives, an important component of the NRDA process. Jennifer was awarded a B.A. from the University of California, Santa Cruz in Biology and a Ph.D. in Zoology from the University of California, Berkeley. She has numerous publications and has presented at scientific conferences and technical workshops in the United States, South America and Europe.

Platform Presentation Abstracts

Please note: Abstract titles followed by an "*" indicate student presenters. Student presenters will also be indentified at the beginning of their talks by the Session Chair. Please remember to fill out an evaluation if you view this presentation.

Session 1: Toxicity Testing and Modeling

Toxicity of Selenium to White and Green Sturgeon. W. N. Beckon, U.S. Fish and Wildlife Service, Sacramento, CA.

Fish of the genus *Acipenser* (sturgeon) are likely to be among the most vulnerable to selenium exposure in the San Francisco Estuary because these fish feed predominantly on benthic invertebrates, including the Asian clam, *Corbula amurensis*. This clam is an efficient bioaccumulator of selenium. The best data available for the most sensitive endpoint for sturgeon come from studies in which the survival of larvae was monitored following micro-injection of organic selenium (L-selenomethionine) into the yolk sacs of newly hatched larvae. Benchmark larval selenium concentrations from these studies were translated, by means of regressions, to selenium concentrations in the tissue and diet of adult white and green sturgeon. This analysis indicates that white and green sturgeon are among the most sensitive of fish to adverse effects of selenium, with the listed green sturgeon being the more sensitive of these two species. These levels of sensitivity evidently put sturgeon at substantial risk at current levels of exposure in the San Francisco Bay area. Selenium concentrations in food items of sturgeon in the San Francisco Bay area are almost always high enough that they may cause at least 10 percent mortality in hatchling green sturgeon (≥3.58 µg/g), and they are frequently high enough that they may cause at least 10 percent mortality among hatchling white sturgeon (≥10.8 µg/g) as well.

Reproduction Toxicity with *Ceriodaphnia dubia*: "False Positives" Due to Epibionts. S.L. Clark, R. S. Ogle, Pacific EcoRisk, CA, D. Schwartz M. Maidrand, and A. Johnson, Sacramento Regional County Sanitation District.

Numerous factors can affect a toxicity test, including the presence of non-target organisms (e.g., pathogens). In the mid-1990's, testing labs began reporting the presence of pathogen-related mortalities (PRM) in the chronic fathead minnow test, which resulted in the EPA's revision of the 2002 chronic testing manual to recognize and address PRM. However, potential pathogens are not limited to the fathead minnows. Recent microscopic examination of *Ceriodaphnia dubia* (exhibiting reduced reproduction) revealed the presence of epibionts (i.e., organisms living on the surface of another organism), which were determined to be stalked ciliates. Food, detritus, and solids readily adhered to the epibionts' sticky stalks. The extremely rapid proliferation of the epibionts and the accumulation of particulates to the ebiponts' sticky stalks resulted in the *Ceriodaphnia* becoming covered such that feeding and molting appeared to be inhibited. The source of the epibionts is unknown, but the test interference occurred in fall/winter; the epibiont has not been previously identified in the discharger's effluent. Without microscopic identification of the epibiont interference in the testing, routine analysis of the test data would have given a

"false positive" for the reproduction test endpoint. Regulatory implications of the epibionts, and possible laboratory procedures/treatments to reduce epibionts will be discussed.

***The Toxicity and Interactions among Common Aquatic Contaminants in Binary Mixtures.** K. Callinan, University of California, Davis, CA, L. Deanovic, University of California, Davis, CA, I. Werner, Eawag, Dübendorf, Switzerland, S. Fong, Central Valley Regional Water Quality Control Board, Rancho Cordova, CA, S. Teh, University of California, Davis, CA.

Mixtures of pesticides and contaminants are ubiquitous in the aquatic environment, yet their toxic interactions are not well characterized. Mixtures containing pyrethroid pesticides are particularly important due to their high toxicity and environmental prevalence. In this study, multiple binary mixtures were tested for toxic effects and interactions on *Hyalella azteca*, including four pyrethroid pesticides in all binary combinations, as well as mixtures of the pyrethroid, bifenthrin, with chlorpyrifos, copper or ammonia. Five replicates of ten amphipods were exposed to variable concentrations of contaminants, both individually and in mixtures. Mortality, swimming velocity and growth were measured upon test termination after 10 days of exposure. Data were analyzed for mixture interactions using Generalized Linear Model statistics and mortality data were compared against the additive models of Concentration Addition (CA) and Independent Action (IA). Results indicate that mixtures of the neurotoxic pesticides, bifenthrin, permethrin, cyfluthrin, lambda-cyhalothrin and chlorpyrifos most commonly followed the model of CA, while mixtures of bifenthrin with either copper or ammonia followed IA or resulted in less than additive toxicity. With the exception of ammonia, most exposures affected swimming performance and growth in a concentration-responsive manner and the binary mixtures of all chemicals were additive.

***Effect assessment of tertiary pesticide mixtures on the amphipod *Hyalella azteca* and the midge *Chironomus tentans*.** S. Hasenbein, Department of Anatomy, Physiology and Cell Biology, University of California, Davis, CA, S.P. Lawler, Department of Entomology, University of California, Davis, CA, J.P. Geist, Chair of Aquatic Systems Biology, Technische Universitaet Muenchen, Germany, R.E. Connon, Department of Anatomy, Physiology and Cell Biology, University of California, Davis, CA.

The aim of the study was to address mixture effects of pyrethroid pesticides permethrin and lambda-cyhalothrin along with the organophosphate, chlorpyrifos, upon two aquatic invertebrates, *Hyalella azteca* and *Chironomus tentans*, following 10 day exposure tests. Exposure of *C. tentans* to chlorpyrifos alone did not cause significant decrease in growth, whereas exposure to the other pesticides and the mixtures did. At lower concentrations swimming behavior in the single-exposures had a greater response than the mixture. Sublethal concentrations of lambda-cyhalothrin used for *H. azteca* resulted in a decrease in weight. Swimming performance was affected at low concentrations of lambda-cyhalothrin and chlorpyrifos, and at higher concentrations in the mixture exposures. The conducted tests highlight the importance of using a number of different endpoints to adequately assess the effects of both single and mixed compounds.

Session 2: Contaminant Fate and Transport

Important Pathways for Residential Runoff Transport of Pyrethroids. R.L. Jones, Bayer CropScience, Stilwell KS, P.C. Davidson, Waterborne Environmental, Champaign, IL, C.M. Harbourt, Waterborne Environmental, Champaign, IL P. Hendley, Syngenta Crop Protection, Greensboro, NC.

Replicated runoff studies to determine the major pathways for transport of pyrethroids applied to suburban residences were conducted at a full scale test facility near Porterville, California. Tests plots mimicked sloping front lawns and house fronts of California residential developments and included stucco walls, garage doors, driveways, sloping lawns, and residential sprinkler systems. Each of the six lots also included a rainfall simulator to generate artificial rainfall events. In the tests conducted to date, transport occurred in runoff from lawn irrigation (mostly from water landing on hard surfaces) and natural and simulated rainfall events. Under typical application practices the washoff from the driveway and garage door and wall directly above the driveway resulted in the largest masses of pyrethroids leaving the plot, with the losses from applications to vertical wall above grass, the grass next to the wall, and the lawn being an order of magnitude less. With recently adopted label practices, the washoff from the driveway decreased by more than a factor of ten and the washoff from the garage door and the walls above the driveway were reduced by about a factor of five.

Mercury Erosion Control and TMDL Implementation at Former Mercury Mine. B. de Berry, T. Cooke, URS, Oakland, CA, M. A. Assaf, Santa Clara County, Los Gatos, CA.

In 2000, pursuant to a Remedial Action Order from DTSC, Santa Clara County removed mercury mining wastes exceeding the human health action level of 400 mg/kg from the Senador Mine area. In 2010, the EPA established fish-tissue water quality objectives and a TMDL for mercury in the Guadalupe River Watershed. Although storm water sampling confirms a significant drop in mercury loads from the Senador Mine watershed post-remediation, the area continues to generate particulate mercury during storms which may contribute to methylmercury formation in downstream reservoirs. URS is leading the study which combines sampling of soils for THg with an erosion potential analysis to prioritize areas for remedial action. Review of the laboratory results confirms that earlier remedial actions were overall successful in achieving the human health action level; only 1.7% of the soil samples had THg concentrations exceeding 400 mg/kg. Analysis of potentially leachable Hg (0.5N HCl extraction) indicated a small percentage of the THg is soluble. TMDL implementation measures will likely consist of channel realignment around contaminated zones to reduce erosion.

Optimization of an Integrated Vegetated Treatment System and Evaluation of Landguard A900 Enzyme: Reduction of Water Toxicity Caused by Organophosphate and Pyrethroid Pesticides. B.M. Phillips, B.S Anderson, K. Siegler, J.P. Voorhees, R.S. Tjeerdema, University of California Davis, Environmental Toxicology, P. Robins, R. Shihadeh, Monterey County Resource Conservation District, R. Budd, Department of Pesticide Regulation.

Runoff from irrigated agriculture in Monterey County contributes a significant amount of water to local stream flow, and several studies have measured toxic pesticide concentrations and biological impacts in receiving systems. On-farm practices such as vegetated treatment systems (VTS) and enzyme application can reduce concentrations of pesticides in runoff. A redesigned integrated VTS was evaluated with a series of field experiments. The VTS was constructed in a ditch that included a 40m section for sedimentation, a 170m section of vegetation, and included a flashboard riser to control the volume of water in the vegetated section. Laboratory experiments were conducted to determine the optimal dose and mixing time of Landguard A900 enzyme to reduce concentrations of organophosphate pesticides. A series of trials were conducted on a larger, unvegetated drainage ditch to determine the efficacy of the enzyme in a setting with up to twenty times the discharge volume. Field trials included measurements of water toxicity and chemistry at the input and output of each system. These trials were conducted during actual irrigation events that varied in runoff magnitude. The VTS reduced concentrations of pyrethroids, organochlorines and total suspended solids by 97-100%. Landguard application in the larger drainage completely removed chlorpyrifos and diazinon.

***Fate of Trace Organic Contaminants in Unit Process Treatment Wetlands.** J.T. Jasper, D.L. Sedlak, University of California, Berkeley, Berkeley, CA.

Trace organic contaminants, such as pharmaceuticals and personal care products, are commonly measured in wastewater effluent at environmentally significant concentrations. While technologies such as ozonation and reverse osmosis have been shown to be capable of removing many of these contaminants from wastewater, they are too expensive to be employed by most municipalities. Engineered treatment wetlands offer a cost-effective, low-energy alternative. In order to design treatment wetlands that efficiently remove trace organic contaminants from wastewater, a greater understanding of the removal mechanisms operating in wetlands is necessary. To address this issue, we have studied the fate of a suite of commonly occurring wastewater-derived trace organic contaminants in a pilot-scale unit process wetland receiving secondary-treated wastewater effluent in the town of Discovery Bay, CA. Monitoring studies have shown efficient removal of all the compounds studied, with the exception of carbamazepine, in both periphyton-dominated and bulrush-dominated unit process wetlands. Laboratory experiments suggest that sorption and biotransformation are important in both the bulrush and periphyton wetlands, while photolysis is also important for certain compounds in the shallow periphyton wetland.

Session 3: Advances in Toxicogenomics

Metallostasis Genes Regulate *in vivo* Aluminium Levels and Sensitivity to Aluminium Exposure in *Caenorhabditis elegans.* K.E Page, UC Berkeley, Berkeley, CA, D.W. Killilea, Children's Hospital Oakland Research Institute, Oakland, CA, K.N. White, University of Manchester, Manchester, United Kingdom, C.R. McCrohan, University of Manchester, Manchester, United Kingdom, G.J. Lithgow, Buck Institute For Research on Aging, Novato, CA.

Aluminium is a highly abundant toxic metal previously shown to alter metal homeostasis (*metallostasis*). Here we show that reducing the expression of genes predicted to encode metal transport or binding proteins in *C. elegans* not only alters susceptibility to Al toxicity, but also alters the *in vivo* levels of Al in unexposed worms. A set of *C. elegans* genes was selected for their predicted roles in metal regulation, based on amino acid sequence similarity to genes in other species. The effect of gene knockdown on the changes to Al levels present in unexposed worms (via ICP-AES), and tolerance/susceptibility to Al exposure were tested using RNA interference (RNAi). Genes were analyzed for significant difference from the control for both assays, and eleven genes (from 55 tested) were found to change both Al abundance and sensitivity to Al exposure. A gene encoding the stress response transcription factor DAF-16 (a FOXO-like protein) was prominent amongst these eleven genes, implicating it as a major regulator of survival in response to Al toxicity.

***Using Yeast Functional Toxicogenomics to Decipher the Toxicity of Organochlorinated Pesticides.** B. Gaytan, UC Berkeley, Berkeley, CA, A. Loguinov, UC Berkeley, Berkeley, CA, N. Denslow, University of Florida, Gainesville, FL, C. Vulpe, UC Berkeley, Berkeley, CA.

Exposure to organochlorinated pesticides (OCPs) has been linked to neurotoxicity, endocrine disruption, and cancer, but the cellular mechanisms of toxicity remain largely unknown. It was hypothesized that a chemical genomics approach using a *Saccharomyces cerevisiae* gene deletion library could help elucidate the cellular mechanisms by which various OCPs induce toxicity. Pools of deletion strains were exposed in triplicate for five and fifteen generations to the IC20, 50% IC20, and 25% IC20 OCP concentrations. The oligo sequences unique to each deletion strain were PCR-amplified and hybridized to TAG4 arrays to identify sensitive, unaffected, and resistant strains. The overrepresented biological terms within the data assisted in the selection of individual deletion strains for growth curve experiments. It is demonstrated here that genes involved in transcriptional elongation, nitrogen utilization, and amino acid sensing are necessary for resistance to the toxaphene OCP. Analyses for the dieldrin OCP indicate that amino acid sensing and components of the pyruvate dehydrogenase complex are critical for cell survival under dieldrin exposure and that leucine rescues its toxicity. Future investigations will refine the mechanism(s) in yeast and perhaps examine how the knockout or knockdown of orthologs in higher organisms, such as *C. elegans* or human cell lines, affects OCP toxicity.

***Genomic Assessments in Delta Smelt (*Hypomesus Transpacificus*) Exposed to River Water Downstream of the Sacramento Regional Waste Water Treatment Plant.** M. Hasenbein, Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technische Universität München, Freising, Germany, J.P. Geist, Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technische Universität München, Freising, Germany, Richard Connon, School of Veterinary Medicine, University of California.

The delta smelt (*Hypomesus transpacificus*) is an endangered pelagic fish species, endemic to the Sacramento-San Joaquin Estuary, California. Multiple factors, including contaminants, are postulated to contribute to their population decline. Impacts of contaminants on aquatic

organisms are often subtle and difficult to determine. We utilize microarray technology to assess the sublethal responses of delta smelt larvae following a 7-d exposure to ambient water collected at the California Department of Water Resources field station at Hood on the Sacramento River. We identified 103 genes responding significantly to exposure (cut-off $p<0.05$). A total of 94 genes were assigned a function/pathway, whereas 9 genes remained unknown. Significant differences in transcriptional responses were confirmed by qPCR assessments for Atrogin-MAFbx32 (+2.48-fold change), Tropomyosin (-1.80-fold change), Alpha Actin (-1.33-fold change), Collagen XI (-4.06-fold change), Tubulin Cofactor beta (+1.84-fold change), relative to GAPDH. These and other transcriptional differences identified by microarray assessments, indicate impacts on molecular pathways involving energy metabolism, DNA and RNA processing, development of bone and muscle and on the immune system. Results indicate that contaminants originating from sites upstream of Hood are a potential cause for delta smelt growth and development abnormalities, significantly impacting on their immune system.

Toxicity of silver nanowires on *Daphnia magna. L.D. Scanlan, University of California Berkeley, Berkeley, CA, B. Gilbert, Earth Sciences Division LBNL, Berkeley, CA, C, Tran, University of California, Los Angeles, Los Angeles, CA, P, Luong, University of California Berkeley, Berkeley, CA, D. Nowinski, University of California Berkeley, Berkeley, CA, C.D. Vulpe, University of California Berkeley, Berkeley, CA.

Nanowires (NWs) are nanoparticles (NPs) with a high aspect ratio; the length of the particle is much longer than the width. Their shape and physiochemical properties make them ideal for use as building blocks in nano-scale devices and their use is expected to increase. In this study, we investigated the physical characteristics and toxicity of four silver nanowires (AgNWs). Because they are made of silver, AgNWs have an inherent potential for toxicity to aquatic organisms such as *Daphnia magna*. We therefore determined the acute LC_{50} for all four AgNWs and performed microarray gene expression assays to investigate each wire's mode of toxicity. We found that none of the AgNWs are as toxic to *Daphnia magna* as ionic silver ($AgNO_3$). Smaller wires were usually but not always more toxic to *Daphnia*. Speciation studies indicate that ionic silver released from the NWs is not responsible for all of the observed AgNW toxicity. AgNWs were observed in the hemolymph of the daphnids after exposure and the AgNW coatings were altered *in vivo*. Gene expression data suggest that modes of toxicity of AgNWs are different from ionic silver.

Session 4: Issues in Human Health Risk

Levels of Halogenated Flame Retardants (HFRs) in House Dust from Northern California Homes. F.R. Brown, Environmental Chemistry Laboratory, Department Toxic Substances Control, Berkeley, CA (1), T.P. Whitehead, University of California, Berkeley, CA, M. Petreas, J.S. Park (1).

As the use of various PBDEs is decreased or eliminated, industry is substituting other brominated and/or chlorinated FRs, i.e. Halogenated Flame Retardants (HFRs). This raises the question about

people's potential exposure to these HFRs. We developed high resolution GC/MS methodology to measure PBDEs, PCBs and new HFRs in house dust samples collected from vacuum cleaner bags in 2010. Thirteen HFRs were measured and, in these preliminary results, the most abundant HFRs measured were TBB, BTBPE, TBPH, and DBDPE, with PBEB and HBB being detected at lower levels. TDCPP was also detected at high levels in the samples, but in the blank as well, thus rendering the results for TDCPP not useable. Four of these HFRs, BTBPE, DBDPE, TBB, and TBPH were also reported in another study of house dust (Stapleton et al, Environ Sci Tech, 2008) and our preliminary results appear to be comparable. The views expressed herein are those of the authors and do not necessarily reflect those of the Department of Toxic Substances Control, California Environmental Protection Agency.

***Pulmonary Toxicity and Biodistribution of Therapeutic Nanomachines.** X.T. Li, UC Berkeley, Berkeley, CA, M. Xue, UCLA, Los Angeles, CA, J. Evans, PNNL, Washington, F. Hayes, UC Davis, Davis, CA, H. Aaron, UC Berkeley, Berkeley, CA, E. A. Eisen, UC Berkeley, Berkeley CA, M.Takeuchi, Kyoto Sangyo University, Kyoto, Japan, C. Vulpe, UC Berkeley, Berkeley, CA, J. Zink, UCLA, Los Angeles, CA, S. Risbud, UC Davis, Davis, CA, K. E. Pinkerton, Center for Health and the Environment, Davis, CA.

The use of nanoparticle carriers is an exciting field to improve drug targeting. Inhalation delivery using nanomachines is becoming more popular in developing delivery methods to efficiently deposit therapeutics into the respiratory and central nervous systems. However, the safety of nanomachines in an inhalation model has not been extensively studied. We aerosolized and delivered functionalized mesoporous silica nanocages in an in vivo model to investigate the effectiveness and toxicity of a model nanomachine taking into account the complex interactions of copolymer functionalization and aerosol optimization. F-MSiN was aerosolized using a miniHEART nebulizer and mice were exposed to the aerosol through a nose-only port system for 5 hours. Aerosol size distribution was sampled using cascade impactors and electrostatic precipitators. Samples were analyzed with confocal microscopy, SEM, EDS, and TEM. Bronchoalveolar lavage fluid (BALF) was collected to assess pulmonary inflammation. Aerosolized F-MSiN ranged from 50nm-2um and localized in alveolar macrophages. Cytotoxicity assays demonstrated a lack of neutrophil or eosinophil influx. We conclude that F-MSiN can be effectively aerosolized as respirable particles that reach the entire respiratory tract with no detected acute toxicity. F-MSiN have the potential to be developed as pulmonary therapeutic nanomachines.

***Microscale Hepatocyte Aggregate Culture (MHAC) and Microcystins (MCs): A potential novel in vitro tool for evaluating congener hepatotoxicity.** A. Roegner and B. Puschner, University of California, Davis**;** A. Khademhosseini, Harvard/MIT Health Sciences, Cambridge.

Globally prevalent in freshwater harmful algael blooms, microcystins (MCs) comprise a family of acutely hepatotoxic cyanotoxins. A tragic acute intoxication of renal dialysis patients in 1996 brought home the importance of developing rapid and accurate assays for toxicity of the over 80 congeners identified in surface waters worldwide. Inhibitors of the ubiquitously expressed

protein phosphatases 1/2A, MCs have resulted in numerous animal intoxications, yet protein phosphatase inhibition poorly predicts congener toxicity in vivo. Organic anion transporter polypeptides (OATPs) expressed on the sinusoidal membrane of liver cells are critical for uptake and hepatotoxicity. We aimed to evaluate whether immortalized liver cells grown in aggregates demonstrate increased expression and functionality of critical transporters normally down regulated in planar culture, thereby providing a potential in vitro tool to rapidly evaluate MC toxicity. Human hepatoma cells HEPG2 grown in MHAC and traditional planar culture were compared for mRNA expression of OATPs and for uptake of fluorescently labeled known substrates. Increased expression of OATPs was documented in aggregates relative to planar culture, along with increased uptake of fluorescently labeled substrates. Inhibition of uptake of the fluorescent compounds by xenobiotics, including microcystins, provides a novel in vitro assay for potential toxicity of surface waters.

Session 5: Monitoring Contaminants in the Environment

The Stream Pollution Trends (SPoT) Program: Evaluating Trends in Stream Contaminants and Toxicity in California K. Siegler, UC Davis, Monterey, CA, B.M. Phillips, UC Davis, Monterey, CA, B.A. Anderson, UC Davis, Monterey, CA, J.P. Voorhees, UC Davis, Monterey, CA, S. Katz, UC Davis, Monterey, CA L. Jennings, UC Davis, Monterey, CA, and R.J. Tjeerdema, UC Davis, Davis, CA.

The Stream Pollution Trends (SPoT) program is a statewide monitoring program under the umbrella of the Surface Water Ambient Monitoring Program (SWAMP). SPoT is designed to detect trends in contamination and toxicity in major watersheds of California. Sites at the base of 100 watersheds were selected for integrative measurements of sediment toxicity and a suite of pesticides, trace metals, and industrial compounds. Toxicity was observed at 20% (2008), 30% (2009), 22% (2010), and 19% (2011) of the sites using the 10d *Hyalella azteca* test. The prevalence of pyrethroid pesticide detections increased from 55% in 2008 to 76% in 2010. Detections of the organophosphate pesticide chlorpyrifos decreased from 11 sites in 2008 to zero in 2010. In 2010 and 2011, a subset of sites was tested for toxicity at 15ºC, as well as the standard test temperature of 23ºC. In 2010, the percent of sites that were toxic increased from 33% (2010) and 33% (2011) when tested at 23ºC to 58% (2010) and 67% (2011) when tested at 15ºC. This suggests pyrethroid pesticides contributed to the observed toxicity. The overall trends suggest that sediment toxicity levels are fairly consistent, pyrethroid detection is increasing, and organophosphate and organochlorine pesticide detections are decreasing.

A powerful technique for the analysis of metal complexation by macro-molecules – a case study of storm event distributions. E.R. McKenzie, University of California Davis, Davis, CA, P.G. Green, University of California Davis, Davis, CA, T.M. Young, University of California Davis, Davis, CA.

High pressure size exclusion chromatography (SEC) coupled with an online inductively coupled plasma mass spectrometer (ICP-MS) is a powerful tool to assess the size dependence of metal

complexation for macro-molecules (<300 kDa) such as natural organic matter (NOM). This system was applied in the assessment of storm event samples from four land uses: highway, urban, agricultural, and natural. Al was associated with large macromolecules. Absorbance (λ=254 nm) was used to detect organic matter (OM), which was primarily detected with molecular weights 3-6 kDa; Cu, Zn, and Ni were also detected in this same size range, indicating that they were likely complexed by the OM. Cr, Mn, Co, Ni, and Pb were commonly detected as dissolved constituents (<100 Da). Only small shift in size associated complexations were observed during the storm. SEC – ICP-MS is a powerful tool for assessing metal complexation; SEC – IPC-MS application to storm event samples revealed both complexed metals (Cu, Zn, and Ni), as well as bioavailable metals (Cr, Mn, Co, Ni, and Pb).

***Oxidative Detection of Precursors of Perfluorinated Acids in Aqueous Film Forming Foams (AFFF) and AFFF-impacted groundwater**. E.F. Houtz, D.L. Sedlak, University of California, Berkeley, Berkeley, CA.

Aqueous Film Forming Foam (AFFF) is a complex mixture of hydrocarbon and fluorocarbon surfactants that is used by the military and municipalities to extinguish liquid hydrocarbon (e.g. fuel) based fires. The use of AFFF above unlined soil has led to high concentrations of AFFF-derived perfluorinated compounds (PFCs), including PFOS and PFOA, in underlying groundwater. The adverse health effects associated with PFOS and PFOA led AFFF manufacturers to discontinue the direct use of these compounds and reformulate their products with different fluorochemicals. Despite reformulations, newly manufactured AFFF contain fluorochemicals that may abiotically or biologically transform to the PFCs, but these PFC precursor compounds are largely proprietary and are difficult to measure directly. To quantify difficult-to-measure precursors, we developed a chemical oxidation method that converts precursors to measurable perfluoroalkyl carboxylic acids. We have discovered through this technique that many major AFFF formulations contain high concentrations of fluorochemicals that may transform to the PFCs in the subsurface. We have used this oxidative method to measure PFC precursors in AFFF-impacted groundwater and sediments. Using oxidative precursor measurements, relative PFC and precursor movement in the subsurface was investigated.

A comprehensive study of pyrethroids in the American River: Information Learned to Date. S.L. Clark & R.S. Ogle, Pacific EcoRisk, CA, T. Albertson, Caltest Analytical, CA, C. Harbourt & G. Hancock, Waterborne Environmental, MI, G. Mitchell, FMC Agricultural Products, NJ, A. Barefoot and D.M. Tessier, DuPont Crop Protection, DE, M. Dobbs, Bayer CropScience, NC, and P. Hendley & K. Henry, Syngenta Crop Protection, LLC, NC.

The American River is considered to be a high quality water source. However, a previous study reported that pyrethroid insecticides were present in water samples collected over a 30 km reach of the American River at concentrations that exhibited toxicity to the amphipod *Hyalella azteca*, based on grab samples collected during 4 storm events and one dry weather event. A follow-up monitoring study is currently underway with the goal of providing a more robust picture of the

condition of the American River. Water samples have been collected during 3 rain ("wet") and 2 dry events along cross-river transects at 7 sites, with 5 stations per transect and 3 depths per station; sediment samples were also collected at the cross-river transect stations during a dry weather event. Two additional events are planned for the future. These samples were analyzed for the same 8 pyrethroid pesticides measured in the previous study. None of the 8 pyrethroids were detected in any of the dry weather event water samples, and sediment samples ranged from ND (not detected) to 5 ng/L. Results for the first wet event are currently undergoing review and will also be discussed.

Poster Presentation Abstracts

(by Poster Number)

Please note: Abstract titles followed by an "*" indicate posters by student presenters. Please remember to fill out an evaluation if you view this presentation.

1. **Degradation Rates of 11 Pyrethroids under Aerobic and Anaerobic Conditions in the Laboratory.** B.N. Meyer, C. Lam, S. Moore, R.L. Jones, Bayer CropScience, Stilwell, KS.

   Registrants of pyrethroids are conducting a number of studies to better understand the transport of pyrethroids from urban and residential applications to surface water, their persistence in water, and their impact on aquatic organisms. In the study described on this poster, degradation of eleven pyrethroids was measured over approximately 100 days in three sediment/water systems under aerobic and anaerobic laboratory conditions at 25ºC in the dark. The three California sediments represented a range of textures and organic matter. Test compounds were bifenthrin, cypermethrin, zeta-cypermethrin, cyfluthrin, beta-cyfluthrin, deltamethrin, esfenvalerate, fenpropathrin, gamma-cyhalothrin, lambda-cyhalothrin, and permethrin. The test compounds were applied as two test mixtures (six active ingredients per mixture, with bifenthrin common to both) at approximately 50 µg of test compound per kg of sediment (dry weight). Extracts of sediment/water were cleaned up by SPE, concentrated, and analyzed by GC/MS (except deltamethrin) against matrix-matched standards with cyfluthrin-d_6 as internal standard. Deltamethrin was analyzed by LC/MS/MS using deltamethrin-phenoxy-$^{13}C_6$ as internal standard. The study was fully replicated and, for the same sediments, results from the two test mixtures indicate general agreement between degradation rates measured for bifenthrin and related isomeric products (e.g. cyfluthrin and beta-cyfluthrin). Degradation was generally faster under aerobic conditions compared to anaerobic.

2. **Monitoring for Imidacloprid in California Surface Waters.** E.A. Kanawi, R. Budd, M. Ensminger, K. Starner, S. Gill, K. Goh, California Department of Pesticide Regulation Environmental Monitoring Branch Surface Water Program, Sacramento, CA.

   Imidacloprid is a systemic neonicotinoid insecticide used for crop and seed protection, structure and landscape maintenance, as well as on domestic pets to control a variety of insects. Imidacloprid acts through disruption of nicotinic acetylcholine receptors within the nervous system of insects including non-target arthropods that may be beneficial to pest management. Because of its moderate solubility and persistence in aquatic environment, imidacloprid has the potential to contaminate surface water in regions where it is applied. Currently there is a paucity of monitoring data evaluating offsite transport. Therefore, the California Department of Pesticide Regulation has begun sampling for imidacloprid. Beginning in 2010 surface water samples were collected from agricultural and urban regions throughout California and analyzed for imidacloprid. Samples were collected during dry conditions and during storm events at sites receiving residential runoff, as well as during the irrigated dry-season at sites receiving predominantly agricultural runoff. Imidacloprid was

detected in 67 of 75 agricultural run-off samples (89%); concentrations exceeded the U.S. EPA's chronic invertebrate Aquatic Life Benchmark of 1.05 µg/L in 14 samples (19%). Within urban run-off samples, imidacloprid was detected in 55 of 100 samples (55%) with a single sample exceeding 1.05 µg/L.

3. **Monitoring pollution variability within watersheds: An analysis of the effectiveness of watershed characterization within the Stream Pollution Trends (SPoT) Monitoring Program.** S.B. Katz, UC Davis, Monterey, CA, B.S. Anderson, UC Davis, Monterey, CA, B.M. Phillips, UC Davis, Monterey, CA, K. Siegler, UC Davis, Monterey, CA, J.P. Voorhees, UC Davis, Monterey, CA, L.L. Jennings, UC Davis, Monterey, CA, J.W. Hunt, UC Davis, Monterey, CA and R.S. Tjeerdema, UC Davis, Davis, CA.

   The Stream Pollution Trends (SPoT) program conducts statewide monitoring surveys as part of the Surface Water Ambient Monitoring Program (SWAMP). Sediment samples have been collected annually since 2008 at streams throughout California and analyzed for sediment toxicity and a suite of pesticides, trace metals and trace organic compounds. These data are used to evaluate long term water quality trends statewide. Sampling stations are located at the base of watersheds using a USGS NAWQA integrator site design. In order to investigate how well SPoT base-stations represent spatial and temporal variability in the watersheds, an additional 2-3 stations were sampled and analyzed 3 times per year (summer, fall and winter) throughout 3 different watersheds in both 2010 and 2011. Toxicity and total pyrethroid concentrations (2010) were then analyzed using an Analysis of Variance (ANOVA) to determine statistical differences among the samples. Results were varied and indicated that there were significant spatial, seasonal and yearly differences in 5 of the 6 watersheds where variability studies were conducted. These findings demonstrate the utility of variability studies in future SPoT surveys.

4. *** Effect of Arsenic and Arsenic Metabolites on L-Type Calcium Channel and Large Conductance Calcium-Activated Potassium Channel Expression and Activities in Vascular Smooth Muscle.** K.P. McPherson, R. Khalili, C.E. Pace, J.E. Angermann, School of Community Health Sciences, University of Nevada, Reno., Reno, NV.

   Chronic ingestion of well water contaminated with inorganic arsenic has also been epidemiologically associated with development of hypertension, yet cellular mechanisms by which both inorganic arsenic and methylated arsenic metabolites exert this effect are not well elucidated. Both inorganic arsenite ('iAs^{3+}') and monomethylarsonous acid ('$MMAs^{3+}$') are believed to affect the activity of the 'L-type' calcium ion channel ('LTCC'), which plays a key role in the maintenance of vascular tone and intracellular Ca^{2+} entry. Intracellular Ca^{2+} can regulate the activity of large conductance Ca^{2+}-activated potassium ion channel ('BK_{Ca}'), a known modulator of cellular depolarization that has been recently implicated in the development of hypertension. The present study examined the effects of iAs^{3+} and $MMAs^{3+}$ on expression and activities of LTCC and BK_{Ca} channels in acutely isolated and primary / tissue cultured rat thoracic aorta, and the experimental A7r5 rat thoracic aorta smooth muscle

cell line using whole-cell patch clamp, vascular contractility, and real-time RT-QPCR. Initial results indicate significant alterations in smooth muscle cell morphology, viability, and responsiveness to phenylephrine-induced vasoconstriction upon acute and subchronic exposure to both iAs^{3+} and MMA^{3+}. LTCC activity is also altered following iAs^{3+} exposure. Both iAs^{3+} and MMA^{3+} affect the activities of key ion channels governing the maintenance of vascular smooth muscle tone.

5. *** Exploring the Mechanisms of Toxicity of Polybrominated Diphenyl Ethers in Daphnia Magna.** D.T. Nowinski, L.D. Scanlan, A.A. Arai, C.D. Vulpe University of California, Berkeley, CA.

   Penta and Octa Brominated Diphenyl Ethers (PBDEs) are flame retardants that were incorporated into a wide array of products until their toxic potential lead to a global ban in 2005. Since the chemicals were manufacturing additives, they are not chemically bound to the products, and they leach out into the environment where they have been found to persist and bioaccumulate. *Daphnia magna* were used as a representative aquatic organism for toxicity testing. A 48-hour acute toxicity assay and probit analysis were used to determine the acute LC_{50}. The LC_{50} of PentaBDE and OctaBDE were found to be 0.058mg/L and 5.963 mg/L, respectively. A 48-hour exposure was set up at one-tenth the LC_{50} for microarray analysis. It was discovered that the differential expression caused by each chemical was unique. A Kegg pathway analysis was determined to be insignificant due to the lack of annotated genes in the *Daphnia* genome. qPCR is being performed to validate array results.

6. ***Benthic macroinvertebrate community responses to a diesel oil spill in an urban stream.** M. G. Peterson, University of California, Berkeley, Berkeley, CA, L. Hunt, University of California, Berkeley, Berkeley, CA, V. H. Resh, University of California, Berkeley, Berkeley, CA.

   Urban streams face multiple challenges from human activities, including un-intentional exposure to chemical contaminants, which can cause both short- and long-term impairment to stream biotic communities. We used a Before-After-Control-Impact (BACI) experimental design to assess community-level effects in macroinvertebrate fauna downstream of an un-intentional 700-850 gallon diesel spill in the north fork of Strawberry Creek, an urban Mediterranean-climate stream in Berkeley, California. Benthic macroinvertebrates were sampled monthly at four sites within the two-fork system for one year pre-spill and at 3, 18, 34, and 65 days post-spill. At 3 days post-spill, the impact reach macroinvertebrate abundance was reduced by 65% and percent Ephemeroptera, Plecoptera, and Trichoptera (%EPT) was reduced by 90% compared with pre-spill levels; meanwhile, upstream control sites in both forks remained similar between pre- and post-spill. Abundance and %EPT remained decreased when sampled 18 days and 34 days later. As of 65 days post-spill, macroinvertebrate abundance had not recovered to pre-spill levels; however, %EPT did recover. Re-colonization by EPT taxa within 65 days at the impact site, which lies below the confluence of the two forks, may be due to input from the unaffected fork, suggesting that

multiple-fork complexity may quicken downstream recovery time in Strawberry Creek.

7. *** Evaluation of Drug Toxicity with the Soil Annelid Contact Toxicity Test.** W. Tang and T.J. Smith, University of the Pacific, Stockton, CA.

   In addition to their potential value for *in situ* bioremediation, the earthworm as a laboratory model may offer insight into mechanisms of xenobiotic toxicity. Using the filter paper contact toxicity test, the LD50s of a series of salicylates and phenolics were determined. The rank order in toxicity of these chemicals were compared with mammalian (rat, oral dosing) LD50s and found to be similar. To determine if protein secretion from chemical stress would be a more sensitive toxicity marker for the above xenobiotics, worms were exposed to either sodium salicylate or acetaminophen at a no effect level (NOAEL) and at the LD100 through filter paper contact. After 72 h exposure, the worms were removed and protein remaining on the filter paper was measured using the Bradford method. For both drugs, differences in protein secretion were statistically significant among control (no drug), NOAEL and LD100 groups ($P < 0.05$). These results indicate that lethality and stress-induced protein secretion assessed with the earthworm contact toxicity test may be useful for the evaluation of xenobiotics for both environmental and pharmaceutical toxicity studies.

8. **Toxicity of Environmental Compounds in Fish Cell Assays: A rapid monitoring tool for assessing contaminant effects.** M.C.Brown-Augustine, C. Clark, and C. Vulpe. Department of Nutritional Science and Toxicology, University of California, Berkeley. Berkeley, CA.

   There is limited toxicological test data available for thousands of commercial chemicals that potentially pose adverse environmental effects. Current evaluations of toxicity rely on standardized whole-animal toxicity tests that are costly, time-consuming and provide little or no mechanistic insight. In addition, changes in the regulatory requirements of Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) require a need for alternatives to animal testing. New screening approaches, such as High Content Screening (HCS) assays, measure multiple cellular endpoints simultaneously and have renewed interest in cell-based toxicity assays. For example, the EPA and the NIEHS are evaluating cell-based assays for use in human toxicology. We are collaborating with the EPA to evaluate cell-based assays in fish for extrapolation to higher-level endpoints (LC_{50}). We are in the process of screening 309 chemicals of ToxCast Phase I in rainbow trout and fathead minnow cell lines, which are representative of freshwater aquatic toxicity test species. Preliminary results indicate a measurable dose-response relationship (EC_{50}) of fish toxicity with environmental contaminants.

9. *** Fact or Fiction: Is there a link between drywells and groundwater contamination?** A. Ashoor, N. Pi, & B. Washburn, Office of Environmental Health Hazard Assessment, Cal/EPA, Sacramento, CA.

Impervious surfaces characteristic of urban areas have resulted in increased stormwater runoff with elevated pollutant levels. In an effort to protect water quality and aquatic habitat, traditional stormwater management systems, which divert stormwater off site, are being replaced with low impact development (LID) practices which infiltrate runoff on site and provide the added benefit of augmenting the aquifer. One challenge to LID practices is poorly-infiltrating soils, common in many parts of California. Drywells can be used to overcome this dilemma. They are typically a 3 foot wide hole in the ground that is filled with rock/gravel which extends down 15-35 feet. Some are concerned that drywells could introduce contaminants into the groundwater and pollute drinking water. To address this issue, OEHHA has reviewed key state and federal reports as well as peer-reviewed literature. There is little data to support this assertion. The data suggests that with proper usage and design, drywells can be used for stormwater management without adverse effects on groundwater quality. Details of the studies and their implications will be presented at the meeting.

10. *** Potential Role of DNA Damage and Repair in Trichloroethylene Renal Toxicity.** Vanessa De La Rosa, Jonathan Asfaha, Chris Vulpe, UC Berkeley, Berkeley, CA

Trichloroethylene (TCE) is a common drinking water contaminate and human carcinogen. Previous studies have implicated the TCE metabolite, DCVC, as a renal toxicant, yet the molecular events mediating renal toxicity remain convoluted. Using a functional genomics approach in yeast, we aim to gain a better understanding of the mechanisms involved in TCE mediated renal toxicity. The yeast deletion library, consisting of over 4600 strains, each with a single gene knocked out was treated with DCVC to identify genes required in response to exposure. Enrichment analysis conducted on the resulting gene profile revealed an overrepresentation of genes involved in DNA repair processes. Confirmation of sensitivity using flow cytometry showed translesion synthesis (TLS) and nucleotide excision repair (NER) deficient strains were most sensitive to DCVC exposure. These genes function in concert to repair DNA crosslink damage in yeast and higher organisms. The involvement of the error prone translesion synthesis pathway in repair can increase the rate of mutagenesis and result in genome instability. Western blot analysis of post-translational modifications further supports the presence of DNA damage and TLS activation. These results suggest the metabolite DCVC causes DNA crosslink damage and DNA repair mechanisms play an important role in TCE mediated renal toxicity.

11. *** Polychlorinated biphenyl spatial patterns in San Francisco Bay forage fish.** B.K. Greenfield, University of California, Berkeley, CA, R.M. Allen, San Francisco Estuary Institute, Richmond, CA.

Industrialized waterways frequently contain nearshore hotspots of legacy polychlorinated biphenyl (PCB) contamination, with uncertain contribution to aquatic food web contamination. We evaluated the utility of estuarine forage fish as biosentinel indicators of local PCB contamination across multiple nearshore sites in San Francisco Bay.

Concentrations in topsmelt (*Atherinops affinis*) and Mississippi silverside (*Menidia audens*) were comparable to those of high lipid sport fish in the Bay, and strongly correlated with spatial patterns in sediment contamination. The average sum of 209 PCB congeners in fish from 12 targeted stations (441 ± 432 ng g^{-1} wet weight, mean ± SD) was significantly higher than 17 probabilistic stations (138 ± 94 ng g^{-1}). At probabilistic stations, concentrations in topsmelt (185 ± 82 ng g^{-1}) were higher than silverside (90 ± 82 ng g^{-1}), likely due to habitat differences and elevated lipid content in topsmelt. The highest concentrations were from targeted Central Bay locations, including Hunter's Point Naval Shipyard (1347 ng g^{-1}; topsmelt) and Stege Marsh (1337 ng g^{-1}; silverside). Targeted sites exhibited increased abundance of lower chlorinated congeners, suggesting local source contributions, including Aroclor 1248. These findings indicate that current spatial patterns in PCB bioaccumulation correlate with historical sediment contamination due to industrial activity.

12. **Evaluating the Toxicity of Hypersaline Brine Using Nine California Ocean Plan Toxicity Test Protocols.** L. L.Jennings, UC Davis, Monterey, CA; J. P. Voorhees, UC Davis, Monterey, CA; S.B. Katz, UC Davis, Monterey, CA; K. Siegler, UC Davis, Monterey, CA; B. M. Phillips, UC Davis, Monterey, CA; B. S. Anderson, UC Davis, Monterey, CA;R. S. Tjeerdema, UC Davis, Monterey, CA.

    As water needs increase in California, coastal cities are exploring ocean desalination as a freshwater supply alternative. Desalinization results in the discharge of hypersaline brine to the ocean, and there is concern this could impact marine receiving waters. This study determined the salinity tolerance of seven marine organisms using nine California Ocean Plan protocols. Test organisms included: red abalone (*Haliotis rufescens*), giant kelp (*Macrocystis pyrifera*), bay mussel (*Mytilus galloprovincialis*), mysid shrimp (*Americamysis bahia),* topsmelt (*Atherinops affinis*), and purple sea urchin (*Strongylocentrotus purpuratus*). Sand dollars (*Dendraster excentricus*) will be evaluated when spawning organisms are available. Salinity tolerances were determined with an initial range-finder test followed by two definitive tests. Preliminary results showed that salinity tolerance varied by protocol. Euryhaline species were more tolerant to higher salinities than were marine species. The most sensitive organisms and endpoints were sea urchin and abalone development (38‰) > mussel development (43‰) > sea urchin fertilization (44‰) > mysid survival (48‰) > kelp germination and growth (55-58‰) > topsmelt survival and biomass (60‰). Results of these experiments will be used by the State Water Resources Control Board to establish discharge requirements for desalinization facilities.

13. *** Spatial variability of methylmercury in San Francisco Bay sediments.** H. Kaufman, B. Oldham, A. Luengen. University of San Francisco, San Francisco, CA.

    Sediments were collected from San Francisco Bay in October and December, 2011 to analyze the spatial variability of methylmercury (MeHg) concentrations. We hypothesized that concentrations would be higher in South Bay than North Bay. Surface sediments were collected using a benthic grab and subsampled using clean techniques and procedures to

avoid oxidation. In the laboratory, samples were digested with a 25% KOH:methanol solution and analyzed using a MERX model III Cold Vapor Atomic Florence Spectrophotometer (CVAFS). Preliminary results showed that MeHg ranged from 0.029 ng g^{-1} to 1.74 ng g^{-1} wet weight. In these preliminary analyses, the lowest MeHg concentrations were found near Honker Bay. The result was consistent with previous studies by the Regional Monitoring Program, which found the lowest MeHg concentrations in sediments in the northern estuary. The highest MeHg concentrations (1.74 ng g^{-1}) were near Candlestick Park, in relatively shallow waters (3.3 m), about 1000 feet from shore. Concentrations south of the Dumbarton Bridge were relatively lower (0.12 ng g^{-1}) than those near Candlestick Park, contrary to previous studies, which have reported high MeHg concentrations in Lower South Bay. Regional variation in methylation rates or proximity to shore may explain our results, but more samples are needed.

14. *** Pesticide Use in the San Francisco Estuary Utilizing updated GC/MS and LC/MS/MS Techniques**. M.M. McWayne, J.L. Orlando, M.L. Hladik, K.L. Smalling, and K.M. Kuivila, USGS Pesticide Fate Research Group, Sacramento, CA.

Current-use pesticides pose a threat to aquatic organisms in the San Francisco Estuary watershed. Pesticide use is continually changing; therefore, analytical methods must also evolve. Gas chromatography/mass spectrometry (GC/MS) is routinely used as a robust and effective technique to measure semi-volatile pesticides in water, while liquid chromatography tandem mass spectrometry (LC/MS/MS) can be used to analyze polar, non-volatile pesticides and pesticide degradates in water. Our GC/MS and LC/MS methods were designed and modified to analyze over 100 pesticides and pesticide degradates in water including several rice herbicides, neonicotinoid insecticides, and 34 fungicides, many of which are rarely included in monitoring studies. These methods were used to analyze water samples collected weekly from April through June of 2011 at three sites in the Sacramento/San Joaquin Delta and Grizzly Bay. These sites are designated as areas of critical habitat for the threatened Delta Smelt. Eighteen pesticides, of varying type and use, were detected including diuron and its degradates 3,4-DCA and DCPMU, several fungicides, and the rice herbicide clomazone. This study illustrates the need for sensitive and robust methods capable of analyzing a variety of pesticides with different physical-chemical properties in order to understand the potential effects of mixtures on aquatic organisms.

15. *** Evaluating Microcystins (MCs) as a Potential Neurotoxin in *Caenorhabditis elegans* (*C. elegans*).** C. Moore, B. Puschner, N. E'toile, University of California, Davis.

Blue-green algae toxins found worldwide, MCs can contribute to multifactorial diseases in mammals through several toxic mechanisms including protein phosphatase (PP) inhibition. While acute hepatotoxic effects have been intensively studied, chronic effects of MCs on the nervous system are unknown. The remarkable genetic and neurobiochemical conservation between *Caenorhabditis elegans* (*C. elegans*) and humans provide an ideal neurotoxicity model. A novel exposure method using *C. elegans* was developed to evaluate the *in vivo*

effects of chronic MC exposure on neurodevelopment. Small agar plates seeded with *E. coli* were covered with 100 µl of MCs, from 0-1000 µg/L, and sterile glass beads were used to evenly spread the MCs. MC solutions were allowed to settle and 300 synchronized *C. elegans* eggs were placed on each plate for 3 days at 20°C. Exposed and non-exposed adult *C. elegans* were compared. Chemotaxis indices to the odors benzaldehyde and diacetyl were used to measure behavior patterns. A colorimetric assay using p-nitrophenyl phosphate was developed to study effect of MCs on PP rates of activity in protein extracts from *C. elegans*. To facilitate MC uptake, *C. elegans* strains with weakened cuticles were utilized. PP activity may increase in chronic exposures, leading to altered behavior.

16. **Detection of PBDEs, TBPH and Other New Brominated Flame Retardants in Human Serum** Weihong Guo, Yunzhu Wang, Myrto Petreas**,** June-Soo Park. Environmental Chemistry Laboratory, California Department of Toxic Substances Control, California Environmental Protection Agency.

    Firemaster 550, a mixture of four flame retardants that are either known to be toxic or lack adequate information, continues to be used as a replacement for polybrominated diphenyl ether (PBDE) flame retardants. Two of the four ingredients, i.e., 2,3,4,5-tetrabromo-ethylhexylbenzoate (TBB) and 2,3,4,5-tetrabromo-bis(2-ethylhexyl) phthalate (TBPH), have been found in blubber of marine mammals as far as the North Pole and also are detected in house dust, sewage sludge from wastewater treatment plants. Sharing similar properties with PBDEs, these new brominated fire retardants (new BFRs) are likely to bioaccumulate through the food chain and/or via inhalation/ingestion of house dust and, therefore, may pose health risks. We have developed an analytical method that can detect TBB, TBPH, as well as other commonly used new BFRs alternatives (2,4,6,-tribromophenyl allyl (ATE), 1,2-dibromo-4-(1,2-dibromoethyl)cyclohexane (α,β-TBECH), 2-bromoallyl-2,4,6-tribromophenyl ether (BATE), Pentabromotoluene (PBT), Pentabromoethylbenzene (PBEB), 2,3-dibromopropyl-2,4,6-tribromophenyl ether (DPTE), Hexabromobenzene (HBB)) simultaneously with PBDEs in human serum. The views expressed herein are those of the authors and do not necessarily reflect those of the Department of Toxic Substances Control, California Environmental Protection Agency.

17. **Simultaneous Determination of Bisphenol A, 2.4-Dibromophenol, 2.4.6-Tribromophenol and Tetrabromobisphenol A in human serum samples by LC-MS/MS.** Syrago-Styliani E. Petropoulou, Tan Guo, Weihong Guo, Myrto Petreas,June-Soo Park, Environmental Chemistry Laboratory, Department of Toxic Substances Control, 700 Heinz Av, S 100, Berkeley, CA 94710.

    Brominated flame retardants, especially polybrominated phenols (PBPs) in commercial products have raised increasing concerns due to their potential toxicities in humans and wildlife. PBPs are used as additive compounds in polymers such as epoxy and polycarbonated resins. BPA is also reported as an obesogen, causing advanced puberty and increasing body weight in female mice offspring. In the present work, we report a new LC-

MS/MS method using isotopic dilution for the determination of PBPs in human serum. BPA is present in serum in its free form, and as a glucuronide adduct that appears to bioaccumulate. The method was validated for the quantitation of the total amount of BPA and the other PBPs in human serum samples. Samples were denatured using formic acid with enzymatic deconjugation of the glucuronides, followed by an off-line solid phase extraction procedure. Based on the accuracy, precision, stability and reproducibility the method can be used for Biomonitoring purposes. The views expressed herein are those of the authors and do not necessarily reflect those of the Department of Toxic Substances Control, California Environmental Protection Agency.

18. *** Does the Pesticide Endosulfan affect Disease Susceptibility in Cascades frogs?** D.R. Reagan, San Francisco State University, San Francisco, California, C. Davidson, San Francisco State University, San Francisco, California.

    Amphibian populations around the world have experienced sharp declines, the causes of which are still not well understood. Disease caused by a chytrid fungus (*Batrachochytrium dendrobatidis*) is a leading cause of amphibian declines, but it is unclear how disease interacts with environmental factors and frog susceptibility. This study aims to determine if sub-lethal exposure to the pesticide endosulfan affects Cascades frog's susceptibility to chytrid fungus. We conducted a laboratory experiment in which we exposed juvenile Cascades frogs from two distinct populations to either endosulfan or the chytrid fungus or a combination of the two. We found that exposure to endosulfan did not significantly affect growth or mortality, either directly or in interaction with chytrid.

19. **Monitoring of Fipronil and Bifenthrin within Urban Streams of California.** E.R. Russell, R. Budd, M. Ensminger, S. Gill, and K. Goh, California Department of Pesticide Regulation, Sacramento, CA, R. Tjeerdema, University of California Davis, Davis, CA.

    Runoff from urban landscapes has been linked to pesticide detections in adjacent waterways, where concentrations can reach levels detrimental to aquatic macroinvertebrates. Over 4 million kg a.i. of pesticides are applied annually by professional applicators for landscape maintenance in California, with an additional unreported amount by residential users. The California Department of Pesticide Regulation has begun monitoring urban streams throughout California to determine presence of pesticides originating from urban landscapes. Water samples were collected between December, 2009 and October, 2011 at 34 sites located at residential storm drain outfalls or within receiving waters of adjacent urban creeks. The insecticides bifenthrin and fipronil were two of the most common pesticides detected both temporally and spatially. Statewide, bifenthrin was detected in 157 of 191 samples, with 82% of samples having concentrations greater than the US EPA aquatic life benchmark (0.0013 ug/L). Fipronil was detected in 89 of 159 samples, with 56% of samples greater than the benchmark (0.011 ug/L). Bifenthrin had a higher frequency of detection in northern California (85%), while fipronil was detected at higher frequency in southern California (74%). Both pesticides were detected at higher frequency during storm events.

20. Exposure to different strains of the fungal pathogen *Batrachochytrium dendrobatidis* results in drastically different levels of mortality among Cascades frogs. D. Rejmanek, University of California, Davis, CA, J. Piovia-Scott, University of California, Davis, CA, J.E. Foley, University of California, Davis, CA, S. Lawler, University of California, Davis, CA, C. Davidson, San Francisco State University, San Francisco, CA, K. Pope, United States Forest Service, Arcata, CA, K. Aceituno, U.S. Fish and Wildlife Service, Sacramento, CA, C. Johnson, U.S. Fish and Wildlife Service, Sacramento, CA.

In 2006, *Batrachochytrium dendrobatidis* (*Bd*), an emerging water-borne fungal pathogen was discovered in Cascades frogs (*Rana cascadae*) in California. In the Lassen area, the Cascades frog was once common but is now found in only 10 small populations. In the Trinity Alps the species is still widespread. The timing and speed of the decline coupled with the discovery of *Bd* in the remaining populations place *Bd* as a prime suspect. We exposed juvenile Cascades frogs to one of two different *Bd* strains – either cultured from a frog collected in the Trinity Alps or from a frog collected in Lassen. In two separate trials we exposed frogs to *Bd* zoospores of either the Lassen strain (N=46) or the Trinity Alps strain (N=56). After 15 weeks, 30 of the frogs exposed to the Lassen strain were still alive. In contrast, all but 1 of the frogs exposed to the Trinity Alps strain died within 2 to 4 weeks of exposure. These findings show drastic differences in virulence between *Bd* strains collected from two separate Cascades frog populations and suggest that, in addition to environmental and chemical stressors, *Bd* strain type likely plays a significant role in frog mortality.

21. Automated Storm Runoff Sampling From Residential Areas. J. Sisneroz, Q. Xiao, L.R. Oki, B.J. Pitton, University of California, Davis, CA, D.L. Haver, T. J. Majcherek, University of California Cooperative Extension Orange County, Irvine, CA, R.L. Mazalewski, Consultant, Davis, CA and M. Ensminger, California Department of Pesticide Regulation, Sacramento, CA.

Since 2006, automated sampling equipment has been used to collect storm runoff samples from residential areas in Sacramento and Orange Counties. The study sites were selected for a University of California study to evaluate pesticide, nutrient, biological, and other constituents in urban runoff. Samples and water measurements are taken at storm drain outfalls to examine runoff at a neighborhood level. Each site utilizes a Hach 950 Flow Meter with bubble depth and a velocity sensor coupled with a Hach 900 MAX Portable Sampler. Rainfall triggers the collection of samples that is based on flow measurements from the flow meter. A sample is collected when a set pacing volume flows through the monitoring point. To collect samples for the duration of a storm, the pacing volume was determined based on forecasted rainfall amounts and a drainshed model that used a surface analysis to estimate the volume of runoff generated by the storm. Flow-weighted sampling allows for a more accurate characterization of pollutant loading in storm runoff due the ability to collect many samples based on runoff volume over the course of the storm.

22. A case study of causal analysis: Stressor Identification. W. Wieland, K. Pulsipher, & B. Washburn. Office of Environmental Health Hazard Assessment, Cal/EPA, Sacramento, CA.

Stressor Identification (SI) is a causal assessment process developed by the US EPA to identify probable causes of impairment in a watershed. We used SI to analyze stressors in the Dry Creek watershed to discover the reason for the decline in the abundance and diversity in aquatic life, in particular anadromous fish. The SI process involves listing candidate causes, analyzing data from the case and from other situations, and characterizing causes based on the weight of evidence. We used five different criteria (e.g., stressor-response relationship, etc.) to characterize cause(s) of impairment. Data was collected from 10 different sites throughout the watershed. Benthic macroinvertebrates (BMIs) were the indicator used to evaluate aquatic health. Relationships between contaminants, physical habitat alterations, land use characteristics, and BMI metrics were compared. Of all of the stressors evaluated, large amounts of silt/sand/fine gravel was found to be the most probable cause of impairment. The surrogate for urbanization, percent impervious cover, was the landscape stressor that was most highly correlated with BMI metrics. Conversely, the percent open space, especially in close proximity to the study sites, was strongly associated with greater abundance and diversity of BMIs. Water quality parameters were weakly correlated with BMI metrics.