

Peat Deposits within the Sacramento–San Joaquin Delta: Timing of Anthropogenic Mercury and Lead Contamination

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Vertical peat profiles from Browns Island, a tule-dominated, brackish marsh within the Sacramento-San Joaquin Delta, contain higher concentrations of inorganic anthropogenic contaminants, including mercury (Hg) and lead (Pb), in the shallow recently deposited peat compared to underlying, older peat. In the top 65 cm of the profile, where peat was deposited since about 1850 CE (common era, equivalent to A.D.) based on ¹³⁷Cs data, Hg and Pb concentrations were (average ± 1 standard deviation) 320 ± 220 nanograms per gram (ng/g, dry) and 42 ± 17 micrograms per gram (µg/g), respectively. In contrast, Hg and Pb concentrations were 42 ± 12 ng/g and 7 ± 4 µg/g, respectively, in deeper material deposited between about 6,300 and 500 calibrated years before present (cal yr BP), based on radiocarbon dating of macrofossils and charcoal. In the peat of transitional age (500 to 100 cal yr BP), when global or regional anthropogenic effects may have occurred, Hg and Pb concentrations were 106 ± 38 ng/g and 9 ± 5 µg/g, respectively. Lead isotope ratios ²⁰⁶Pb/²⁰⁷Pb and ²⁰⁸Pb/²⁰⁷Pb, determined from acid digests of bulk peat, indicate a systematic shift towards less radiogenic Pb isotope ratios starting approximately 450 cal yr BP (1,500 CE). This shift is accompanied by increased Hg concentrations and predates influence of organolead gasoline additives. These data may reflect increased mining and metallurgical activity in Mexico after European colonization, or increased global fluxes of Pb and Hg from China and (or) Europe associated with industrialization. Observed decreases in Hg and Pb concentrations normalized by Ti (to correct for variable inorganic content) during the most recent 25–35 years of deposition (post-1970 for Hg, post-1980 for Pb) are consistent with decreasing global atmospheric fluxes of these contaminants in recent decades. Peat deposits represent a useful archive for trends in geochemical cycling.

Key Words - mercury, lead, anthropogenic effects, peat, Sacramento-San Joaquin Delta

Theme: Contaminants

Poster Board Number: 131. Submission Number: 127

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

POSTER ABSTRACTS: Contaminants

Development of a Selenium TMDL for North San Francisco Bay – A complex puzzle in a dynamic system

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The North San Francisco Bay is identified as impaired by selenium, a pollutant that also occurs naturally in the Bay-Delta Estuary. The first listing on the Clean Water Act 303(d) list of impaired waters occurred in 1998 and identified all North Bay segments including the Central Bay segment as impaired by selenium. Anthropogenic sources of selenium to the Estuary include agricultural inputs to the San Joaquin River and refinery discharges. Despite implementation of actions to reduce these two sources taken during the last decade, San Francisco Bay biota have selenium concentrations higher than levels commonly associated with toxicity and reproductive impairment in fish and other wildlife species. Selenium concentrations are highest in species like white sturgeon feeding mainly on sediment-dwelling (benthic) organisms. Unfortunately, selenium bioaccumulation in Bay sturgeon has been both complicated and exacerbated by the introduction of the Asian clam (*Corbula amurensis*) into the Bay in 1986. These invasive clams are not only prodigious filter-feeders but they are very efficient in accumulating and retaining selenium, and they continue to thrive in the Bay. The selenium accumulated by these clams is, in turn, transferred to species like sturgeon whose diet contains an increasing proportion of these abundant bivalves. In addition, changing flow regimes in the Estuary due to adaptations to climate change and to address water supply issues will likely impact the fate of selenium in the system. The selenium TMDL project was initiated in 2007 to assess the current state of impairment in the North Bay, identify pathways for bioaccumulation, enhance our understanding of the relationship between sources of selenium and fish and wildlife exposure, develop site-specific water quality targets protective of aquatic biota and, and identify a strategy for attaining water quality standards. A principal component of the study is the development of a model to interpret the fate and transport of selenium in the North Bay and show the linkage between sources and water quality impairment. This work is showcased in a companion poster Modeling Selenium in North San Francisco Bay prepared by Limin Chen and others.

Key Words - *selenium; bioaccumulation; TMDL*

Theme: Contaminants

Poster Board Number: 138. **Submission Number:** 207

Our Actions, Our Estuary
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POSTER ABSTRACTS: Contaminants

Potential effect of the herbicide Diuron on phytoplankton productivity and nitrogen uptake in the San Francisco Estuary

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Herbicides and other chemicals have the potential to negatively affect marine and aquatic ecosystems since rain and other factors flush them from the land and into the watershed. Diuron is an herbicide of concern in the northern San Francisco Estuary because it is heavily used for both agricultural and urban land, is relatively toxic, and is persistent in the environment. Despite its known presence in the SFE, little is known about Diuron's potential impact on pelagic primary production. Using stable and radioactive tracer techniques, a series of experiments were conducted to empirically determine the impact of elevated Diuron on primary production and nitrogen uptake by phytoplankton assemblages from the SFE. Results show reduced primary production with Diuron additions as low as 0.7 ug /L; these concentrations fall within the range of Diuron concentrations that have been previously reported for the northern SFE and Delta. Nitrate and ammonium uptake rates were also collected and show that Diuron inhibits nitrate uptake much the same as carbon. These findings highlight yet another potential contributor to the overall decline in estuarine productivity and may represent an important driver of the pelagic organism decline.

Key Words - *Primary Production; herbicide; diuron; contaminant; nitrogen uptake; phytoplankton*

Theme: Contaminants

Poster Board Number: 135. **Submission Number:** 120

The Potential for Endocrine Disruption in Suisun Marsh: response of a resident fish species to varied sources of estrogenic compounds

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Endocrine disrupting compounds (EDCs) are widespread in the environment and are known to damage the reproductive systems of fishes. Deleterious effects of estrogenic EDCs include the production of female reproductive proteins in male fish, reduced female egg production, altered behavior, and population decline. A large body of work exists on EDC effects in commonly used laboratory species (fathead minnow, medaka); however, fewer studies have considered resident species that inhabit areas of concern. One such ecosystem is Suisun Marsh in Solano County California, the largest contiguous brackish marsh remaining on the west coast of North America. This vital conduit between the San Francisco Bay and Sacramento / San Joaquin Rivers serves both as a nursery and as vital habitat for a number of threatened fish species. Our work utilizes the inland silverside (*Menidia beryllina*), a euryhaline resident fish of Suisun Marsh, as an indicator of EDC exposure. We are investigating whether marsh sites exposed to varied sources of estrogenic EDCs cause males to express the biomarker choriogenin, an egg shell protein normally found only in females that has been shown to be more sensitive than a frequently utilized indicator of exposure to xenoestrogens - vitellogenin (yolk protein). Results demonstrate that wild males collected from Suisun Marsh are expressing choriogenin, and data from an outplanting experiment conducted during the spring and summer of 2009 suggest that the level of expression at marsh sites is significantly greater than laboratory controls and is equivalent at sites exposed to treated wastewater effluent, urban run-off or ranch run-off. Histological examinations of gonads from wild fish are also being conducted to assess reproductive health. Chemistry conducted on water samples and on extracts from polyethylene devices (PEDs) from study sites will help to clarify these results and will identify estrogenic mixtures of concern to be used for confirmatory aqueous exposures in the laboratory.

Key Words - *endocrine disruption; bioindicator; fish; xenoestrogen*

Theme: Contaminants

Poster Board Number: 140. **Submission Number:** 232

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

POSTER ABSTRACTS: Contaminants

Modeling Selenium in North San Francisco Bay

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This poster describes the application of a numerical model of selenium fate and transport in the North San Francisco Bay (NSFB), in support of the development of a selenium TMDL in this water body. The model application builds on a previously published application, and considers known point and non-point sources of selenium entering the bay, transport and mixing in the bay, and transformation and biological uptake. The model considers the behavior and uptake of different dissolved and particulate species. Dissolved species considered include selenate, selenite, and organic selenide. Particulate species considered include inorganic selenium (selenate plus selenite), organic selenide, and elemental selenium. Data on all these species is available for a set of sampling dates in the mid-1980s and late-1990s. The flows and selenium loads from the Sacramento and San Joaquin Rivers are dominant in the bay, although in the dry season, some of the point sources, such as refineries, can become more important. Dissolved selenium concentrations (all species combined) in the NSFB are generally low (~0.2 ug/l). However, selenium present in particulate forms in the water column of the estuary bioaccumulates in filter feeders, such as bivalves, and then into predator organisms that feed on these bivalves. Selenium-associated impairment in NSFB is largely a consequence of elevated concentrations in these predator organisms, specifically the white sturgeon and diving ducks. The modeling framework allows an examination of the relationship between selenium loads, in-bay concentrations, and biota concentrations to support TMDL development.

Key Words - *selenium; bioaccumulation; modeling; TMDL*

Theme: Contaminants

Poster Board Number: 137. **Submission Number:** 233

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

POSTER ABSTRACTS: Contaminants

A complete microbial community approach to tracking fecal pollution in coastal waters

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Current methods for assessing microbial water quality focus on only a few types of fecal indicator bacteria and have several shortcomings. Fecal matter contains thousands of microbial species that could potentially serve as more reliable and specific indicators. New methods of DNA sequence analysis enable rapid and simultaneous detection of thousands of microorganisms in a single sample. We are using a high-density oligonucleotide microarray to measure over 30,000 types of bacteria and archaea in fecal sources and track the fate of these microorganisms once they enter receiving waters. We tracked the 700,000 gallon sewage spill at the Sausalito-Marín City treatment plant in February 2009 and conducted a follow-up experiment using in situ diffusion chambers to determine the fate of all detectable sewage microorganisms in Richardson Bay. In addition, we used diffusion chambers to monitor microbial communities in septage and cattle waste once they entered fresh and marine waters around Tomales Bay. For each waste we identified groups of bacteria and archaea that persist or rapidly decay in receiving waters, and determined how these patterns of survival differed between freshwater and marine environments. The results provide new insight into the microbial ecology of these wastes and suggest dozens of new organisms that could be targeted for improved fecal indicator tests.

Key Words - *fecal indicator bacteria; microbial source tracking; sewage*

Theme: Contaminants

Poster Board Number: 143. **Submission Number:** 205

Emerging Contaminants in Wastewater and Solids at the San Jose/Santa Clara Water Pollution Control Plant

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Recently, there has been significant media attention on the environmental fate, transport and effects of a broad class of compounds referred to as emerging contaminants. These include personal care products, pharmaceuticals and trace organics. The pathways, loadings, effects and persistence of these compounds in the environment are poorly understood. A critical first step to understanding the potential for environmental impacts of these compounds is to characterize and begin to quantify potential sources and pathways. One pathway some of these compounds travel into environmental media is through wastewater treatment plants (WWTPs). The San Jose/Santa Clara Water Pollution Control Plant (Plant) is a large, 167 MGD capacity advanced treatment WWTP located in South San Francisco Bay in California. City of San Jose staff collected wastewater and digested solids samples from three process locations (influent, effluent and digested solids) during three separate sampling events from the Plant. Aqueous and solids samples were analyzed for a suite of microconstituents to trace levels. Concentrations of Pharmaceuticals and Personal Care Products (PPCPs), Steroids and Hormones (STHM), and Polybrominated Diphenyl Ethers (PBDEs) were measured in all samples using EPA Methods. The primary objective was a basic characterization of emerging contaminants entering and leaving the Plant to provide information to wastewater managers and scientists. This information is valuable for public outreach, prioritizing future studies of emerging contaminants, and prioritizing pollution prevention or source control efforts. Of the 100 analytical endpoints measured in this study, 59 were either not detected or not quantifiable. Of the 41 quantifiable analytical endpoints, most (32) were removed or reduced at 75%-99% efficiency through treatment. Based on average Plant flows and concentrations at the three process points, staff calculated a preliminary estimate of mass balance for the quantified compounds and results are presented based on hypothesized removal processes.

Key Words - *Emerging contaminants; wastewater; biosolids; pharmaceuticals; steroids; hormones; microconstituents; San Jose; personal care products*

Theme: Contaminants

Poster Board Number: 142. **Submission Number:** 206

Our Actions, Our Estuary
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POSTER ABSTRACTS: Contaminants

A Summary of Impacts to Natural Resources from the Cosco Busan Oil Spill

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State and federal trustee agencies have been assessing the ecological injuries caused by the Cosco Busan oil spill of November 2007. This process is known as natural resource damage assessment (NRDA). The goal is to quantify injuries to wildlife, habitat, and lost uses of those resources, and then to determine how to best restore the resources and compensate for the losses. This poster focuses on injuries to wildlife and habitat, and lost human recreational use. In the course of this NRDA, the trustees have conducted over 70 studies, as well as considered the results of studies done by others. This poster provides a summary of the results to date, specifically describing the impacts to birds, mammals, fish, rocky intertidal habitat, saltmarsh, mud and sand flats, sandy beaches, eelgrass beds, and human recreation. The ultimate goal of the trustees is to restore and compensate for the injured resources. The poster will also describe the processes to achieve this compensation, including upcoming public meetings and other opportunities to provide comment on proposed restoration actions.

Key Words - *Cosco Busan; oil spill; NRDA; natural resource damage assessment; restoration*

Theme: Contaminants

Poster Board Number: 134. Submission Number: 143

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

POSTER ABSTRACTS: Contaminants

Removal of total and methyl mercury in island drain water of the Sacramento-San Joaquin Delta through coagulation with metal-based salts.

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The presence of mercury (Hg) and methyl mercury (MeHg) in surface waters of the Sacramento-San Joaquin Delta (Delta) is an ongoing issue facing state and local regulatory agencies. Previous studies that investigated Hg removal by metal-based coagulants concluded this method was not effective. However, a majority of these studies were published between 1970 and 1980, before the development of Hg-clean techniques, which required that samples were spiked with high concentrations of Hg. Given more recent understanding of Hg dynamics which have highlighted the critical role dissolved organic matter (DOM), plays in Hg solution chemistry, coagulation may indeed prove to be a viable technique to remove Hg from Delta waters. This study assessed whether coagulants effectively remove both inorganic Hg (IHg) and MeHg under ambient conditions and provides additional information regarding Hg associations with DOM and metal hydroxides. Three industrial-grade coagulants were studied: ferric chloride, ferric sulfate, and polyaluminum chloride. Water samples collected from Twitchell Island drainage waters were treated with a range of coagulant doses and analyzed for Total Hg (THg), MeHg and dissolved organic carbon (DOC) concentration and composition. In the absence of DOM, all three coagulants released Hg, however in the presence of DOM the coagulants removed up to 95% of THg, 97% of IHg, 80% of MeHg and 85% of DOC. The coagulants preferentially removed DOM with higher aromatic content, consistent with past studies. The ratio of Hg to DOC removed decreased with increasing coagulant addition, indicating preferential association of Hg with more aromatic DOM. Results from this study have regulatory and management implications regarding Hg control using metal-based coagulants in the Delta and other regions.

Key Words - *Mercury; inorganic mercury; methyl mercury; coagulation; dissolved organic carbon*

Theme: Contaminants

Poster Board Number: 129. **Submission Number:** 230

Uptake, Distribution and Excretion of Selenocompounds in Juvenile White Sturgeon (*Acipenser transmontanus*)

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Selenium (Se), an essential micronutrient to vertebrates, is an integral part of many antioxidant proteins and has the ability to interact with heavy metals. However, at a slightly elevated concentration, it is also a potent toxin. In the San Francisco Bay Delta, Se from anthropogenic sources biomagnifies through trophic levels via filter-feeders such as Asian clam and poses serious threat to aquatic predators. In the present study, a combined technique of stomach intubation, dorsal aorta cannulation and urinary catheterization was utilized to characterize the short-term kinetics of Se in the forms of selenate, selenite, selenocysteine (SeCys), selenomethionine (SeMet), Se-methylselenocysteine (MSeCys) and selenoyeast (SeYeast). An ecologically relevant Se dosage (500 ug/ kg body weight) was intubated in groups of five white sturgeons. Blood and urine were repeatedly collected over the 48 hr post intubation period and fish were sacrificed for tissue distribution at 48 hr. The uptake, distribution and excretion of Se significantly ($P < 0.05$) differ among forms. In general, organic selenocompounds maintain higher absorption with MSeCys maintaining the highest total Se absorption, storage (AUC) and Cmax in the blood. Regardless of source, Se is preferentially distributed into metabolically active organs with SeMet treated animals achieving the highest Se concentration in most tissues. Selenite has very similar uptake and tissue distribution profile to SeCys and SeYeast but Selenate is not stored in blood but rather rapidly taken up by the liver and white muscle. Urinary excretion of Se is form dependent and peak between 3-12 hr post intubation .

Key Words - *selenium; kinetics; white sturgeon*

Theme: Contaminants

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Our Actions, Our Estuary
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POSTER ABSTRACTS: Contaminants

Sediment quality assessment in tidal salt marshes in northern California

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A sediment quality study was conducted in four tidal salt marshes in San Francisco and Tomales Bays (California, USA), utilizing a sediment quality triad (SQT) approach, which included measures of toxic chemicals, sediment toxicity, and benthic macroinvertebrate communities. Additional chronic toxicity indicators (e.g., apoptosis and histopathological damage in liver cells and embryo abnormalities in indigenous species such as longjaw mudsucker and lined shore crab) that were measured by colleagues of the Pacific Estuarine Ecosystem Indicator Research (PEEIR) consortium were integrated together for an expanded multiple lines of evidence approach. Previous studies have shown that toxicity potential of sedimentary contaminants, based on mean probable effects level quotients (mPELQs), was highest in Stege Marsh in San Francisco Bay and lowest in reference marshes in Tomales Bay. Sea urchin (*Arbacia punctulata*) porewater toxicity tests showed a significant decrease in fertilization in 7 of 13 samples from San Francisco Bay. Toxicity identification evaluation (TIE) tests with pore water revealed that organic contaminants that were not measured in the present study were likely responsible for the observed fertilization reduction. Benthic macroinvertebrate survey showed an alteration in their community structure. Significantly declined species diversity and richness and a significantly higher contribution of oligochaetes were found in Stege Marsh. The results of the present study indicate that sediments in Stege Marsh are highly degraded by contaminants and do not fully support a healthy benthic community.

Key Words - *Sediment quality assessment; mean PELQs; Porewater toxicity; Elutriate toxicity; Benthic macroinvertebrate community; Sublethal toxicity*

Theme: Contaminants

Poster Board Number: 145. **Submission Number:** 334

Delta RMP: Developing the Delta Regional Monitoring Program for Contaminants

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A diverse array of agencies and other entities monitor water quality, flows, and ecological conditions in the Delta. However, under the current monitoring framework, our ability to develop an integrated assessment of water quality in the Delta is limited by a number of factors, including variability in the level of assessment, reporting, and access to the data among these programs. In addition, there is a general recognition that significant data gaps exist, notably with respect to contaminants. The State Water Board and Central Valley Regional Water Board have initiated an effort to develop a Delta Regional Monitoring Program (Delta RMP) using a collaborative stakeholder process in coordination with similar efforts in the Bay-Delta and upstream tributaries. Development of a comprehensive monitoring program for the Delta was identified as a priority action in the Strategic Workplan for Activities in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, which was adopted by the State Water Board, Central Valley Regional Water Board, and San Francisco Bay Regional Water Board (collectively Water Boards) in 2008. Development of the Delta RMP is expected to proceed in a phased approach. The first phase of the program development (pilot phase) will focus on three objectives: 1. Develop capabilities for regularly compiling, synthesizing, and reporting data from existing, ongoing monitoring efforts; 2. Build interest, involvement, and momentum by answering important questions that require a comprehensive, regional view; and 3. Use this effort as a proof of concept that sets the stage and creates capabilities and recommended approaches needed for an integrated, coordinated RMP that is capable of informing environmental management program and policy decisions. Phase II will have the purpose of defining the long-term structure and goals of the Delta RMP. We expect that the long-term program will strive for integration across different programs based on the results of the pilot phase.

Key Words - *regional monitoring; program development; Sacramento-San Joaquin Delta*

Theme: Contaminants

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Our Actions, Our Estuary
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POSTER ABSTRACTS: Contaminants

Assessment of Endocrine Disruption in Splittail (*Pogonichthys macrolepidotus*) in the Lower Sacramento-San Joaquin River Drainage

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In recent years, there has been increasing concern regarding the role of environmental contaminants in the decline of several fish species in the Sacramento/San Joaquin River Delta, California. To assess potential endocrine disruption in the Sacramento splittail (*Pogonichthys macrolepidotus*), a native fish of the Delta, we measured vitellogenin (Vtg) in blood and developed sample site contaminant profiles by deploying semi-permeable membrane devices (SPMD) and Polar Organic Chemical Integrative Samplers (POCIS). Sampling sites were located in Suisun Marsh. We found two male splittail out of 12 had extremely elevated levels of Vtg. Legacy organochlorines were detected at varying levels which included DDT, DDE and dieldrin at 67.2 ppb, 429 ppb and 390 ppb, respectively. In addition to the organochlorines, elevated levels of the organophosphate pesticide chlopyrifos and dioxathion at levels ranging from 745 to 71.5 ppb. Pyrethroids were also detected. Bifenthrin, cypermethrin and fenpropathrin were detected at levels between 12.7 to 1.45 ppb. Triazine herbicides such as atrazine, troton, prometon and simetryn were also observed varying between 74.0 to 27.2 ppb. Of greatest concern is data from the northern region of the Delta, an area heavily used by delta smelt for spawning, where samples contained chlopyrifos concentrations in excess of 100 ppb.

Key Words - *endocrine disruption, pesticides, splittail*

Theme: Contaminants

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Our Actions, Our Estuary
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POSTER ABSTRACTS: Contaminants

Evaluation of Estrogenic Activity and Chemical Contamination in Surface Waters of the Sacramento River Delta, CA USA

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Over the past 8 years, abundance indices of several pelagic fish species residing in the Sacramento-San Joaquin Delta of California, USA, have shown marked declines and record lows. In order to evaluate the contribution of endocrine alterations in resident fish, water samples were evaluated for estrogenic activity, using a rainbow trout liver hepatocyte assay for vitellogenin transcription and an in vivo Japanese medaka exposure assay for vitellogenin protein. In addition, a series of analytes were measured including estrogen steroids, alkylphenols and alkylphenol ethoxylates. None of the sites had in vitro estrogenic activity above the detection limit of 0.02 ng/L estradiol equivalents (EEQ). However, in vivo activity was observed in two sites (711, lower Sacramento River, and 405, Carquinez Strait near Benicia) ranging from 13-26 ng/L EEQ. Concentrations of 17 β -estradiol, estriol and estrone were below quantification limits (0.1 ng/L), but measurable alkylphenols and ethoxylates were observed at combined concentrations less than 1 μ g/L at site 711 (below known effects thresholds for both assays). Additional analytical evaluation of 31 pesticides and enantiomers at site 711 only indicated the occurrence of bifenthrin (~1 ng/L) and diuron (41-86 ng/L). These results indicate in vivo estrogenic activity, which was not associated with concentrations of steroid estrogens, but mixtures of alkylphenols, alkylphenol ethoxylates and pesticides as contributing agents cannot be ruled out.

Key Words - *endocrine disrupters, estrogens, hormones*

Theme: Contaminants

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Our Actions, Our Estuary
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POSTER ABSTRACTS: Contaminants

Growth performances and tissue burdens of juvenile green sturgeon (*Acipenser medirostris*) fed graded levels of methyl mercury chloride.

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San Francisco Bay Delta has a long history of mercury (Hg) contaminations. However, there are very limited studies on the toxic effects of Hg in its native fish, especially predatory species that bioaccumulate Hg through the food chains. Triplicate groups of juvenile green sturgeon (30 g ± 2) each were exposed to four levels of dietary methylmercury chloride (MeHg; 0, 20, 40, 80 mg Hg/kg diet) for 8 weeks to determine the effect on growth performances and tissue burdens of Hg in the sturgeon. Mortality, growth rate, feed efficiency, condition factor, hepato-somatic and gonado-somatic indices, body proximate composition, and Hg tissue (gill, heart, liver, kidney, gonad, white muscle) burden were determined. Significantly (P<0.05) increased mortality were observed in the highest dose group after week 6 and significantly decreased growth rate was observed in the highest dose group after week 2. Feed efficiency showed significant decreases in the highest dose group at or after week 2. Dietary Hg accumulated in a dose-dependent manner in all tissues; the highest Hg tissue concentrations were found in the kidney and the lowest in the gonad. In conclusion, dietary Hg at or above 40 mg Hg/kg significantly affected mortality, growth rate, and feed efficiency. Dietary Hg concentrations at or above 20 mg Hg/kg significantly elevated tissue Hg concentrations.

Key Words - *Mercury; sturgeon; growth performances*

Theme: Contaminants

Poster Board Number: 128. **Submission Number:** 234

Guadalupe River Watershed Model: Support tool for regional Hg and PCB management

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San Francisco Bay is listed as impaired for mercury (Hg) and PCBs, and the associated TMDLs call for improved regional loads estimates and greater than 50% load reductions from urbanized small tributaries in general and over 90% load reduction in the Guadalupe River watershed over the next 20 years. In order to address this call, managers need improved information on which BMPs may be effective and what magnitude of application will be needed to see measurable loads reductions at the watershed and regional scales. To inform the management questions, the Regional Monitoring Program for Water Quality in San Francisco Estuary funded a pilot study to develop a dynamic watershed model of the Guadalupe River Watershed. This watershed offers a unique opportunity to study legacy Hg from the largest-producing former Hg mine in North America as well as legacy PCBs from the manufacturing industries of the 1950s and 1960s. An abundance of local water, sediment, and contaminant data make the Guadalupe River Watershed an ideal study area.

The objective of the Guadalupe Watershed Model project is to understand the source, release, and transport of sediment and contaminants from a large mixed land-use, highly urbanized watershed. The first phase of the project was to develop the underlying hydrological model in the EPA's watershed modeling software suite BASINS/HSPF. A reasonably accurate model (within 20% of annual flow volumes) was developed despite challenges due to the high degree of watershed hydromodification including numerous reservoirs and percolation ponds. The second phase, currently underway, is to add sediment, Hg and PCBs into the model. The final model will serve to improve the accuracy of Hg and PCB load calculations, to investigate inter-annual load variability due to climate, and to allow scenario testing for optimizing management practices.

Key Words - *mercury; PCBs; watershed model; BMP*

Theme: Contaminants

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Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference
POSTER ABSTRACTS: Contaminants

Field Collection and Stabilization of Reactive Mercury in Natural Waters

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Reactive mercury [Hg(II)_R] is a term used to encompass a variety of inorganic mercury complexes. It is referred to as Hg(II)_R due to its high probability of either undergoing biotic methylation to create methylmercury or becoming bound to other substances such as particulates. Variability has been shown in Hg(II)_R in natural water samples, even within 24 hours of collection, limiting the ability of field personnel to transport samples to the lab without changes in Hg(II)_R concentrations. Hg(II)_R is an important mercury species to understand due to its relationship to methylmercury; however, to date there has been a lack of a robust, accurate, and precise method for measuring Hg(II)_R in aqueous samples.

The work presented here describes a new method developed for the field collection and stabilization of Hg(II)_R, thus avoiding any species shift that may occur after collection. In this method, the sample is chemically reduced and collected onto a gold trap in the field. The gold trap can then be sent to the laboratory for analysis. This field-sampling system is unique due to its utilization of the sample collection bottle as the purge vessel, greatly reducing the equipment needed in the field as well as potential routes of contamination. Additionally, this allows for anoxic samples to be collected and purged in the field without the use of a glove box, providing a simple method to prevent potential species shift caused by oxidation. By limiting the time from collection to volatilization, as well as creating a completely anoxic collection technique, the field-sampling system offers a simple way to get precise results for Hg(II)_R species in natural waters. Given the importance of Hg(II)_R in the study of mercury cycling in the environment and the difficulty of obtaining accurate *in situ* data, this field sampling technique offers a clear improvement in obtaining specific and definitive results.

Key Words - *reactive mercury, field collection, stabilization*

Theme: Contaminants

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POSTER ABSTRACTS: Contaminants

Trophic transfer of methylmercury in a simple food chain

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In previous laboratory experiments assessing the influence of naturally occurring dissolved organic matter (DOM) from the San Francisco Bay Delta on methylmercury (MeHg) bioavailability, we found that phytoplankton accumulation of MeHg was inversely proportional to the DOM concentration over a natural range of DOM concentrations. The goal of this experiment was to determine if the differences in MeHg concentrations in phytoplankton would be passed on to amphipods (*Hyaella azteca*) consuming those phytoplankton. We exposed the diatom *Cyclotella meneghiniana* to MeHg for 24 hours in water with (10 mg/L) or without organic matter from Mandeville Tip in the Delta. Radiolabeled cells were then resuspended into unlabeled fresh water (to minimize potential for amphipods to take up MeHg from the dissolved phase). Amphipods were fed radiolabeled cells for 35 minutes and then fed unlabeled algae during depuration. We followed the depuration of MeHg from the amphipods for 96 hours. Amphipods feeding on phytoplankton from the high DOM treatments initially accumulated less MeHg than amphipods feeding on phytoplankton from the no DOM treatment. However, assimilation efficiencies of ingested MeHg in the amphipods were around 65-70% for both treatments and MeHg retention in amphipods was unaffected by DOM. The results suggest that DOM decreases the amount of MeHg that can be accumulated in aquatic food chains by influencing the amount taken up from water by phytoplankton but not by influencing the trophic transfer process itself.

Key Words - *mercury; methylmercury; bioaccumulation; dissolved organic matter; phytoplankton; amphipods*

Theme: Contaminants

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POSTER ABSTRACTS: Contaminants

Transport and fate of ammonium supply from a major urban wastewater treatment facility in the Sacramento River, CA.

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Effluent from wastewater treatment plants (WWTP) represent a major source of anthropogenic nitrogen to coastal and estuarine waters. In the Sacramento River, ammonium (NH₄) loading from WWTP's has increased three-fold since the 1980's and represents 90% of the river's total NH₄ load. Despite the large WWTP influence on river nitrogen, little is known about how riverine phytoplankton may respond to nutrient enrichment or the potential consequences of elevated NH₄ downstream in the San Francisco Estuary and Delta. Recent studies in the northern San Francisco Estuary suggests that elevated NH₄ may contribute to the documented decline in estuarine primary production and phytoplankton standing stocks by limiting diatom growth. Working with the regional water quality control board, we evaluated the potential for perturbations in primary production as a result of wastewater discharge in the Sacramento River using data from long-term monitoring programs and focused experimental manipulations. Our goals were to characterize nutrients, primary production and phytoplankton standing stocks along a 75 km riverine transects near the sewage outfall and to assess the capacity of the Sacramento River phytoplankton to process NH₄, and reduce NH₄ loading to estuarine receiving waters. These results may be used to guide current wastewater permitting, test future loading scenarios, and provide the basis for assessing downstream impacts of changing wastewater practices.

Key Words - *Wastewater; NH₄; ammonium; phytoplankton; Sacramento River; Delta*

Theme: Contaminants

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