



**Exposure and Effects Pilot Study  
Science Advisory Panel Meeting  
San Francisco Estuary Institute  
Meeting Minutes  
July 26<sup>th</sup> 2006**

In attendance:

Terry Adelsbach, USFWS  
Sarah Cohen, RTC/San Francisco State University (SFSU)  
Jay Davis, SFEI  
Ben Greenfield, SFEI  
Letitia Grenier, SFEI  
Jen Hunt, SFEI  
Harry Ohlendorf, CH2M-Hill  
Daniel Schlenk, UC-Riverside  
Meg Sedlak, SFEI  
Robert Spies, AMS  
Richard Looker, SFRWQCB  
Bruce Thompson, SFEI  
Steve Weisberg, SCCWRP  
Don Weston, UC-Berkeley

By telephone:

Michael Fry, American Bird Conservancy  
Margy Gassel, OEHHA

**1.0 Introduction**

Meg Sedlak gave an overview of goals for the meeting and described the purpose of EEPS. The goals of the meeting were to provide an update of existing 2006 activities and to allocate the remainder of 2006 budget. Approximately \$40,000 had been set aside for an egg injection study using PBDEs. This study was not feasible at the time so the funding needed to be re-allocated. Ms. Sedlak distributed the most recent budget for EEPS.

**2.0 Update on Small Fish Project and Discussion of 2006 Plan**

Ben Greenfield presented the results of the 2005 small fish sampling effort. Copies of the first year report (*“Mercury in Biosentinel Fish in San Francisco Bay: First Year Project Report.”*) are available by contacting Mr. Greenfield ([Ben@sfei.org](mailto:Ben@sfei.org)).

Benthic and pelagic small fish were collected from seven sites of the eight sites proposed for sampling; no fish were collected from the Napa River site. Extant marsh sites including China Camp, Newark Slough, and Benicia State Park were compared with sites where wetland restoration is proposed (Bird Island, Eden Landing, Alviso Slough, and Oakland Middle Harbor). In addition, five sites in the open water portion of the Bay were sampled by the IEP and Bay gobies provided to the RMP for analyses. At each site, five to ten fish in a size range of 40 to 80 mm were composited and sent for mercury analysis.

A significant difference was observed among species. Mississippi silversides (pelagic) that inhabit the shallow portions of the wetlands had higher concentrations than Bay gobies (benthic) that inhabit the open water portion of the Bay. In addition, variation within species based on location was also identified. For example, Mississippi silversides from the South Bay had higher concentrations than from the North Bay. Darell Slotton of UC-Davis has collected and analyzed Mississippi silversides from the Central Valley as part of the CALFED-funded Fish Mercury Project. This data, which are presented in the 2006 Pulse of the Estuary, show that the EEPS samples collected in the South Bay are some of the highest samples observed. Harry Ohlendorf asked why there might be variation in species; Ben indicated that the fish diets vary depending on location and size.

Ben noted that of the 97 composite samples, approximately 40 percent had concentrations higher than the proposed Hg TMDL standard of 0.03 ug/g (wet weight). Terry Adelsbach commented that although the Hg TMDL standard is applicable to fish less than 50 mm, terns frequently consume fish larger than this size. Mr. Greenfield stated that at some locations all fish (e.g., Alviso Slough) exceeded the threshold level of 0.03.

Bob Spies asked how the impact of wetland restoration would be evaluated; Ben indicated that one of the purposes of the study was to establish a baseline for comparisons after the restorations are initiated. Steve Weisberg commented that the study allowed the RMP to develop a spatial pattern of Hg concentrations; to compare to a threshold; and to examine variation among differing species and habitats.

Don Weston suggested that there should be more samples at the restoration sites; Richard Looker commented that it was not the expectation of the Regional Water Quality Control Board that the RMP conduct all of the wetland monitoring.

Terry Adelsbach suggested that Ben consider conducting stable isotope surveys to determine what the fish were eating.

**Action item: Ben Greenfield to evaluate whether stable isotopes would be useful.**

### **3.0 Update on USFWS Avian Studies**

Terry Adelsbach gave an update on the USFWS studies of mercury in terns in San Francisco Bay. The objectives of the study are to:

- Determine the dietary mercury exposure and bioaccumulation in three avian guilds;
- Determine the effects of mercury on birds and reproduction in birds; and
- Conduct egg-injection studies. This work is being conducted by Gary Heinz at the USGS Patuxent Wildlife Research Center.

Mercury concentrations in birds varies by guilds with some of the highest concentrations observed in terns and rails. This project is examining mercury concentrations in diving benthivores which eat benthic organisms and bivalves (surf scoters), littoral foragers which eat insects and crustaceans (avocets and stilts), and obligate piscivores which eat fish (Forster's and Caspian terns).

The study examines exposure through the reproductive cycle: prebreeding exposure in adults is determined through diet and blood and radiotelemetry; eggs are monitored for nest success and concurrently egg injection studies are being conducted in the lab; chicks are monitored for growth rate, survival, diet and ability to fledge.

Harry Ohlendorf indicated that there have been studies near the Chevron Refinery and in Hayward Marsh in 1994 looking at avocets and stilts.

With the telemetry information, USFWS was able to generate maps of habitat usage in select locations such as Alviso Slough and Moffett Field. USFWS was able to couple this information with mercury data from blood, livers, and feathers. Stable isotopes were also used to determine where the birds were foraging.

Terry Adelsbach presented preliminary results which suggest that for avocets and terns the highest concentrations in liver were observed in the South Bay. The terns had the highest concentrations some of which exceeded the LOAEL threshold; in contrast the avocets which feed in open water did not have concentrations that exceeded the LOAEL.

Differences in mercury concentrations were noted between the pre and post breeding females suggesting that much of the mercury load is depurated to the eggs. The data to date suggests that Forster's tern is at great risk; however, there is predation of the nest. Avocets also show predation from gulls.

The EEPS has funded a portion of the study focusing on nest and hatching success. Tern hatchability may be impacted by mercury – fail-to-hatch eggs had higher concentrations than randomly collected ones. This pattern was most distinct for Forster's terns. Forster's terns are probably at greatest risk of mercury and organochlorine toxicity due to their habitat use and home range. When co-located with Caspian terns, Forster's have higher concentrations.

#### **4.0 Update on Fish Effects Work**

Dr. Bob Spies of AMS received funding in March 2005 for a two-year study (\$50,000 per year) to examine contaminant effects on shiner surfperch. In addition, in late 2005, an

additional \$10,000 was awarded to Dr. Spies to develop a laboratory culture. Dr. Spies gave a status update on the project.

#### Summary of Research Project

The objective of the two-year study is to determine if shiner surfperch (*Cymatogaster aggregata*; Embiotocidae) show effects of contamination on some aspect of their fitness, growth or reproduction. In the second year, available information and data will be synthesized to develop the framework for understanding the relative contribution of contamination in the well-documented decline of the population in the San Francisco Estuary.

#### Project status to date:

Dr. Spies highlighted the progress that has been made to date:

- Collected 20 adults from Oakland Middle Harbor,
- Collected 26 fish from State Park Beach at Candlestick Park, South San Francisco, and
- Collected 20 fish from a new reference site in Tomales Bay.

All fish were measured, weighed, dissected, sexed, young counted, and tissues stored. The first two sites were considered to be contaminated sites; the Tomales Bay site is a new reference site.

In addition, 56 shiners were caught from Big River and used to establish a laboratory culture at Bodega Bay.

- Estradiol injection experiment performed.
- Chorionenin assays completed at Bodega Marine Laboratory on estradiol injected fish.
- Histopathological analyses completed on 2005 fish at Duke University.
- EROD assays on 2006 fish completed.
- Genetic analyses completed on 2005 fish at Tiburon Center.

#### Observations to date:

- All of the fish caught in SF and Tomales Bay were sexually mature. Smaller fish >8 g from Big River in 2005 were generally not sexually mature.
- All female fish from SF Bay were pregnant except 5 (17%) large females from Candlestick (2005-2006).
- Sex ratio (M:F) (2005-2006) more skewed in SF Bay towards females. Oakland Middle Harbor: 1:10.5; Candlestick Park 1:2.02; Tomales bay 1:1.08 Big River: 1:1.16
- Heart's Desire Beach, Tomales Bay appears to be a better control than Big River.
- Big River fish are exposed to p4501A inducers (2005 finding).

Dr. Spies noted that there were significantly more females than males in the Oakland and Candlestick locations relative to the reference sites: Tomales and Big River. The condition factor suggested that Tomales Bay fish were much healthier than other sites.

Gonadal Somatic Index showed the highest values for the Tomales Bay site. Higher EROD activity was observed at the Candlestick site; levels of EROD were comparable for Tomales Bay and Oakland. Overall the EROD levels were quite low <10 in comparison to 2005 where males were over 100.

Results of the histopathology analyses did not show much effect of contaminants; few lesions were observed.

Results of the choriogenin analyses suggested that choriogenin was not a suitable marker as the antibodies were highly cross-reactive in the livers of all fish.

Sarah Cohen then gave a brief presentation on a population genetics survey that she had conducted with shiner surf perch.

Bob Spies then wrapped up the presentation by stating that for 2006, he anticipated conducting the following activities:

- Histology of the gonads;
- Chemical analyses of the carcasses;
- Examination of testosterone and estradiol ratios in plasma as an alternative to choriogenin;
- Otolith work to age fish
- Analysis of EROD data

## **5.0 Update on Benthos**

Approximately \$40,000 per year for the next three years has been allocated to benthos studies. As background, Bruce Thompson mentioned that the Sediment Quality Objectives are scheduled to be promulgated in 2008 and that the EEPS benthos project would be used to validate thresholds for effects and to better understand contaminant gradients in the Bay. Dr. Thompson stated that the causes of sediment toxicity and benthic impacts have not yet been identified in most Bay locations. Therefore, a second objective of this study is to identify contaminants or mixtures that are causing toxicity. Dr. Thompson proposed examining a contaminant gradient in the Bay to determine impacts to benthos.

## **6.0 Discussion of Allocation of Remaining 2006 Funds (\$40,000)**

Meg Sedlak explained that approximately \$40,000 had been set aside for conducting a PBDE egg-injection study. At this time, it is not feasible to conduct this study. Several

proposals were solicited including (copies of the proposals were included in the agenda package):

- A study by USFWS to examine organics in tern livers to paired values for reproductive success and cytochrome P450. This study would be part of a larger study being conducted by USFWS. At present, the agency does not have funds for the organic analysis; EEPS could provide this funding.
- A study by NOAA fisheries to examine bioindicators in salmonids exposed to urban runoff. Urban estuaries frequently have elevated concentrations of contaminants such as copper, polyaromatic hydrocarbons, and pesticides. As a result very high mortality rates of prespawning females have been observed. The goals of this study would be to evaluate the impact of urban storm water on developing coho salmon; to characterize the effects of these contaminants on embryos; and to develop biomarkers.
- A study by Pacific Ecorisk to develop an EDC assay for San Francisco Bay fish and invertebrates.
- A study by Cal State University – Long Beach to apply EDC assays used in the Southern California Bight to the San Francisco Bay. The goal of this study is to understand the degree to which endocrine disruption is occurring in native species in the Bay by looking at stress hormones, growth, and reproduction. In addition, contaminant concentrations in liver will be correlated to EDC impacts.

#### **7.0 Summary of Panel Members Closed-Door Meeting:**

The panel members met amongst themselves to discuss the projects. After this meeting, Steve Weisberg summarized the findings of the internal meeting. Overall, the panel was concerned about process and requested that:

- All proposals be submitted using the same format;
- All documents be received prior to the meeting to allow for adequate review;
- Presenters submit written proposals (e.g., avoid large conference calls with multiple presenters on the line);
- Additional time be allocated for deliberations; and lastly
- SFEI staff consider making recommendations.

#### Benthos

The Panel would like to see the benthos work move forward; however, there were several concerns about the proposal that was submitted. There was little connection in the proposal to the workshop that was hosted by SFEI in the Spring. Also the proposal did not consider the variation of salinity within the Estuary and the impacts that this would have on the benthic community.

Meg Sedlak suggested that Bruce Thompson speak directly with Steve Weisberg to address his concerns. Steve Weisberg indicated that it was not necessary for Bruce to revise his proposal.

Allocation of 2006 \$40,000

The panel indicated that both the tern project and the fish EDC project had ranked highly with a slight preference by the panel for the EDC project proposed by Cal State – Long Beach.

The panel indicated that there was insufficient time to discuss the 2007 program elements and that this would need to be deferred to the next meeting.

**8.0 Wrap-up and Adjournment**

Meg Sedlak thanked the panel for their constructive comments and the meeting ended at 3:00.