

RMP Exposure and Effects Workgroup Meeting
November 26th, 2007
DRAFT Meeting Minutes

In Attendance:

Josh Ackerman (USGS)
Collin Eagles-Smith (USGS)
Laura Hoberecht (NMFS)
Mike Kellogg (SFPUC)
Harry Ohlendorf (CH2M Hill)
Dan Schlenk (UC Riverside)
Karen Taberski (SFB RWQCB)
Steve Weisberg (SCCWRP)
Don Weston (UC Berkeley)

Mike Connor (SFEI)
Jay Davis (SFEI)
Ben Greenfield (SFEI)
Letitia Grenier (SFEI)
Aroon Melwani (SFEI)
Meg Sedlak (SFEI)
Bruce Thompson (SFEI)

Via telephone:

Brian Anderson (UC Davis)
Michael Fry (American Bird Conservancy)

A. Introductions and Review of Agenda

Meg Sedlak began the meeting with introductions and then outlined the goals of the day: finalizing the Five-year Plan for benthos and bird monitoring and discussion of the food web accumulation element using small fish.

B. Revised Five-year Plan for Benthic Effects Work in the RMP

Jay Davis gave an overview of the revised benthic element and outlined the specific questions that the benthic element will address in the next five years:

1. What are the spatial and temporal patterns of impacts of sediment contamination on benthic biota?
2. Which pollutants are responsible for observed impacts on benthic biota?
3. Are the toxicity tests, benthic community assessment approaches, and the overall SQO assessment framework we are using reliable indicators of impacts on benthic biota? We need to build confidence that the indicators we are using are accurately reflecting the condition of the Bay.

Harry Ohlendorf said that he supported the questions and the strategy for addressing these questions. Karen Taberski said that “pollutants” should be modified to say “pollutants and stressors”. Steve Weisberg agreed that the questions were well articulated and addressed Bay concerns.

1. Spatial and temporal patterns of benthic impacts

Within the Five-year Plan, there is a proposed budget for benthic work (see Table 4 of the plan). Much of this work will occur under the existing Status and Trends program. Under the assessment of spatial and temporal patterns of benthic impacts, Mike Kellogg said \$50,000 set aside for benthic characterization may not be sufficient. Steve Weisberg said that the costs seem high based on his experience in Southern California. Mike Kellogg said that based on SFPUC’s

work in the Bay it can be difficult to characterize benthos. Steve Weisberg offered to share information on typical costs for benthos.

Both Mike Kellogg and Steve Weisberg suggested that more than one lab should be involved in the characterization of benthos. They suggested that periodically the labs should convene workshops to share information. This could be especially valuable when new species are found. Steve Weisberg said a consortium of benthic labs in Southern California (SCAM-IT) meets periodically.

2. Causes of benthic impact and causes of toxicity

The group thought that it made sense to wait until after the current study of sediment toxicity is completed before beginning another study examining the causes of toxicity. This element will be deferred to 2009. Planning will begin in 2008 as the results of the study are reviewed.

3. Understanding and improving benthic assessment tools

One of the goals of the benthic element will be to improve and validate benthic assessment tools. It was noted that pyrethroids have been particularly toxic to benthos and should be included in the sediment chemistry. Michael Fry suggested including Dimilin, which is used for mosquito control, particularly on the east coast. It is a juvenile hormone analogue and is devastating to arthropods and fairly persistent.

Steve Weisberg said that the workplan is vague on understanding and improving assessment tools. Bruce Thompson agreed and said he is working on refining the details. The group agreed that it was important to convene several workshops to achieve consensus on the methodologies used in the Bay Area. Steve indicated that it was important to get all of the experts to agree on the data.

Steve Weisberg said that the objectives for benthos are different than for fish. Jay Davis said that it was somewhat subjective. This needs to be clarified for the reader.

C. Update on USGS/US FWS Avian Studies

Josh Ackerman presented an update on the USGS mercury monitoring in Forster's terns. Water birds are sensitive to methyl mercury. Effects include impacts to the reproductive success of the birds. Many Forster's terns have blood mercury concentrations above LOAEL and the concentrations are observed to increase once they arrive in the Bay. (The birds typically arrive in January/February and breed in May. Fifty-eight percent of Forster's terns have blood mercury concentrations in the high and extra high risk categories.

There is a need to develop a better understanding of toxicity and sensitivity in San Francisco Bay birds. Current toxic categories are based on work using mallards and loons. Josh Ackerman indicated that the sensitivities vary widely across different species.

Karen Taberski asked why concentrations of mercury are so much higher in Forster's terns compared with other Bay birds. Josh Ackerman said that Forster's terns tend to feed in marginal tidal flats while Caspian terns feed in the pelagic zone.

The goal of this work is to develop a toxic threshold for mercury in eggs that accounts for egg abandonment, egg hatchability, ability to fledge, and chick mortality. The USGS group will 1) determine toxic thresholds in eggs by comparing mercury concentrations in randomly collected eggs to concentrations in failed-to-hatch and abandoned eggs, 2) examine effects of mercury on chick mortality by comparing mercury concentrations in down feathers of alive and dead chicks and, 3) link mercury concentrations in eggs to those of down feathers in just-hatched chicks.

Using randomly collected surrogate eggs as representative of the whole nest is problematic because there is a wide range of variability in concentrations within clutches. They have developed a technique for micro-sampling individual eggs. This enables them to relate the mercury concentrations of an individual egg to the fate of that egg.

To date they have found that mercury concentrations are higher in failed-to-hatch eggs than in randomly collected eggs, chick mortality is higher at sites with high mercury concentrations, and chick mercury concentrations are highly correlated with whole egg mercury concentrations, which allows conversion of chick mercury concentrations into egg mercury concentrations.

Future research will focus on refining egg hatchability thresholds using egg micro-sampling technique and larger sample sizes, establishing chick toxicity thresholds for mortality and growth rates, investigating mercury interactions with other contaminants such as selenium, and identifying mercury hot-spots around the Bay.

Don Weston asked if they had tried to link small fish mercury concentrations to tern concentrations. Josh Ackerman said that they had tried to link prey fish to adult birds and that it was unsuccessful. To be successful they would need to identify what specific fish each individual bird was eating and the birds' home ranges. In larger spatial scales, such as north vs south Bay, they can make a connection between fish and birds.

Dan Schlenk asked how large the feeding range of a Forster's tern can be. Josh indicated that over a six to eight week period a tern might feed over 60 hectares. Letitia Grenier asked how tightly linked the bird colony is to the food web. Josh Ackerman said that site is by far the most dominant factor and that they observe very high site fidelity. Letitia asked what the different indicators such as terns and small fish telling us about food web dynamics? Harry Ohlendorf said that different indicators tell us different things at different scales.

Karen Taberski asked why avocets and stilts, which over winter in the Bay, have lower concentrations of mercury than Forster's terns. Josh Ackerman said that stilts and avocets forage in the same areas. Harry Ohlendorf noted that in the Hayward Marsh stilts had much higher mercury concentrations than avocets.

Ben Greenfield asked if they had found a connection between sediment mercury concentrations and concentrations in birds. Josh Ackerman said that they are working with Mark Marvin-DiPasquale at USGS-Menlo Park to address this question. Letitia Grenier asked whether they had found reference sites for their studies. Josh said yes, but that predation can drastically affect the results.

Dan Schlenk asked if they knew what hatching success rate was necessary to maintain the populations. Josh Ackerman said they did not.

Michael Fry asked how many individuals were necessary to have a reliable indicator of nest success and hatchability. Josh Ackerman said 75 individual nests and 150 chicks for survival rates. Michael Fry asked if it takes a large number of eggs come up to confidence intervals.

Steve Weisberg commented that there were very clear effects and dose-response thresholds. Josh Ackerman indicated that it was important to identify the toxic threshold for species of concern for the Bay.

D. Five-year Plan for Bird Work

Jay Davis presented the draft Five-year Plan for birds. He noted that San Francisco Bay is important to migratory and resident birds.

There are several pollutants of concern in the Bay. Concentrations of mercury appear to be high enough to affect bird populations and are considered an important factor for the California clapper rail (an endangered bird) at the population level. PCB concentrations are elevated, but it is not known if they are impacting bird populations. PBDE concentrations in Forster's tern eggs from Hayward shoreline are the highest ever observed in bird eggs. It is not known if they are impacting bird populations.

There are several applicable regulatory guidelines:

- Bioaccumulative substances – “shall not cause a detrimental increase in toxic substances found in bottom sediments or aquatic life”
- Toxic substances – “no toxic or other deleterious substances in ... quantities which will cause deleterious effects on aquatic biota, wildlife, or waterfowl...”
- Egg “monitoring target” in mercury TMDL (0.5 ppm)
- Wildlife prey target in mercury TMDL (0.03 ppm).

The specific questions to be addressed in the next five years are:

1. Is there clear evidence of pollutant effects on survival, reproduction, or growth of individual birds?
2. Are pollutants in the Bay adversely affecting bird populations?
3. Do spatial patterns in accumulation indicate particular regions of concern?

Letitia Grenier asked what an okay population level would be, in reference to question 2. Karen Taberski asked what the threshold for impairment is and if it is okay to just focus on an individual, in reference to question 2.

A population may be declining, but supported by migration. If this is not important it may not be valuable to pursue as it could be expensive.

Harry Ohlendorf suggested that it may be possible to model population dynamics and the effects of contaminants on the population.

Karen Taberski said that objective 2 is not necessarily needed, but it is desirable. Mike Kellogg agreed that it is desirable.

Harry Ohlendorf said that a study in the Great Salt Lake looked at effects on recruitment. Most loss is due to predation, habitat change, flooding etc. Pollutant effects on population would have to be quite severe before effects were observed.

Letitia Grenier said that Steve Schwarzebach thinks that the populations should have rebounded based on the hatchling success.

Steve Weisberg asked how thresholds are developed. Karen Taberski said that it would be related to bird mortality. There is not currently a threshold as part of the TMDL, but the RWQCB anticipates that there will be one in the future. Eggs will be the target. Because the current thresholds are based on mallards there is low confidence and a need to develop a threshold based on sediment. It is hard to link to sediment.

Jay Davis outlined the budget for the various EEWG-related projects including elements from Status and Trends and Pilot and Special Studies.

Tern and Cormorant eggs will be discussed at the next EEWG meeting in more depth. They would provide spatial data. Steve Weisberg said he was okay with the bird elements of the Five-year Plan.

Steve Weisberg asked what data would be needed to show that birds are affected.

Harry Ohlendorf suggested it may be possible to define a threshold using the already collected data.

The priorities for effects studies in 2009 and beyond are eggs, chicks, and parental behavior. Karen Taberski said that she would like developing an endpoint to be a specific task.

Josh Ackerman and Jay Davis both said that developing thresholds are the highest priorities. This includes determining which threshold (chick mortality, hatchability, etc.) has the largest effect.

Josh Ackerman suggested that the priorities be 1) egg hatchability, 2) mortality and growth rates, and 3) parent behavior. He said that it is possible that we might miss the right threshold. Letitia Grenier said that conventional wisdom holds that the right threshold is the embryonic system. Dan Schlenk said that the central nervous system is the last thing that develops.

E. Update on Small Fish Work

Ben Greenfield presented the proposed plan for Small Fish sampling in 2008 and an update on the 2005–6 results. The goal of this project is to characterize spatial and temporal variation of mercury using small fish as biosentinels. Ben Greenfield noted that mercury is a key management priority.

The specific questions that the Small Fish study aims to address are:

1. Where is mercury entering the Bay food web?
2. What habitats, conditions, or factors help to identify hotspots of food web accumulation in Bay margins?
3. Are there interannual trends in MeHg bioaccumulation resulting from wetland and margin restoration activities?
4. What are the best biomonitoring tools for characterizing hotspots of MeHg bioaccumulation?

In 2008 the sampling approach will be continuing annual monitoring at 10 trend stations that have been sampled since 2005, spatial survey of approximately 40 stations, and comparison of biosentinel tools (fish vs. bivalves vs. sediment vs. diffusive gradient thinfilm devices) at a subset of the stations. Half of the trend stations are sites with on-going restoration activity and half are reference sites with no restoration. The spatial sites would target factors that may be related to mercury concentrations and bioavailability including land use, land cover, mercury sources, spatial location in Bay, subtidal hydrology and bathymetry, and sediment physical and chemical parameters.

Ben Greenfield presented the preliminary results from 2005–6 for Mississippi silversides and topsmelt, for which there is the most complete spatial coverage. Concentrations of mercury were significantly elevated in Mississippi silversides from southern stations in 2005 and from Point Isabel, which was not sampled in 2005, in 2006. Mercury concentrations in topsmelt were elevated at southern stations in 2005 and significantly elevated at southern stations, Point Isabel, and Tiburon in 2006. Ben Greenfield noted that RMP sediment methyl mercury concentrations are elevated at southern stations and Tiburon. He suggested that there may be a link between small fish and sediment concentrations.

In summary, Ben Greenfield noted that spatial variation has been detected using small fish (South Bay, Tiburon, and Point Isabel appear elevated), topsmelt and Mississippi silversides are detecting different signals, and that the biosentinels are sensitive to change.

Ben Greenfield asked for feedback from the workgroup on several parts of the 2008 sample design:

- sampling Bay margins vs. salt ponds and wetlands,
- using a probabilistic vs. gradient and sources sampling design, and
- collecting additional parameters.

Thus far, the Small Fish project has focused on sampling Bay margins. There has been limited sampling of wetlands and salt ponds, which are areas of avian wildlife risk, have greater variability of methyl mercury concentrations, and may provide clues as to sources. Letitia Grenier is interested in coordinating the South Baylands Mercury Project (SBMP) and Small Fish. Ben Greenfield asked for feedback as to how much effort to allocate to sampling wetlands and salt ponds.

Karen Taberski said that characterizing spatial variation is the most important. She is potentially interested in ponds and marshes, but does not want to duplicate on-going work, such as SBMP.

Ben Greenfield asked for feedback on a probabilistic or gradient sample design. He said that using a gradient and sources design would allow the study to select specific attributes expected to be important for mercury exposure and for explicit hypothesis testing. A probabilistic design would use the EPA Generalized Random Tessellation Stratified (GRTS) or some other spatially-balanced survey design. The Bay margin samples would be chosen along a line of the Bay shoreline and a probabilistic design would ensure selection of representative conditions.

Ben Greenfield proposed collecting several different parameters at the sites where small fish are collected. He asked for feedback from the workgroup on which parameters to include. The proposed parameters were redox, total organic carbon, grain size, and methyl mercury in sediment; TSS, nutrients, and chlorophyll in water; more detailed bathymetric profile and water retention time data; and methyl mercury using Diffusive Gradient Thinfilm devices. The goal of including these parameters would be a better understanding mechanisms for spatial variation in bioavailable mercury, but the trade off is reduced number of stations. Ben Greenfield suggested that the science advisory panel consider collecting ancillary parameters for subset of 20 – 30 stations.

F. Update on South Bay Salt Pond Work

Letitia Grenier presented an update on the South Baylands Mercury Project (SBMP). The SBMP uses year-round resident species as biosentinels. They have high site fidelity to a small home range, which along with year-round residence, makes them valuable for monitoring mercury at the habitat scale. Mercury cycling varies at the scale of habitats, which are an important spatial scale for biological organization. Managers and restoration designers can act on the scale of habitats.

The biosentinels (long-jawed mudsuckers, three-spine stickleback, brine flies, and Song Sparrows) are sampled in ponds and adjacent sloughs to compare pre-restoration salt ponds to tidal marsh and pre-restoration to post-restoration.

In 2007 three salt ponds (A5, A7, and A8), adjacent sloughs, and reference marshes for the birds were sampled. Pond A8 is a seasonal pond with high dissolved organic carbon and organic matter and is a sulfide sweet spot. Ponds A5 and A7 are seasonal ponds. The preliminary results show that demersal fish have higher mercury in pond A8 than in Alviso Slough, pelagic fish have similar or higher mercury in ponds A5 and A7 relative to Alviso Slough, brine flies have higher mercury in pond A8 than Alviso Slough, Song Sparrow mercury is lower in Alviso Slough compared to reference marshes, and site is a significant source of variation for mercury in song sparrows, marsh wrens, and common yellowthroat.

Josh Ackerman asked if the birds are feeding in the marsh or if they are getting supplemental food from other sources. He asked if the Alviso birds were hopping the levee and feeding on things outside of the slough.

The biota results to date show that Pond A8 > Alviso Slough ~ A7 > A5 and that Alviso Slough marshes are not higher than other marshes south of Dumbarton Bridge.

The conceptual model of the system is that areas that are always wet, low elevation, inorganic sediment, and low root volume have lower methyl mercury than areas that experience wetting and drying cycles, high elevation, peat sediment, and high root volume. This means that perennial ponds tend to be lower in methyl mercury than seasonal ponds with high dissolved organic carbon and organic matter and that high elevation, saline, peat, (old?) marshes tend to be higher in methyl mercury than low elevation (subsided), freshwater, inorganic, (new?) marshes.

Letitia Grenier said that during bird sampling they noticed that 7% of the sparrows had bill deformities. She said the actual occurrence is probably higher, but that birds with bill deformities tend to have low survival. Bill deformities are linked to dioxin-like PCB exposure in the literature. The deformities were observed at Alviso Slough, Coyote Creek, and Carl's Marsh.

G. Next Meeting

The next meeting will be May 12th, 2008.