

RMP Exposure and Effects Workgroup Meeting

November 13th, 2008

DRAFT Meeting Minutes

In Attendance:

Josh Ackerman (USGS)	Jay Davis (SF EI)
Collin Eagles-Smith (USGS)	Letitia Grenier (SF EI)
Arleen Feng (ACCWP/BASMAA)	Katie Harrold (SF EI)
Michael Fry (American Bird Conservancy)	Sarah Lowe (SF EI)
Laura Hoberecht (NMFS)	Meg Sedlak (SF EI)
John Incardona (NOAA)	Bruce Thompson (SF EI)
Kevin Kelley (CSU Long Beach)	
Michael Kellogg (SFPUC)	
Harry Ohlendorf (CH2M Hill)	
Dan Schlenk (UC Riverside)	
Karen Taberski (SFB RWQCB)	
Steve Weisberg (SCCWRP)	
Don Weston (UC Berkeley)	

A. Introductions and Review of Agenda

Meg Sedlak began the meeting with introductions and a review of the agenda.

B. Status of the Five-Year Plan and EEPS Summary Report

Meg indicated that these items will be presented and discussed at the next EEWG meeting. They are slated to be finished in the first quarter of 2009. The Five-Year Plan is lacking an introduction and bird egg monitoring section.

ACTION ITEMS:

- Complete draft Exposure and Effects Five-Year Plan to be completed and distributed to the Workgroup prior to the next meeting.
- Draft EEPS Summary Report to be completed and distributed to the Workgroup prior to the next meeting.

C. 2007/8 Update and Plans for 2009: Causes of Sediment Toxicity

Sarah Lowe presented the current status of work on the Causes of Sediment Toxicity project and plans for 2009. The goals of this work are to determine 1) the spatial and temporal patterns of impacts of sediment contamination on benthic biota, 2) which pollutants are responsible for observed impacts on benthic biota, and 3) if the toxicity tests, benthic community assessment approaches, and the overall SQO assessment framework being used are reliable indicators of impacts on benthic biota.

The goal of the 2007-8 amphipod TIE study was to verify and improve newly-developed sediment TIE methods for the estuarine amphipod *Eobausorius estuarius*. The study screened the toxicity of sediment at 13 sites in an effort to identify two sites with high toxicity, but only one, Mission Creek, had less than 50% survival. Three additional sites: Islais Creek, Dumbarton Bridge, and Airport, had 60 – 70% survival indicating moderate toxicity.

The toxicity of whole sediment samples was analyzed in pure sediment samples as well as diluted sediment samples and sediment samples mixed with additives intended to reduce toxicity due to either metals or organics. The additives amberlite and PCC (powdered coconut charcoal) remove organics and SIR-300 removes metals. Samples of Mission Creek sediment mixed with amberlite and PCC both showed decreased toxicity compared to unaltered Mission Creek sediment, dilute Mission Creek sediment, and Mission Creek sediment mixed with SIR-300.

Tests of the toxicity of interstitial water samples found that one treatment to remove ammonia (zeolite) did decrease the toxicity somewhat, but that a different treatment to remove ammonia (air-stripping) did not reduce toxicity. Treatment with HLB-PCS columns did not remove organics. It is possible that the toxic organic compounds are bound to DOC and therefore could not be removed by the columns. Michael Fry asked if HLB-PCS columns are known to be able to remove chlordane. Sarah said that she did not know, but that future goals of the project include evaluating other columns and discussing possible options with chemists.

For 2009 – 10 Sarah presented three proposed ideas: 1) develop more LC₅₀ data for Bay species, 2) continue work on the amphipod TIE methods, and 3) develop a strategy to further address the causes of toxicity in moderately toxic sediments through a workgroup process.

Meg and Jay clarified that the funding for Causes of Sediment Toxicity for 2009 has already been approved. The purpose of this presentation and discussion was to get input on possible directions and what areas to emphasize.

Steve Weisberg said that he thought the work was very important because the sites that fail the Sediment Quality Objectives (SQO) in San Francisco Estuary tend to fail because of sediment toxicity and also tend to be due to low-level toxicity, which is especially difficult to deal with.

Sarah noted that this is why the third proposal for 2009 is a workgroup to address the moderate toxicity. Jay noted that the specific ideas (e.g., micro array) listed under the third idea had not yet been selected and were intended to be representative of the possible kinds of ideas being considered.

Sarah noted that there are minimal LC_{50s} for native Bay species which makes interpretation of chemical concentrations difficult.

Bruce Thompson added that it is unclear what 50/50 survival/death means for a population and that there is a need to develop an understanding of the process and mechanism.

Steve suggested setting aside money to address the issue of low toxicity in the future.

Dan Shlenk said that EPA is pursuing an *in silico* mode of action computer based model for both human health and eco-risk.

Don Weston asked how the proposals had changed since being presented to the EEWG Toxicity Subgroup and noted that several major issues with the proposals had been raised at the meeting. He added that he supported moving forward with the first and third ideas (development of LC_{50s} and strategy for moderate toxicity), but could not support the second (continuing work on the TIEs) until the concerns had been addressed. Meg noted that the purpose of this agenda item is to discuss

possible ideas and get feedback from the group. She added that a proposal for the second idea would be resubmitted to the Toxicity Subgroup.

Arleen Feng raised an issue from the last SC meeting regarding concerns about EEWG continuing to have a dedicated set-aside fund, which the other workgroups do not have. She also added that it is important to keep in mind the concerns and needs of RMP participants and that it is valuable to be able to compare the value of proposals from various workgroups.

Don noted that he is in favor of continuing TIE work in principle, but not the specifics proposed thus far. Jay and Sarah indicated that any proposals will go back to the Toxicity Subgroup for approval.

Jay said that the goal of the discussion was not to get feedback on funding. Arleen noted that the economy is tighter and that based on her reading of the SC minutes it appears that some SC members presented reservations about existing allocations. Meg indicated that issues of policy and budget are the purview of the TRC and SC.

Jay reiterated that the proposals will be more scoped out and re-presented to the Toxicity Subgroup.

Sarah noted that the workgroup had invested significant time and effort in the Five-Year Plan for Benthos and that the proposed ideas were drawn directly from the goals in the Five-Year Plan.

Karen Taberski elaborated on Arleen's previous comment. She noted that the EEWG only approves projects under the purview of the WG. When originally formed the EEWG was a pilot study with a specific pot of money set aside. There is dwindling support for continuing to have a dedicated amount of funding for the Workgroup. The other workgroups do not have dedicated funds for each, but rather all pull from the same pool. There are new permits and TMDLs and therefore permittees are interested in the RMP addressing these new needs with studies.

Jay suggested that the feedback so far indicated the greatest emphasis on idea 1 with less on 2 or 3. Karen said she expected 1 to be fairly inexpensive. Don said that 1 could be as large as the group is interested in making it since new compounds could always be added. Bruce Thompson suggested that choosing which idea to emphasize wait until after the full proposals have been presented.

Arleen said that she agreed with Don.

Mike Kellogg said that he felt all the ideas were important. He agreed that TIEs are an important tool and supported it so long as it goes back to the Toxicity Subgroup. He also agreed that developing LC_{50s} for Bay species is important.

Michael noted that the LC_{50s} will help when evaluating sediment chemistry and that TIEs are the bridge between sediment chemistry and organisms.

Arleen said that LC_{50s} are important for having a baseline understanding for the concentrations and toxicity observed.

Karen added that there is a dearth of information on *E. estuarius* and that without thresholds it is extremely difficult to interpret the available data.

Harry Ohlendorf asked if a list of priority compounds for LC₅₀ testing had been drafted. Sarah said that there was not yet a list, but that in developing the list they would look at what compounds have already been evaluated in the literature, what compounds are detected in the Bay, and what compounds were found in the Mission Creek TIE sediments. She added that the list will be developed and distributed to the group for feedback. She noted that LC_{50s} for several compounds were already developed as part of PRISM and previous RMP work. Chlordane will be on the list. Don also suggested fluoranthene, copper, and bifenthrin.

John Incardona added that his research group has found surprising results when analyzing mixtures. Michael said that John's experience with mixtures makes TIEs more compelling to him. Don noted that current TIE work is not yet at the level of being able to effectively manage this kind of work. He said it is necessary to begin with just one compound.

Steve asked what the purpose of the feedback was and what would be done with it. Meg and Jay said that the ideas would be conveyed to the TRC and that researchers would use the feedback to revise their proposals. Steve indicated that he did not think there had been Workgroup consensus. Jay said that he did not believe that there had been closure on the item. He asked for feedback on his assessment: a large emphasis on idea 1, smaller emphasis on idea 3, and possibly a small emphasis on 2 pending a revised proposal.

Don said he was concerned about the size of the Toxicity Subgroup and would like to see more input from outsiders. Sarah said that although they had been unable to attend the meeting she was anticipating feedback from several additional scientists. She asked for any ideas for additional members.

Jay noted that the proposals for 2009 for the Causes of Sediment Toxicity were more nebulous because SFEI staff are in the midst of incorporating and responding to feedback from the Toxicity Subgroup that was received last week.

Steve said he was fine with sending the revised proposals back to the Toxicity Subgroup. He also noted that if the goal is to be able to say that the EEWG came to a conclusion they need to have closed door sessions with discussion and a vote.

ACTION ITEMS:

- Sarah Lowe asked that feedback on the draft Causes of Sediment Toxicity Workplan be submitted to SarahL@sfei.org by Wednesday November 19th, 2008.
- SFEI staff to draft a proposed plan for the 2009 studies addressing the concerns raised by the Toxicity Subgroup and distribute to the Toxicity Subgroup and the EEWG for feedback and approval prior to beginning any studies.
- A list of priority compounds for development of LC_{50s} to be distributed to the Toxicity Subgroup and EEWG.

D. 2008 Update and Plans for 2009: Refinement and Validation of Mesohaline Benthic Indices

Bruce Thompson presented an update on the Benthos Workshop and plans for 2009. He noted that this project is funded through the Data Integration task. The objectives of the project are to

revise and validate mesohaline benthic indices for San Francisco Estuary and coordinate and collaborate with the SQO Project.

The refinement and validation of mesohaline benthic indices is necessary because efforts so far have focused on polyhaline benthic indices. Mesohaline refers to the estuarine (moderately saline) portions of the Bay, which includes San Pablo Bay and much of the South Bay. As SQO are implemented it is important to have appropriate and validated indices for these large portions of the Bay. Currently there are two indices (RBI and IBI) that have been applied to the mesohaline portions of the Bay; however, the results were frequently in disagreement. Therefore, the indices need to be evaluated and it is possible that they will either be refined or that a new index will be developed. These efforts include coordination and collaboration with SQO because the results will be applied to SQO and be valuable for mesohaline areas outside of the Bay.

The original goals for 2008 were to: 1) organize a Benthic Workgroup, 2) hold a Benthic Workgroup meeting to review past efforts, discuss concepts, and plan analyses, 3) conduct data analysis and best professional judgment exercise to determine mesohaline disturbance gradient, 4) hold a second Benthic Workgroup meeting to review analyses and agree on metrics, and 5) write a progress report. However, the plans were revised and reorganized. The revised goals for 2008 are: 1) organize a Benthic Workgroup, 2) update database of relevant studies and conduct classification and ordination analyses, 3) hold a Benthic Workgroup meeting to identify assemblages, index concepts, and plan best professional judgment exercise, and 4) write progress report. It was decided that having the new classification and ordination analyses would be more valuable prior to the first meeting. The existing database of relevant studies has updated with many additional studies and classification and ordination analyses have been conducted. The Benthic Workgroup has been organized. The remaining tasks will be completed by March, 2009. The 2009 project goals (excluding the previously mentioned 2008 revised goals that will be finished in 2009) are: 1) conduct best professional judgment exercise to determine mesohaline disturbance gradient, 2) identify metrics and revise indices, 3) hold Benthic Workgroup meeting to review best professional judgment results, metrics and draft revised index, and 4) write report and publications on best professional judgment results and revised index description.

Sarah added that the new studies added to the database include NOAA 2000 & 2001, WEMAP 2000, and DWR through 2007. This provides much better coverage.

Karen asked if Sarah and Bruce had confidence in the 2000 WEMAP taxonomy data. Sarah said that 50 samples were validated, but noted that the analysis was done by a lab in Virginia that is not as familiar with West Coast species.

Steve said that he felt the project was on the right track and that the work is very important since with the promulgation of SQO it is necessary to interpret the benthic data.

The group asked how additional funding would help. Bruce said that another area that has not yet been evaluated regarding benthic indices is Suisun and that with additional funding the group could accomplish the same tasks of refining and validating benthic indices for that environment. However, currently, they have enough funding. The development and validation of benthic indices for the Delta is funded through SQO.

Michael asked how many experts would be involved in the best professional judgment exercise. Bruce said that the experts had not yet been selected, but that as an example nine had participated in a similar exercise for the Central Bay.

Michael asked how the experts' opinions would be used to determine metrics. Bruce said that the same group of experts would participate in looking for gradients and causes of the gradients after their responses had been pooled.

Michael asked how easy it would be to add Suisun Bay to the existing project. Steve noted that in Southern California there is a common thought process shared amongst the various relevant players that does not yet exist in San Francisco Bay. He added that he thought the best professional judgment exercise would be very valuable to developing this commonality of thought.

Karen asked what the plans for funding SGO are. Steve said that in the short-term the focus is on developing a triad approach in the Delta. There will be two seasons worth of sampling, which the RMP is leading. Other plans include looking at indirect effects such as in the upper levels of the food chain.

Arleen asked what the two existing indices are and how they differ and how they would be tested and how much revision might be needed. Bruce said the RBI uses several indicator species to look at sensitivity and tolerance. The IBI uses similar indicator taxa and also includes measures of community diversity and abundance. Bruce noted that in previous experiences with SGO 6 indices were tested and 4 selected. They are keeping an open mind as to whether either of the existing indices will be compatible with the results of their best professional judgment exercise. They may decide to revise an index. Arleen noted that if one part of the plan needs a contingency plan and could use additional funding it is this task.

E. 2008 Update and Plans for 2009: Terns and Mercury & Selenium

Collin Eagles-Smith presented a summary of the results from 2007 (which are also available in the report distributed: *A Dual Life-Stage Approach to Monitoring the Effects of Mercury Concentrations on the Reproductive Success of Forster's Terns in San Francisco Bay*), reviewed results from 2008, reviewed plans for 2009, and discussed the plans for RMP sampling in 2009. The leads on this work are Collin and Josh Ackerman.

Forester's Terns have the highest egg mercury concentrations of any species sampled in the Bay.

The objectives of the study "A Dual Life-Stage Approach to Monitoring the Effects of Mercury Concentrations on the Reproductive Success of Forster's Terns in San Francisco Bay" were: 1) link mercury concentrations in eggs to those of down feathers in just-hatched chicks, 2) determine toxic thresholds in eggs by comparing mercury concentrations in randomly collected eggs to concentrations in failed-to-hatch and abandoned eggs, and 3) examine effects of mercury on chick mortality by comparing mercury concentrations in down feathers of alive and dead chicks; with the goal of developing toxic threshold for mercury in eggs that accounts for both egg hatchability, egg abandonment, and chick mortality.

In order to link mercury concentrations in eggs to those of down feathers in just-hatched chicks they collected pipping eggs and compared the concentrations of down feathers collected from the

pipping chick to concentrations in the whole egg homogenate. They found a very tight correlation between the two concentrations which can be used to calculate the concentrations in the egg from just-hatched chick feathers and conversely down-feather concentrations from egg concentrations. They also compared concentrations in just-hatched chick down to concentrations in down from recaptured chicks ≤ 10 days old and found a strong correlation between the two concentrations. Therefore they can use chick down feathers from chicks ≤ 10 days old to predict egg mercury concentrations.

Harry asked what the moisture content of feathers is. Collin said that it is quite low. Harry asked why they use fresh wet weight (fww) for the eggs. Collin said they found that because of losses of mass over the course of incubation due to respiration and loss of carbon, the mercury becomes concentrated. So they now report all egg measurements in fww.

In order to determine toxic thresholds in eggs they compared mercury concentrations in randomly collected eggs to concentrations in failed-to-hatch and abandoned eggs. They found a significant difference in the concentration of failed-to-hatch and randomly collected eggs from successful nests (where at least one egg hatched). Because lots of failed-to-hatch eggs are lost, through predation as they wait to make sure that it does not hatch, they pooled the results of eggs collected in 2005 and 2006 with the results from 2007.

Michael asked what causes nest abandonment. Collin and Josh said that many things can cause nest abandonment such as habitat disturbance, predators, young inexperienced parents, etc., but that they excluded known predation. They also noted that they separated abandoned nests from randomly collected nests because mercury is known to decrease concentration of prolactin which can influence nest tenacity.

They found nest success tended to decline with colony egg mercury concentrations, failed-to-hatch egg mercury concentrations were significantly higher than random egg mercury concentrations in 2007 and in 2005-2007. This presents evidence for impaired hatchability due to mercury.

They examined the effects of mercury on chick mortality by comparing mercury concentrations in down feathers of alive and dead chicks. They only used chicks ≤ 10 days old in an effort to limit the mercury to maternally derived mercury. They found chick mortality tended to increase with colony chick mercury concentrations and that mercury concentrations in chicks found dead on colony was not statistically higher than live chicks. Therefore, it is inconclusive whether *in ovo* mercury is impairing chick survival.

The conclusions of this study are: 1) mercury concentrations in chick down are highly correlated with whole egg mercury concentrations and that this allows conversion of chick mercury concentrations into egg mercury concentrations, 2) mercury concentrations are higher in fail-to-hatch eggs than random eggs, and 3) *in ovo* mercury may not be different in dead and live chicks.

They also found that for stilts, chick down feather concentrations were significantly greater in dead chicks than in live chicks, but that for avocets, like Forester's Terns, the concentrations in dead chicks was not significantly greater than live chicks.

The future directions of this study are: 1) refine egg hatchability thresholds using the newly developed and tested egg micro-sampling technique and larger sample sizes of failed-to-hatch eggs, 2) establish chick toxicity thresholds for mortality and growth rates, 3) look at mercury interactions with other contaminants, such as selenium, and 4) identify mercury hot-spots around the Bay.

For the study “Mercury-Selenium Effects on Reproductive Success of Forster’s Terns in San Francisco Bay” the objectives are 1) demonstrate applicability of micro-sampling method to full-scale study and 2) evaluate effects of mercury and selenium on hatchability of individual eggs with the goal of developing toxic thresholds for mercury and selenium in eggs.

The micro-sampling method is extremely useful because of within-clutch mercury concentration variability. In traditional surrogate-egg sampling methods a whole egg is sampled and the fates of sibling eggs are followed. However, because within-clutch mercury concentrations can be quite variable this is not ideal. Therefore, a micro-sampling method in which a small sample of albumin is removed from the egg for analysis and the egg is then resealed and allowed to incubate and hatch has been developed. There is a strong correlation between mercury concentrations in the micro-sample and whole egg. This method was tested in a small pilot study and will be used for all samples in 2009. In 2008, 141 tern nests from 6 colonies were micro-sampled; 31 nests were lost to flooding, depredation, or abandonment. The hatching success rate of the sample eggs was 82%.

Michael asked how much albumin is sampled. Collin said that they take < 1% of the egg. Harry asked who conducted the analyses. Collin said that they do the mercury analyses and Texas A&M conducts the selenium analyses. Harry said he knew of a method that would take much less sample material.

The 2009 schedule is:

- Jan. 2009 – Complete mercury analyses of albumin samples
- Mar. 2009 – Complete selenium analyses of albumin samples
- April 2009 – Begin second field season
- May 2009 – Draft annual report

Collin and Josh are also conducting the RMP Status and Trends tern egg sampling. The sampling occurs triennially and was scheduled to occur in 2008. However, due to permitting issues was postponed until 2009. The eggs will be analyzed for mercury, selenium, and PBDEs. Except for mercury, the eggs will be composited with three composites per site and seven eggs per composite.

Letitia Grenier raised questions about what was represented by the core area and where the birds were foraging. She said that usually the 95% utilization is used for foraging (which would indicate mercury exposure) since the birds leave their nest area to forage.

Five of the six tern colonies to be sampled were selected: Eden Landing, Pond A16, Napa Marsh, Ponds A7 or A8, and Pond A1 or Charleston Slough. The sixth colony will be chosen once it is clear where the birds are nesting. It was noted that Corte Madera may be the only site where the birds can’t be foraging in salt ponds and therefore are feeding in the Bay margins and wetlands.

ACTION ITEMS:

- Josh and Collin to investigate presence of tern colonies in Suisun.

- A sixth tern colony to be selected for sampling as part of Status and Trends once the colonies have been established.

F. 2008 Update and Plans for 2009: PAHs and Juvenile Flatfish

John Incardona presented an update on the results of his group's study of the effects of PAHs on juvenile flatfish from 2008 and the plans for 2009. The objectives of the study are to 1) conduct systematic analysis of individual PAHs and mixtures modeled on San Francisco Bay sediments and 2) determine the threshold for effects of PAHs in sediment-exposed larvae of resident San Francisco Bay flatfish (California halibut).

John noted that the toxicity of PAHs is based on a crude oil model, which has a very different fingerprint than weathered oil or combustion. Effects of PAHs have been known since chimney sweeps were found to have a much higher incidence of skin cancer; which is similar to the neoplastic liver lesions found in flatfish. The incidence of liver lesions led to the hockey stick model of effects. But the hockey stick only deals with liver lesions, not reproduction or development.

The initial research and knowledge of PAHs in the aquatic system came from the Exxon-Valdez oil spill, which was crude oil. The spill resulted in oil washing onto pink salmon and herring eggs which are adhesive and demersal. Because there is so much mortality in early life stages of fish, any additional mortality can have a very large impact on the adult population.

A NOAA lab experiment of fish eggs exposed to 5-20 ppb of PAHs. Most of the fry developed normally and were raised in a hatchery. The fish that did not have any external defects were tagged and released along with unexposed fish. Significantly fewer exposed, normal appearance fish returned than untreated fish.

They have also found that particulate associated concentrations of PAHs may be orders of magnitude greater during stormflow than baseflow. These PAHs likely end up in the sediments.

The toxicity of different PAHs is very stage specific. Their experiments with zebrafish have been targeting higher molecular weight (pyrogenic) PAHs and focused on the step by step evaluation of individual PAHs and mixtures. The zebrafish is ideal because its development and anatomy are very well understood. Crude oil exposure causes edema and cardiac problems. Benzanthracene seems to be mediated by the dioxin receptor; cardiac toxicity is through different receptors.

Investigation 5-ring compounds they found that 1) benzo[e]pyrene, benzo[a]pyrene, and benzo[k]fluoranthene induce pericardial edema late in development (or not) according to AHR affinity, 2) pattern of cardiac CYP1A induction by benzo[a]pyrene fits dioxinlike toxicity model, and 3) pattern of CYP1A induction by benzo[k]fluoranthene is confounding. They currently are conducting AHR knockdown studies to further investigate.

The maximum swim speed of fish is closely correlated to the maximum heart output, so effects on cardiac function are extremely important. A study of adult fish swim speed in fish exposed to oil as embryos versus controls found significantly reduced swimming speeds in adults exposed to oil as embryos.

Kupffer's Vesicle is a signaling structure that exists temporarily in the developing embryo. It tells organs which side to go to. Fluoranthene and pyrene both affect Kupffer's Vesicle, it does not disappear in later stages of development. Together the two synergize and have a greater affect. An urban mixture of PAHs also causes Kupffer's Vesicle to remain.

In summary, fluoranthene experiments have found it to produce cardiac and early developmental defects (Kupffer's vesicle and blood vessels). The effects of fluoranthene are enhanced by pyrene. Additionally, there is complex synergism between fluoranthene and 5-ring compounds.

The experiments thus far have focused on zebrafish since they are well understood. The next phase will use California halibut, a native flatfish. Although there are other native flatfish in the region California halibut eggs are available from a commercial hatchery, which makes them the practical choice.

Because there are many other contaminants in San Francisco Bay sediments, sediment from Kitimat harbor will be used instead. Kitimat is a relatively pristine area with few pollution sources. Except, there is an aluminum smelter, which produces PAHs with a fingerprint fairly similar to that found in San Francisco Bay. It is possible that the PAHs in Kitimat sediments are less available than those in San Francisco Bay because a major source may be from unloading of coal tar, which means that the PAHs are likely more bound to the coal tar.

In March, 2008 they received 15,000 yolk sac California halibut larvae, 120 successfully went through metamorphosis, and 16 survived to be fully settled juveniles. Their fish specialist then altered the settings and regimen and in June 2008 they received another 15,000 yolk sac larvae, 300 successfully went through metamorphosis, and 150 survived to be fully settled juveniles.

The experimental plans for spring 2009 are to expose California halibut to Kitimat sediment at stage F-G (mohawk), assess metamorphosis success or lethality, fix all larvae, and collect subsamples for CYP1A induction and histopathology.

Michael asked if there are dioxins in the Kitimat sediments. John did not think that there were, but he will check.

Kevin Kelley suggested they look at thyroxine levels if impairment is found.

Dan asked if effects on Kupffer's Vesicle could affect which way the halibut settle (left or right sided). John said that California halibut are a species that generally settles in both directions, but that they will keep track of the rates.

ACTION ITEMS:

- Are there dioxins in the Kitimat sediments?

G. 2008 Update: EDCs and Fish Year 3

Kevin Kelley presented an update on his three-year study of endocrine disrupting compounds in Pacific staghorn sculpin and shiner surfperch. The objectives of the study are to: 1) measure the incidence and magnitude of endocrine disruption in wild fishes in San Francisco Bay, 2) determine whether spatial differences can be established between different San Francisco Bay locations, 3) determine associated liver contaminant concentrations in individuals, and 4) characterize

mechanisms/potential causes underlying thyroid disruption in San Francisco Bay fish. Objective 4 has been a major focus of the last year.

The fish were collected at 10 sites selected because they are contaminated with different known chemicals: San Pablo Bay (marina), Richmond Lauritzen Channel (DDTs), Richmond Waterfront (marina) replaced with Berkeley Waterfront, Oakland Inner Harbor and Port, San Leandro Bay (PCBs), San Francisco Waterfront (industrial, marina), Hunter's Point(PCBs), Redwood City, and Bodega Bay (remote reference site).

Thyroxine (T4) levels in shiner surfperch were depressed in fish from Oakland Inner Harbor in year 1. Redwood City, Berkeley, and San Pablo Bay had concentrations similar to those of the reference site. In year 2 similar patterns were seen in the repeated sites. Additionally, other sites were added. Concentrations in fish from San Leandro Bay and Hunter's Point were also depressed. Concentrations in fish from Richmond Lauritzen Channel and San Francisco Waterfront were not depressed.

In year 1, thyroxine levels in Pacific staghorn sculpin were also depressed in fish from Oakland Inner Harbor as well as in fish from San Pablo Bay and Berkeley Waterfront. The sculpin from Redwood City, like the surfperch, did not have depressed concentrations of thyroxine. The sculpin also showed lower concentrations at more sites in year 2 compared to the shiner surfperch. In year 2 concentrations were depressed in fish from Richmond Waterfront, Richmond Lauritzen Channel, San Pablo Bay, Oakland Inner Harbor, San Leandro Bay, and Hunter's Point.

They also measured triiodothyronine (T3) concentrations in the fish. They found that in general T3 concentrations were lower than T4 ($T3/T4 < 0.45$). However, in San Leandro Bay the ratio of T3 to T4 was approximately 1.5.

The results from Oakland Inner Harbor, with concentrations of both T3 and T4 depressed, suggests reduced thyroid hormone production or increased thyroid hormone turnover, but no change in peripheral deiodinase(s).

The results from San Leandro Bay suggest reduced thyroid hormone production or increased thyroid hormone turnover, and abnormal activation of peripheral deiodinase(s).

They are also analyzing liver contaminant concentrations from individual livers. Chlordanes, nonachlors, and PAHs showed different profiles at different locations. DDT and DDT metabolites were much higher in fish from Richmond Lauritzen Channel; DDT was only detected in fish from Lauritzen Channel. The highest PCB loads were found in fish from San Leandro Bay and Oakland Inner Harbor with concentrations generally twice the concentrations found in fish from other sites.

In 2008, they also tested the response of fish to stimulation by TRH (Thyrotropin-releasing hormone) and TSH (thyroid stimulating hormone). TRH stimulates the pituitary thyrotropes and TSH stimulates the thyroid. TSH injections caused very high T4 concentrations in shiner surfperch from Redwood City and less strong, but still elevated concentrations relative to the controls, in Pacific staghorn sculpin from Redwood City and in both species from Oakland Inner Harbor. TRH injections did not affect T4 concentrations in either fish species. This may be due to an inability of the hormone to access the pituitary. The hormones were injected intraperitoneally. Michael noted that is difficult for compounds to get from the blood to the pituitary and that it is likely that the

hormone was processed by the liver quite quickly. T3 concentrations were also elevated in shiner surfperch from Redwood City after injection by either TSH or TRH. Kevin noted that TRH can activate deiodonases, which turn T4 into T3; so although TRH may not be activating the part of the system they were trying to affect it was entering the fish and altering the hypothalamo-pituitary-thyroid axis.

Kevin summarized that: 1) wild fish in San Francisco Bay are exposed to chemical contaminants, 2) resident fish are experiencing several types of endocrine disruption which can impact health/physiology (thyroid axis, HPI/stress axis, growth factors), 3) there is evidence that resident fish are experiencing toxicological responses to accumulated contaminants (proteomics, CYP1A1), 4) they have found correlations with individual contaminants accumulated in animals (endocrine, phenotypic), and 5) they are using integrative, multi-biomarker (“systems”) analysis to characterize physiological impairment and potential causes.

H. 2008 Update: Small Fish

This item was postponed and will be discussed at the next EEWG meeting.

I. Solicitation of Ideas for 2010

Meg and Jay presented a summary of the EEWG priority questions regarding risks to birds, benthos, and fish as well as the questions behind the Small Fish study. They also presented the knowledge and progress to-date regarding these questions and asked for feedback on the direction of the Workgroup for 2010. Jay said that they would return to the Workgroup with more developed possible questions to pursue in 2010 at a future meeting.

The priority questions addressing risks to birds are:

- Is there clear evidence of pollutant effects on survival, reproduction, or growth of individual birds?
 - There is clear evidence that mercury is affecting the survival, reproduction, or growth of individual birds, but it is unclear how the thresholds being developed relate to the egg monitoring threshold in the TMDL. There is not yet evidence for adverse effects from emerging contaminants such as PBDEs.
- Are pollutants in the Bay adversely affecting bird populations?
 - Unknown
- Do spatial patterns in accumulation indicate particular regions of concern?
 - Maybe. Work by CalFed and in the South Bay Salt Ponds suggests that some high marshes may have higher concentrations of methylmercury.
 - Unknown for other contaminants.

The priority questions addressing risk to benthos are:

- What are spatial and temporal patterns of impacts of sediment contamination on benthic biota?
 - Maybe. SQO identified areas of concern. Status and Trends benthic work will provide more information and takes a random approach which will help make assessments on regional scales.
- Which pollutants are responsible for observed impacts on benthic biota?
 - Not sure, yet. Further development of TIEs will help identify pollutants.

- Are the toxicity tests, benthic community assessment approaches, and the overall SQO assessment framework we are using reliable indicators of impacts of benthic biota?
 - Yes, the consensus from experts is that we are best available methods for sediment toxicity.
 - Recommendation from saline organisms to consider switching to freshwater test organisms in samples from river sites for toxicity testing.
 - Benthic assessments will be refined through benthic workshops in 2009.
 - Need to coordinate on SQO assessment approaches/techniques.

The priority questions addressing risks to fish are:

- Are pollutants, individually or in combination, reducing reproductive ability, growth, and health of sensitive fish populations?
 - Maybe. There are fish population concerns including POD and reduced fish runs. It is unknown if specific pollutants are contributing to these phenomena.
- What are appropriate thresholds of concern for contaminant concentrations for Bay species?
 - Working developing a threshold for PAHs that takes into account effects and is not just based on the liver lesions hockey-stick model.
 - Thresholds still need to be develop for other compounds including emerging contaminants.
- What are cost-effective indicators for monitoring effects of contaminants on fish populations?
 - Currently working on developing monitoring of hormone systems.
 - There is still a need to develop methods for inclusion in Status and Trends.

The Small Fish study priority questions are:

- Where is mercury entering the food web?
- What factors contribute to uptake?
- Are there trends in methylmercury bioaccumulation based on restoration activities?
- What are the best monitoring tools for characterizing methylmercury bioaccumulation?

The Small Fish study is in its first year of an intensive three-year expanded study. The sampling for year one was just completed at the end of October and results are not yet available.

J. Next Meeting

To be determined.

Summary of Action Items

- Sarah Lowe asked that feedback on the draft Causes of Sediment Toxicity Workplan be submitted to SarahL@sfei.org by Wednesday November 19th, 2008.
- SFEI staff to draft a proposed plan for the 2009 studies addressing the concerns raised by the Toxicity Subgroup and distribute to the Toxicity Subgroup and the EEWG for feedback and approval prior to beginning any studies.
- A list of priority compounds for development of LC_{50s} to be distributed to the Toxicity Subgroup and EEWG.
- Josh and Collin to investigate presence of tern colonies in Suisun.

- A sixth tern colony to be selected for sampling as part of Status and Trends once the colonies have been established.
- John to find out if there are dioxins in the Kitimat sediments?