

RMP Exposure and Effects Workgroup Meeting
September 6th, 2007
Meeting Minutes

Attendees:

Josh Ackerman, USGS
Brian Anderson, UCD
Tracy Collier, NOAA
Michael Fry, American Bird Conservancy
Kevin Kelley, CSU-LB
Michael Kellogg, CCSF
Harry Ohlendorf, CH2MHill
Chris Pincetich, EBMUD
Jesus Reyes, CSU-LB
Daniel Schlenk, UC-Riverside
Karen Taberski, SFRWQCB
Don Weston, UCB
Steve Weisberg, SCCWRP

Jay Davis, SFEI
Amy Franz, SFEI
Ben Greenfield, SFEI
Letitia Grenier, SFEI
Katie Harrold, SFEI
Susan Klosterhaus, SFEI
Sarah Lowe, SFEI
Aroon Melwani, SFEI
Sarah Rothenberg, SFEI
Meg Sedlak, SFEI
Bruce Thompson, SFEI

A. Introductions and Review of Agenda

Meg Sedlak presented an overview of goals for the meeting. As part of the redesign of Status and Trends and the RMP as a whole, EEWG will be asked to review all exposure and effects work in the Program including elements of Status and Trends. The goals of the meeting were to review draft five-year plans that have been developed for benthic and fish work and to review and make a recommendation regarding the detailed scopes of work for proposed 2008 exposure and effects pilot and special studies.

B. Five-year Plan for the Exposure and Effects Work in the RMP

Meg Sedlak presented the plan for the exposure and effects five-year plan. Draft plans for benthos and fish have been developed and are discussed in greater detail below. The remaining topics (risks to humans (sport fish monitoring), risk to birds, and temporal and

spatial patterns in food web accumulation) will be developed and presented at the next EEPS meeting in November.

C. History and Status of Sediment Effects Studies in the RMP

Bruce Thompson presented an overview of sediment effects studies in the RMP. Status and Trends included sampling sediment biannually, during both the dry and wet seasons, until 1999 when the program switched to annual dry season sampling only. In 2002, the RMP switched to sampling random sites.

Many pilot and special studies have focused on various aspects of sediment effects. These have included projects on toxicity to resident species, episodic toxicity and development of TIEs (Toxic Identification Evaluation), influence of chemical and physical factors on benthos, and a sediment workgroup focusing on toxicity.

The RMP has also participated in many collaborative studies focusing on sediment in the Bay. The projects have included Local Effects Monitoring Program (BACWA, 1994-1996), CisNet (1999-2001, EPA and UCD), EMAP SF Estuary Surveys (EPA, NOAA), State Board BioCriteria (SWRCB, SCCWRP), SQO (SWQCB, SCCWRP, DWR, 2005 to present), Non-Indigenous Benthos (EPA, 2000), Long Term Sediment Management Study (ACOE, BCDC), and Delta Dredged-Sediment Reuse Study (CALFED, RWQCB 5).

Several conceptual models have been developed as tools to understanding sediment effects in the Bay. These include models focusing on exposure and effects, toxic dose response, and benthic response to disturbance.

Through all of these studies we have developed a better understanding of sediment contamination, sediment toxicity, and benthos in the Bay. Sediment in the Bay may contain elevated levels of As, Cu, Hg, Zn, Ni, DDT, PAHs, chlordanes and mixtures, depending on the location of the sediment. The highest concentrations are found in muddy sediments (<50% sand) near margins of the Bay, mouths of tributaries, ports, and BPTCP “hot-spots.” Sediment toxicity in the Bay is widespread and persistent. Higher toxicity is observed during the wet season and at the margins of the Bay. Preliminary results suggest that higher toxicity has been associated with chlordanes, mixtures of compounds, and copper (Suisun Bay), non-polar organics (Redwood Creek), and pyrethroids (some tributaries in the Delta). The distribution and composition of seven benthic assemblages have been characterized, but some additional assemblages may exist. Changes in benthic assemblages have also been characterized. The change in benthic distributions is largely believed to be a response to freshwater inflows. The composition and abundance of species within an assemblage have been observed to change in response to contamination, salinity, and sediment type. The causes of these changes are mostly unknown.

D. SQO Assessment in San Francisco Bay

Bruce Thompson presented the results from the sediment quality objectives (SQO) assessment in San Francisco Bay. The SQO for bays and estuaries is a new regulatory approach developed to assess the quality of sediment using a triad approach. The methods have been developed since 2004 and are expected to be promulgated in 2008 at the State level.

SQO assessment of SF Bay employed three lines of evidence for direct effects: chemistry, sediment toxicity, and benthos. The chemistry indicators used a maximum probability of toxicity. Sediment toxicity was measured using amphipod survival. A second test is necessary for the final implementation of SQO, which will assess chronic toxicity. Two benthic indices were used to assess benthic effects (Index of Biotic Integrity and Relative Benthic Index) at estuarine sites; two additional indices, River Invertebrate Prediction and Classification System and Benthic Response Index, were used at the remaining sites.

Each line of evidence uses four categories of impact: no impact, low, moderate, and high. The multiple lines of evidence (MLOE) are combined into six categories: unimpacted, likely unimpacted, possibly impacted, likely impacted, clearly impacted, and inconclusive.

A statewide assessment using SQO was conducted by SCCWRP for the EPA and Regional Water Quality Control Board using random sampling data. The assessment estimated the area of California with impacted and unimpacted sediment quality and compared the results to previous assessments of sediment quality. Forty sites were used to assess San Francisco Estuary. Eleven of 12 Bay sites, 20 of 21 estuary sites, 1 of 1 marina sites, and 6 of 6 port sites were classified as poor (Possibly Impacted, Likely Impacted, or Clearly Impacted). The other two sites were classified as good (Unimpacted or Likely Unimpacted). Seventy-three percent of San Francisco Bay's area was estimated to be possibly impacted, compared to 17% of the area assessed in Northern California and 24% of the area assessed in Southern California. And 19% of San Francisco Bay's area was estimated to be likely impacted compared with 4% in Northern California and 12% in Southern California. Using these results to estimate the area of the sediment that is poor quality, the assessment estimated that 91% of the Bay and 99% of the Estuary is poor quality.

Karen Taberski asked why the hundred samples collected by NOAA were not used. Bruce Thompson indicated that the data were not available at the time the study was conducted.

Karen Taberski asked why the line was drawn between likely unimpacted and possibly impacted, and not possibly impacted and likely impacted in determining whether a site was impacted (bad) or not (good). She also indicated that she would be interested in seeing the results of this comparison. Bruce Thompson indicated that it would be easy to change the comparison and that he did not know what the results would be.

Harry Ohlendorf asked for details on why the two sites next to each other in San Leandro Bay had such different classifications, one red (clearly impacted) and one green (likely unimpacted). Bruce Thompson indicated that this was an extremely important question and

one to which there is no answer at this time. He noted that this assessment was based on one sampling event and could not incorporate temporal variability.

In order to put the results of the statewide assessment in context and facilitate the interpretation of the results, a study of RMP and BPTCP samples was undertaken by SFEI staff using the same criteria as the statewide assessment. However, the samples used were not randomly sampled so the results cannot be used to draw conclusions about the Bay as a whole or sections of the Bay. Sixty samples from seven sites over six years were used. All the sites except for two (Horseshoe Bay and San Pablo Bay) were impacted at some point in the time series. Impacts were largely driven by toxicity and chemistry.

Additional analyses and studies are needed to refine and interpret results, especially identification of the causes of observed impacts (“stressor identification”).

Don Weston asked what the effect on the SQO assessment would be if not all three lines of evidence were available. Steve Weisberg indicated that the science team recommended the use of all three. Regional Boards may decide to only use one or two lines of evidence, but the results are not as strong. Steve Weisberg indicated that they had conducted analyses of using one or two lines of evidence. With only one or two lines of evidence the results were more likely to classify an area as impacted than the triad approach.

Harry Ohlendorf asked which of the three lines of evidence was the most critical. Steve Weisberg indicated that toxicity was the most important line of evidence.

Karen Taberski asked if there were plans to conduct the same analysis on RMP sites from 2002-2006, which were randomly sampled. Bruce Thompson said that they would not be because they were missing the benthos line of evidence.

E. Influence of Physical and Chemical Factors on Benthos

Aroon Melwani presented results of a study on the influence of chemical and physical factors on macrobenthos. The objective was to test a method of identifying benthic stressors. The methods were used to determine which sediment contaminant(s) have the highest association with benthic impacts observed in the Estuary.

The study used data from the RMP and other projects. A common set of chemical and physical variables were evaluated (silver, arsenic, cadmium, chromium, copper, mercury, nickel, lead, zinc, total DDTs, total PCBs, total chlordanes, total low molecular weight PAHs, total high molecular weight PAHs, salinity, % TOC, fine sediment, and mERMq). Individual benthic metrics identified by Thompson and Lowe (2004) as representative indicators of Estuary benthos were used as dependant variables. These included total number of taxa and total abundance as well as number of amphipod taxa and *Capitella capitata* abundance in polyhaline assemblages and number of mulluscan taxa, oligochaete abundance, and *Streblospio benedicti* abundance in mesohaline assemblages.

Harry Ohlendorf noted that there is a recent paper on copper and zinc effects on *Capitella*.

The study was conducted in six locations: San Pablo Bay marshes, CCSF wastewater discharge area, South Bay, Suisun Bay, Richmond Harbor, and San Leandro Bay.

The study methods used a Pearson's Correlation Analysis (PCA) between chemistry and sediment variables, multiple regression of sediment variables and mERMq, Principal Components Analysis (PCA) of chemical variables, and multiple regression of PCA factors and sediment variables. The PCA was used to identify variables that were correlated with each other. Using the PCA, it was then possible to determine the combined effects of chemical and physical factors.

Chris Pincetich asked if they had tried pulling out the primary factor and rerunning PCA analyses. Aroon Melwani noted that they only used the PCA on the contaminants, not the physical characteristics.

Don Weston asked if they saw a response to a DDT/Dieldrin gradient. Aroon Melwani indicated that mollusks did not show a response but that oligochaetes and amphipods did.

Bruce Thompson indicated that they used Richmond Harbor because it was well studied and they found that the method was able to tease out different factors such as contamination.

F. Draft Five-year Plan for Benthic Effects Work

Jay Davis introduced the five-year plan for benthic effects work and the goals for this item. He requested feedback on the prioritized list of questions, allocation of funds among the various elements of the program, timing of allocation, and details of specific elements.

Karen Taberski asked if pilot and special studies proposals would still be requested and considered by the work group and TRC. Jay Davis indicated that pilot and special studies proposals would still be solicited, but that the scope of the request would be more focused.

Jay Davis suggested that the work group propose a budget in the range of \$100,000 to \$200,000 for benthos with the realization that this amount of funding for benthos is unlikely to be available. He also suggested that the work group prioritize the items within the budget so that if it is necessary to reduce the budget key elements are retained.

G. Update on Causes of Toxicity Study

Sarah Lowe presented an update of the 2007 Causes of Toxicity study. The goal of the study is to identify two sites with significant toxicity to develop amphipod TIEs and refine TIE tools to better understand the causes of toxicity. The group identified twelve potential sites and segregated them into three prioritized groups for screening purposes. A suitable site was defined as having less than 50% control normalized amphipod survival.

In the first group of four sites, one site, Mission Creek in San Francisco, was identified as suitable for TIE development. The second group of sites will be screened this winter.

Brian Anderson elaborated on the TIE process. It involves the manipulation of sediment to determine what is causing toxicity, which requires highly toxic sediments. Mission Creek sediment had less than 20% survival. The addition of two carbon sources, resin beads and coconut-derived carbon, resulted in 70 to 80% survival. This suggests that the cause of toxicity may be non-polar organic compounds. The resin beads can be sieved from the sediment and the compounds extracted and analyzed. The eluate from the resin beads was spiked back into water, which was highly lethal to amphipods. None of the other sediment treatments changed the toxicity. Brian Anderson's team also tested interstitial pore water for toxicity. The pore water was highly toxic and remained toxic after ammonia was removed. The eluate, solid phase, and pore water have been sent for chemical analysis and identification. They expect a suite of chemicals will be identified and will conduct additional spiking experiments. This represents the first successful removal of toxicity from San Francisco marine sediments.

Karin Taberski asked if Brian Anderson's group had been able to get better than 70% survival in pore water. Brian Anderson indicated that they are exploring using multiple HLB columns to see if they can get higher survival. He suggested that column break through might explain the mortality.

Don Weston asked why samples were collected in the Spring. Brian Anderson said that they chose the Spring because it is the end of the rainy season when toxicity is hypothesized to be elevated due to spring application of fertilizers and pesticides. He was not sure why there was not as much sediment toxicity in 2006. It was suggested by several group members that the low rainfall may have had something to do with the lack of toxicity.

Don Weston asked how long samples can be held during TIE development. Brian Anderson said that samples can be held indefinitely. The major risk is that in organic matter rich samples ammonia concentrations will build up over time, which increases the toxicity of the sample.

H. Draft Five-year Plan for Benthic Effects Work

Sarah Lowe presented the five-year plan for benthic work. She began with background of the program and the status of benthic work in San Francisco Estuary.

The specific questions that the benthic effects five-year plan seeks to address are (in order of priority):

1. What are the causes of sediment toxicity?
2. Are Estuary sediments toxic?
3. Are the benthos impacted by pollutants?
4. Is the SQO method a valid way to evaluate ecological condition in this Estuary?
5. What are the causes of benthic impacts?

The toxicity workgroup recommended:

1. Evaluate toxicity during the Winter near potential sources

2. Follow the most relevant matrix (sediment)
3. Investigate causes of persistent sediment toxicity
4. Develop LC₅₀s for estuarine species
5. Integrate this study with benthic work and other SQO work that is planned

Harry Ohlendorf asked if there were planned projects to couple TIE toxicity work and benthic work. Sarah Lowe indicated that there were no planned projects at this time but it was a possibility in the future. Aroon Melwani said that chamber experiments might be a possibility. Sarah Lowe suggested conducting gradient studies with benthic metrics to determine where studies linking toxicity and benthic work might be fruitful.

Don Weston asked if stormwater TIEs had ever been conducted in the Bay. Sarah Lowe said that PERL had conducted limited studies on this in the past. Brian Anderson noted that in recent years there hasn't been very much water toxicity; the chemicals that were causing water toxicity are not being used as much and the new chemicals replacing them are hydrophobic and largely found in the sediment. Harry Ohlendorf suggested that in low salinity environments the compounds might be more available. Sarah Lowe noted that the RMP conducted water toxicity testing for many years and that after 1997 saw little toxicity even after storm events. Brian Anderson suggested switching to a different organism such as *Hyalella*. Sarah Lowe indicated that in 2004-5 sediment and water testing was done with *Ceriodaphnia* and no water toxicity was observed. Based on limited studies, it appears some of the sediment toxicity is associated with pyrethroids. Daniel Schlenk noted that studies evaluating pelagic organism decline (POD) tend to observe increased toxicity in the Winter.

The workgroup recommended that at stations where sediment chemistry and toxicity are conducted benthos sampling should be included. It was also recommended that as in years previously, sediment toxicity should continue to be conducted at 27 sites in the Summer. Fourteen sites will be analyzed in alternating years in the winter for sediment chemistry, toxicity, and (proposed at the EEPS meeting) benthos.

Jay Davis asked if the priority questions laid out in the plan are the right questions and if they have been appropriately prioritized.

Harry Ohlendorf indicated that his order would be 4, 2, 1, 3, 5. He asked if 4 should go first or if it is a summation of questions 1-3. Bruce Thompson noted that SQO is a state-wide assessment tool that is going to be adopted and that stressor identification was important for management actions.

Karen Taberski noted that the workgroup is going to have oversight of RMP projects and that there are 15 years of data which should be used when prioritizing. She noted that it is well known that there is sediment toxicity in the Bay; the big question is what is causing the toxicity.

Harry Ohlendorf suggested eliminating questions 2 and 3, unless questions of where toxicity occurs and if it continues to occur are important. Jay Davis indicated that the RMP wants to continue tracking toxicity.

Harry Ohlendorf indicated that question 1 is the right question to be asking but that 2 needs to be refined to include where and when. He suggested that 4, as it stands, may not be necessary. Chris Pincetich asked if 4 should even have been included in the questions since there is a need to include a biological aspect and SQO is due to be promulgated shortly. He suggested that it will be adopted. Harry Ohlendorf noted that there is a difference between “cost-effective” and “valid”. He suggested changing the wording of the questions. Michael Fry suggested that question 4 has a place in a five-year plan; that SQO should be implemented and that in five years the questions of appropriateness and cost-effectiveness can be revisited.

Don Weston asked if benthic work was going to be incorporated into the RMP. He noted that in the TRC minutes from July the TRC decided not to incorporate benthic work into Status and Trends. Karen Taberski indicated that the TRC had decided not to incorporate benthic work at that point, but that they could always incorporate it at a later date and likely would.

Karen Taberski suggested question 2 be rephrased to discuss spatial and temporal aspects. She asked how question 4 fit into the five-year plan and what the end result would be. She liked Sarah Lowe’s integrated iterative process.

Bruce Thompson noted that SQO has been validated nationally. He suggested that “evaluate” or “understand and interpret” might be possible rewordings. Karen Taberski indicated that she liked “understand and interpret”.

Steve Weisberg indicated he felt that SQOs need to be evaluated and enhanced for the management community. In order to do this he suggested:

- refining the benthic indices, especially because using two sometimes results in divergent results and benthic ecologists in the area have not endorsed the methods
- testing the toxicity tests to determine if the recommended species are the correct ones for the area; the SQO suggests test species, but because toxicity is regional the statewide suggestion may not be appropriate

He suggested that the RMP program be expanded to include MLOE (the triad approach) at more sites. He also suggested that the factors causing SQO failure need to be investigated and that they fall within causes of sediment toxicity and benthic impairment.

Karen Taberski noted that in 1995 six toxicity tests were evaluated.

Don Weston suggested that SQO should not be mentioned by name in the priority questions. He noted that SQO is a tool and that the priority questions should be basic science questions instead of tools. Steve Weisberg agreed and suggested that SQO be replaced with “MLOE”. Don Weston suggested that the questions should be agency non-specific.

Jay Davis asked that the workgroup members comment on funding for the benthic effects work.

Steve Weisberg suggested that benthic effects work needs to be as well funded as is possible. He noted that there is a paucity of data. He indicated that his priorities are to 1) collect triad data at as many sites as possible, 2) determine why there is such a large difference between the relationship of toxicity and chemistry in San Francisco Bay relative to Southern California (perhaps by using TIEs or multiple toxicity tests), and 3) increase comfort with benthic indices.

Karen Taberski agreed with Steve's comments. She also noted that gradient studies are incredibly hard to do and urged caution in thinking about and undertaking them. She noted that San Francisco Bay is very well mixed, unlike Southern California, and that gradients will be hard to find.

Sarah Lowe indicated that the TIE and toxicity studies are starting small and that based on the preliminary results it will be important to further refine them.

Steve Weisberg indicated that his priorities for funding would be to fund 1) SQOs/MLOE as highly as possible, 2) causes of sediment toxicity including comfort with sediment toxicity tests (possibly including the addition of a second and third test), and 3) develop benthic indices in the fourth year once toxicity and chemistry are better understood.

Don Weston indicated that he felt that MLOEs and causes of sediment toxicity were under funded. He noted that an old TIE could not be used to do a gradient study and that to do another TIE along with a gradient study would be a substantial undertaking. He said that benthic community assessments might also be underfunded. He also asked if benthic community assessments would be possible if causes of sediment toxicity were not fully understood due to lack of funding.

Steve Weisberg suggested allocating more money to sampling in the first several years and archiving them for analyses in future years.

Sarah Lowe indicated that her budget estimates were just for the benthic grabs and assumed that they could be piggy-backed onto Status and Trends sampling.

Bruce Thompson suggested creating a gradient experimentally. Brian Anderson indicated that he did not think a spiked mesocosm experiment would work.

Karen Taberski indicated that she is concerned about the success of a gradient study and that it might be appropriate as a longer term project. She indicated that refinements to benthic indices would be worthwhile.

Jay Davis summarized the feedback:

- SQO/MLOE are important and should be well funded especially in the beginning of the five years
- Causes of sediment toxicity needs more funding and thought devoted to developing the idea

- Benthic community assessments should be funded in the later part of the next five years.

Sarah Lowe noted that the first two goals are parallel. Harry Ohlendorf said he thought it would be good to study them together.

ACTION ITEMS:

- **Jay Davis to reword benthic effects priority questions to reflect workgroup members' recommendations.**
- **Jay Davis and Sarah Lowe to rework benthic effects budget.**

I. Update on 2007 EEPS Project: EDCs in Shiner Surfperch and Pacific Staghorn Sculpin

Kevin Kelley presented his work to date on endocrine disruption effects in shiner surfperch (*Cymatogaster aggregata*) and Pacific staghorn sculpin (*Leptocottus armatus*) emphasizing assessment of endocrine systems regulating stress responses, growth, repair, thyroid, and reproduction. Endocrine systems are sensitive, responsive, and reflective of stressors. His group is also evaluating contaminants in individual fish livers to correlate between specific contaminants and types of endocrine disruption.

2006 samples were collected at San Pablo Bay, Berkeley Waterfront, Oakland Harbor, Redwood City, and Tomales Bay. Tomales Bay is the far field reference site.

The hypothalamo-pituitary-interrenal (HPI) axis releases cortisol in response to stress. Kevin Kelley found that both Pacific staghorn sculpin and to a lesser extent shiner surfperch from Oakland Inner Harbor and San Pablo Bay did not produce normal responses to stress. They found impaired responses from the thyroid endocrine system and hypothalamo-pituitary-thyroid (HPT) axis, in Pacific staghorn sculpin from San Pablo Bay, Oakland Harbor, and Berkeley Waterfront and, to a lesser extent, in shiner surfperch from Oakland Harbor. Preliminary results of the growth hormone IGF (insulin-like growth factor) are inconclusive. Kevin Kelley's group is also looking at 17β -estradiol and the hypothalamic-pituitary-gonadal (HPG) axis in shiner surfperch. Pacific staghorn sculpin are not appropriate for measuring disruption of the HPG axis because they are immature when caught and have undeveloped gonads. They have not found 17α -estradiol in San Francisco Bay, but it has been detected in the Southern California Bight.

2006 was the first year of measuring chemicals in individual fish livers. The researchers detected the following chemicals in liver: chlordane-gamma, chlordane-alpha, trans-nonachlor, cis-nonachlor, 4,4'-DDE, naphthalene, 2-methylnaphthalene, 1-methylnaphthalene, biphenyl, fluorine, phenanthrene, and PCB 95, 149, 138, 180, 194, and 153. Kevin Kelley indicated that they have been able to correlate the contaminant loads with fish effects. There is a trend towards higher levels of contamination in Pacific staghorn sculpin. The results were not normalized for lipid content, so if Pacific staghorn sculpin have more fatty livers this may be skewing the results.

Tracy Collier commented that he was surprised that Kevin Kelley's group had detected LPAHs (low molecular weight PAHs); he would have expected them to be metabolized.

Samples have been collected from San Pablo Bay (Loch Lohmand Marina), Richmond (Lauritzen Channel), Richmond/Berkeley Waterfront, Oakland Inner Harbor, San Leandro Bay, San Francisco Waterfront, Hunter's Point, Redwood City, Tomales Bay, and Bodega Bay in 2007. Tomales and Bodega Bay are the far field reference sites. Santa Catalina Island (Two Harbors) and LA Harbor (Inner Cabrillo Beach) were also added.

Kevin Kelley presented the status of the 2007 work. His group has continued to look for parasites. Less than 10% of Pacific staghorn sculpin have parasites. The prevalence of parasites on shiner surfperch is more variable. Approximately 60% of fish from Redwood City have parasites, 55% from San Leandro Bay, 60% from Richmond Waterfront, and 20% from Richmond-Lauritzen Channel. The presence of parasites is strongly correlated with gill damage. They will continue to look at gill damage and parasites. Cortisol measurements are completed and the data are currently being analyzed. Sex ratios and gonadal somatic indices have yet to be determined for each site. Interrenal histological work and liver contaminant measurements are underway. Cortisone measurements, ACTH-challenge to determine if interrenal responsiveness is impaired, growth endocrine system impacts, and steroidogenic enzyme expression work have not yet begun.

J. Draft Five-year Plan for Fish Effects Work

Meg Sedlak presented the five-year plan for fish effects work. She introduced the management context for fish work in the Bay. San Francisco Bay is critical habitat for estuarine fish (e.g., Delta smelt), marine fish (e.g., herring and anchovies), and anadromous fish (e.g., Chinook salmon, steelhead, sturgeon) including nine endangered species. Many of the Bay fish are in population decline, the reasons for which are unclear but may include water diversions, invasive species, loss of habitat, and/or contaminants. There is a lack of regulatory fish effects standards or guidelines. One that does exist is NOAA's 1 ppm PAH threshold for disposal of dredged sediments. The concentration of PAHs in San Francisco Estuary sediment is generally much higher than this guideline.

Meg Sedlak presented the specific questions proposed for the next five years of fish effects work.

1. Are pollutants, individually or in combination, reducing viability of fish populations?
2. What are appropriate thresholds for PAHs in sediments to protect fish?
3. What are cost-effective indicators for monitoring fish effects?

Past fish effects studies in the Bay have included relatively few marine fish effects studies. Starry flounder have been studied from PAH and PCB contaminated sites and were found to have a higher incidence of aryl hydrocarbon hydroxylase (AHH) an indication of cytochrome P450 induction, lower egg survival, decreased fertilization, and decreased embryo success. A study of flounder found increased liver lesions correlated with higher concentrations of PAHs, PCBs, and pesticides.

Past fish effects studies by the RMP have included studies of white croaker, shiner surfperch, and Pacific staghorn sculpin. A study of white croaker found a significant increase in liver lesions in white croaker, but it was difficult to correlate contaminants with effects. A study of the effect of contaminants on growth, fitness and reproduction of shiner surfperch found a skewed sex ratio, few histopathological effects, and somewhat ambiguous results from ethoxyresorufin-O-deethylase (EROD) activity, which is used as a biomarker of chemical exposure. Kevin Kelley's on-going study is evaluating hormones and contaminants in shiner surfperch and Pacific staghorn sculpin.

Meg Sedlak presented priorities for fish effects work:

- Link current effects work to population-level evaluations
 - Identify fish effects
 - Identify suitable biomarkers of effects
 - Apply models to translate individual effects to population-level effects
- High priority pollutants
 - PAHs
 - PCBs
 - Endocrine disruptors
 - Others?
- Lower priority pollutants
 - Legacy pesticides
 - Trace metals
 - Others?
- Evaluate thresholds for decision-making in the Bay
 - PAH threshold
- Implement use of fish effect indicators in S&T triennial sportfish monitoring
 - Liver lesions
 - Gonad histopathology
 - Incidence of parasites
 - Others?

Letitia Grenier noted that it is hard to scale effects to a population level. She suggested designing studies with a quantitative catches (e.g., constant effort) in order to start answering population questions. She noted that models have high uncertainty.

Tracy Collier noted that fish can be recruited from many areas. He suggested using otoliths to determine nursery areas based on micro-chemistry. He suggested that this would allow researchers to determine if the fish were from nurseries with urban or non-urban signatures.

Tracy Collier said he thought the questions were good. He suggested that the focus on sediment may be limiting and suggested including loading of non-accumulating compounds from POTWs, run-off, etc.

Don Weston noted that population effects are only included in the last two paragraphs of the workplan. He suggested that we determine what our ultimate goal is and make sure that the

plan addresses that issue. He suggested that we focus on effects now and then work on population wide issues.

Ben Greenfield noted that Don Weston's comments were accurate. He asked if we can bridge from individual effects to population effects and if so, is it advisable to do so? If not what are the alternatives to get at population effects?

Dan Schlenk suggested that reproduction is a missing segment in the workplan and studies, which links individual effects to population effects. Reproductive indices can estimate population changes. He suggested adding a gender component to the sportfish study. He noted that POD researchers have found that the young of year are missing and that this immediately implies two possible causes spawning issues or first year survival issues.

Kevin Kelley noted that growth is a critical aspect that can be tied to population effects.

Tracy Collier suggested broadening question 1 to include reproduction, growth, and health. He suggested future funding of a model that would tie results on reproduction, growth, and health to population effects.

Kevin Kelley noted that immuno-depression can be tied back to survival.

Tracy Collier noted that parasite susceptibility can be affected by contaminants.

Karen Taberski noted that the questions cover management issues and that she agrees with the proposed refinements. She suggested making sure that the link back to contaminants is made. She noted that 1 is all encompassing and that 2 and 3 are more management related and practical. She indicated that she supports adding sexing to sportfish.

Steve Weisberg indicated that he feels that the current prioritization order is correct, 1, 2, 3.

Ben Greenfield suggested that studies focused on question 1 build off of the on-going shiner surfperch and Pacific staghorn sculpin studies. He noted that the Pacific Estuarine Ecosystem Indicator Research (PEEIR) has done work on long-jawed mudsuckers in wetlands may be useful for question 2. He suggested that zooming out for question 3 might be useful.

Dan Schlenk suggested choosing a target species in known decline. He noted that the intervariability of genomics is huge.

Chris Pincetich suggested that question 3 be changed to "cost-effective and robust".

Karen Taberski suggested that "potential" be added to question 1.

Dan Schlenk suggested that water soluble compounds have been found to cause estrogenic activity. He suggested doing a TIE. Tracy Collier noted that the strongest indicator of

reproductive impairment not tied to PAHs appears to be wastewater effluent and that waterborne exposure has been linked to vitellogenin production.

ACTION ITEMS:

- **Meg Sedlak to revise table based on workgroup's feedback and present to committee**

K. Selection of Pilot Studies for 2008

The advisory panel went into closed door session to rank the proposals. Based on the EEPS priorities identified at the day's meeting, the panel ranked the proposals as follows: Hg-Se in terns; Effects of PAHs on early life stage development; and EDCs and contaminants in fish. Funding for the first two studies will consume the EEPS budget for 2008; the EDC fish study will be recommended for funding through the general pool of 2008 RMP funding.

Next meeting Monday November 26th