

RP Comments on the Draft Fish DARP

OVERVIEW:

The current draft of the Fish Section to the Damage Assessment & Restoration Planning (“Draft Fish DARP”)¹ examines the possible effects of the *Cosco Busan* oil spill on various aquatic species. The Trustees have concluded that there was either no evidence or inconclusive evidence of injury for most of the species studied. The Trustees, however, concluded that Pacific herring were injured by exposure to oil spilled from the *Cosco Busan* (“CBO”).

The RP disagrees with the Trustees conclusion regarding injury to herring, for several reasons. First, there is no evidence that CBO was present in the tissues of abnormal herring embryos from the 2008 studies, or in the surrounding waters or sediments. In fact, all of the tissue, water and sediment sample analyses for 2008 associated with the abnormal embryos were negative for CBO polycyclic aromatic hydrocarbons (PAHs). Thus, there is no evidence of exposure of the affected embryos to CBO.

Moreover, since other environmental factors can lead to poor hatch rate and embryo abnormalities like those observed in the 2008 studies, the Trustees should have undertaken to examine whether the abnormalities observed may have been caused by these other environmental factors. Because the Trustees failed to show that the abnormal embryos were exposed to CBO, and failed to examine whether other potential factors caused the observed abnormalities, the Trustees cannot reasonably conclude that CBO caused injury to Pacific herring.

4.3.3

The RP concurs that it is unlikely that significant amounts of oil would be found submerged due to the specific gravity of the oil, and agree with the Trustees conclusion that it is unlikely that the *Cosco Busan* oil spill (“CBOS”) had measurable impacts on fish or other organisms inhabiting subsurface waters. This fact is important when assessing impacts of CBO on subtidal herring embryo samples.

While the Trustees acknowledge that some of the oil had evaporated or decayed in the first week, the Draft Fish DARP fails to acknowledge that over 19,000 gallons of CBO were recovered during clean-up operations and that additional decay and evaporation occurred over time beyond the first week. The clean-up response effort following the CBOS resulted in one of the highest ever recovery rates for spilled oil.

¹ The draft Fish DARP references an Appendix D. This Appendix has not yet been provided to the RP, and therefore the PR’s Comments and Proposed Revisions are subject to receipt and review of said Appendix D.

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This fact is significant in assessing any possible injury from CBO, and should be addressed in the Draft Fish DARP.²

We suggest adding the following language to the Fish DARP on the first page:

“In the initial days and weeks after the spill the Trustees investigated the potential for injuries to several species of fish, crabs, and other aquatic fauna from the *Cosco Busan* oil spill. These animals may be harmed by oil spills if they are exposed directly to the oil, or to a fraction of the oil that may dissolve into the water, or if they eat contaminated prey.

The type of fuel oil spilled, IFO-380, is a thick black oil with a specific gravity less than that of seawater or bay water, making it unlikely that significant amounts of oil would be found submerged. Past experience and scientific models (e.g. California Type A Model from Applied Science Associates) suggest that a week after the spill approximately 90% of the *Cosco Busan* oil remaining in the environment was either beached or still floating on the surface of the water, 8% had evaporated, 2% had decayed, and less than 0.01 % was in the water column. It is also important to note that over 19,000 gallons of the 53,000 gallons of *Cosco Busan* oil was recovered during clean-up efforts following the spill. Additional decay and evaporation of the *Cosco Busan* oil occurred over time.”

4.3.3.1

The Draft Fish DARP notes on page 3 under the subheading “Report on the Safety of Consuming Fish and Shellfish from Areas Impacted by the M/V Cosco Busan Oil Spill in San Francisco Bay, California” that mussels collected from two locations exceeded the human health concentration limit for benzo[a]pyrene equivalents. However, laboratory analyses clearly demonstrated that the source of the benzo[a]pyrenes was from a combustion byproduct or byproducts which were not present in CBO. Thus, CBO was not the source of the elevated levels of benzo[a]pyrene. The current reference under the sub-heading is misleading and should be deleted, or at a minimum clarified.

We request the following language be added to this section 4.3.3.1:

- i **“Report on the Safety of Consuming Fish and Shellfish from Areas Impacted by the M/V Cosco Busan Oil Spill in San Francisco Bay, California**
 - ± On November 13, 2007, California governor Schwarzenegger issued an

² There appears to be a typographical error on the top of page 2 third line of the first full paragraph. The word, “Forshorelines” should be “shorelines.”

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executive order suspending all fishing for human consumption in a five county area and ordered the Office of Environmental Health Hazard Assessment in conjunction with the Department of Public Health to issue a consumption advisory and conduct an assessment of potential human health risks from consuming marine life caught from areas affected by the spill. Several species of commonly caught fish and shellfish were collected and analyzed to determine levels of contamination and safety of human consumption. A report was prepared by California Environmental Protection Agency. The report concluded that consumption advisories should be lifted for all species and areas with the exception of mussels collected from Berkeley Marina and Rodeo Beach, because mussels collected from these two locations exceeded the human health concentration limit of concern for benzo[a]pyrene equivalents. It is important to note that benzopyrenes are products of the combustion of petroleum products. Since the Cosco Busan oil that was spilled consisted of uncombusted fuel oil, the benzo[a]pyrenes detected in the mussels collected from Berkeley Marina and Rodeo Beach could not have been related to the Cosco Busan oil spill.

The Draft Fish DARP should address the fact that herring spawning areas were treated as a high priority during cleanup operations. Shorelines in these areas were a primary focus of the clean-up operations; they were carefully inspected, and any discovered oil was swiftly removed by qualified clean-up crews well before the herring spawning season. In fact, several months elapsed between the time of the spill/clean-up and the arrival of Pacific herring. It is not surprising therefore that no CBO was detected in sediment or water samples taken during the collection of herring embryos. The lack of CBO on the shorelines, in the water or in the sediment in herring spawning areas strongly supports a finding that the herring embryos were simply not exposed to CBO. This point is further confirmed by the fact that no CBO was found in any herring embryo tissues.

We suggest the following specific language change, in addition to a document-wide adjustment:

- **“Herring Spawning Locations Assessment**
 - ± Historical spawning data were obtained and analyzed, to compare with areas impacted by oil. A map was created that overlays recent herring spawning locations with SCAT data on oiled shorelines and tar ball collections. The map layers indicated that herring were likely to spawn in several areas where shorelines had been oiled by the spill. A concerted effort was made to clean the Cosco Busan oil from these efforts and the clean-up was completed well before spawning occurred in the areas.”

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In regards to the Herring Spawning Site Water Sampling, the Draft Fish DARP should specify the date when the water sample designated a “probable match” to CBO was collected.

The RP does not agree with the statement in the Draft Fish DARP that Keil Cove was “moderately to heavily oiled.” Based on categorizations in other oil spills, Keil Cove would be moderately oiled.

Please note the following proposed change to the Draft Fish DARP:

- **“Herring Spawning Site Water Sampling**

- ± Water from oiled herring spawning sites and non-oiled control sites were collected and analyzed for Polycyclic aromatic hydrocarbons (PAHs). A water sample collected offshore of Tiburon in Keil Cove (which had been moderately to heavily oiled) was determined to be a probable match with the *Cosco Busan* source oil. However, this sample was taken prior to Keil Cove oil spill clean-up activities, and before any spawning occurred in the area.”

The RP concurs with the Trustees’ summaries of the Submerged Oil Screening Survey, Redwood Creek Salmon Data Analysis, Tidewater Goby Habitat Assessment, Tidewater Goby Surveys, Dungeness Crab Analysis and the California Grunion Assessment. In fact, we believe that the herring toxicity benchmark analysis should be more aligned with the toxicity benchmark analysis used for grunion. While the Trustees have considered the increase in ocean temperatures as a factor that may impact grunion populations, this same consideration is not included in the analysis for herring.

The accompanying reports prepared by NewFields articulate multiple stressors known to cause adverse effects in Pacific herring embryos. Despite the facts that no CBO was present in the water or sediments when Pacific herring were spawning, and no CBO was found in embryo tissues, the Trustees dedicated themselves to proving that CBO caused the observed abnormalities in Pacific herring embryos. In so doing, the Trustees unfortunately ignored the likelihood that those abnormalities were caused by other factors.

Under the subheading “Herring Spawn Collection and Developmental Assessment,” we believe it appropriate to clarify that the herring eggs were collected from shallow intertidal areas. Additionally, it should be noted in the Draft Fish DARP that because the hatch was excellent in the subtidal areas, the poor intertidal hatch rates did not translate into an impairment of reproductive success.

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Please note the following proposed edits to the text of the Draft Fish DARP:

“• 2007/08 Herring Spawning Studies

± **Herring Spawn Collection and Developmental Assessment**

Natural and artificially spawned herring eggs were collected from locations both inside and outside the spill zone after the areas had been cleaned, and were examined for pre-hatch mortality, hatching rates and embryo-larval deformities. The result was that naturally spawned herring eggs collected from shallow intertidal areas inside the spill zone suffered very high levels of mortality, embryo-larval deformities, and poor hatching rates, while those from outside the spill zone were largely normal. Results were not as dramatic for artificially spawned herring placed in cages in deeper, subtidal water, leading to a hypothesis that the more dramatic effects found in the natural spawn collected from shallows may have been a result of photo toxicity. However, it must be noted that the disparity in hatch rates between the subtidal and intertidal areas do not translate to an indication that hatch rate in the intertidal areas was impaired.”

We believe that it is important to note in the Draft Fish DARP under the “PEMD and Sediment Study” subheading that no CBO signature was found in the analysis of the PEMD samples. Without evidence of the presence of CBO in the herring embryo sampling areas, there is no evidence of exposure of the herring eggs or embryos to CBO, and thus no causal connection between poor hatch rate and abnormalities and the CBOS. It likewise should be noted in the “Herring Tissue PAH study” section that the tissues from herring collected in intertidal areas within the spill zone did not contain any trace of CBO.

See suggested edits to the Draft Fish DARP below:

± **“PEMD and Sediment Study**

At the same time as the 2007/08 Herring Spawning Study, polyethylene membrane devices (PEMDs) were also deployed in the water column and sediments were collected at each herring egg or cage study sampling location in order to measure PAH and Persistent Organic Pollutants (POP) levels in the water column and sediments. The result was that no *Cosco Busan* oil signature was found in the samples taken. Without the presence of a *Cosco Busan* oil signature in the herring embryo sampling areas, it cannot be determined that there was any exposure of the herring embryos to the *Cosco Busan* oil. It therefore cannot be determined that the abnormalities observed in the herring embryos or the poor hatch rate were due to the *Cosco Busan* oil spill. PAH and POP levels inside and outside the spill zone did not show a strong spatial pattern several months after the spill. “

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In the discussion of the 2009 Laboratory Herring Injury Studies, the Draft Fish DARP should clarify that, although the lab studies were intended to mimic intertidal conditions, it is not certain that the lab studies actually did so. We request the words “attempt to simulate” replace the words, “in a way that mimics.” Also, there is no mention of the substantial and well documented difficulties that were encountered when running the laboratory tests, including the algal blooms that were noted throughout. The omission is material and we suggest that these difficulties be identified.

Please see the following proposed edits:

“• 2009 Laboratory Herring Injury Studies

A study testing hypotheses about *Casco Busan* bunker oil toxicity and phototoxicity to herring eggs was conducted by NOAA's Northwest Fisheries Science Center and the University of California Bodega Bay Marine Laboratory. An array of flow-through oiled gravel columns were prepared to generate various doses of dissolved oil constituents in seawater ~~in a way that mimics~~ in an attempt to simulate intertidal conditions following an oil spill. The gravel columns included replicates of clean gravel, typical urban gravel, and three doses each of *Casco Busan* bunker oil and Alaska North Slope crude oil (the latter being a type of oil that has been extensively studied for contaminant effects since the 1989 Exxon Valdez oil spill and provides a useful comparison with bunker oil). Half of the columns were exposed to ultraviolet light (UV) from natural sunlight and half were UV shaded. Endpoints of embryonic and larval development and hatching success were measured, and concentrations of PAHs were analyzed in eggs and water. The success of these experiments in achieving the goal of replicating intertidal conditions was questionable. Several factors confounded the experiments. The samples were clouded with algal blooms, water flow issues created temperature extremes, poor egg quality was noted in at least one run, and increased oxygen saturation and pH drift were also noted. At the request of the RP, an additional study also was conducted to examine potential effects on developing herring embryos from different salinities of water. Results and more detailed information on these studies are provided below (Section 4.3.3.2) and further detailed in Appendix D.”

The RP has not yet seen the 2010 Herring Spawning Study results which are referenced. We look forward to receiving this data and will comment further when we have that information. However, the Draft Fish DARP seems to indicate prematurely there was a phototoxic effect from the spill, despite the lack of a CBO signature in any samples obtained from the spill areas.

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We request that the word “lingering” be removed from the Draft Fish DARP when referring to phototoxic effects

“• 2010 Herring Spawning Study

Herring eggs were collected from shallow areas in the vicinity of two of the 2007/08 sample sites, Sausalito and Keil Cove, and from Paradise Cove, a site that was not oiled after the spill. Suitable spawning did not occur at appropriate depths for collection at the other prior 2007/08 sample sites. Examination of herring spawn from these sites to determine degrees of pre-hatch mortality, abnormalities, and hatching rates found no evidence of ~~lingering~~ phototoxic effects from the spill, i.e., the natural spawn from all sites was normal (greater than X% hatch rates and low X% levels of larval deformities). [waiting for numbers in final report]”

4.3.3.2

The opening sentence of this section gives the impression that there was an abundance of oil remaining on shorelines in the spawning areas. As noted above, these areas were cleaned well before the spawning season. Moreover, water and sediment samples taken in late January and early February found no trace of CBO. It is also argumentative and somewhat misleading to represent that naturally spawned herring eggs were collected “soon after the spill.” Preferably, the actual collection dates should be included.

Suggested revisions to the Draft Fish DARP follow:

~~Because most of the Casco Busan oil that was not cleaned up became stranded along shorelines, †~~ The Trustees conducted an in-depth assessment of the potential for injuries to spawning Pacific herring. Because of their spawning behavior and high sensitivity to oil toxicity, the Trustees considered herring to be a reasonable proxy for nearshore spawning species of fish in San Francisco Bay at risk for exposure from the spill (see Appendix D). Furthermore, restoration activities focused on herring also will benefit other nearshore spawning species.

Sampling and photographs documented the presence of *Casco Busan* oil at several locations where Pacific herring typically spawn in San Francisco Bay. ~~Soon~~ During the first spawning event after the spill and after the shoreline in the spawning areas had been cleaned, the Trustees were able to collect naturally spawned herring eggs at three sites along the southern Marin County coast that were oiled, and from one unoiled site along the northern Marin County coast. These samples were examined and dramatic differences were observed in the developing embryos collected from oiled and unoiled sites. Eggs collected from oiled sites had a high proportion of mortality in late term embryonic development and poor hatching outcomes, while eggs collected from the unoiled site developed and hatched normally.

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As stated before, while a high mortality rate and poor hatching outcomes may have been observed, these conditions could have well been caused by other environmental factors. It is undisputed that CBO was not detected in any of the embryonic tissue samples.

When discussing the water depths at which the eggs were placed and collected, we believe it would be more informative to note the actual depths. For natural spawn the depth was 0 to +1 ft MLLW and for caged eggs the depth was -3 to -6 ft MLLW.

While the Draft Fish DARP concludes that there were elevated occurrences of cardiac edema in the embryos that developed from caged eggs in oiled sites, subsequent analysis demonstrated that this was due to the technique utilized to measure the pericardial edema. The variability inherent to the technique was so high that it could not be reasonably relied upon or used to distinguish any differences between oiled and reference areas. The live normal hatch rate from all sites from artificially spawned eggs was excellent and no adverse effects could be attributed from CBO to eggs in the subtidal areas.

The Draft Fish DARP appears to conclude that the 2009 laboratory tests confirm that a phototoxic effect occurred in the 2008 herring spawn from the presence of CBO. However, laboratory analyses were able to detect levels of CBO in herring eggs used in the laboratory tests, demonstrating that CBO exposure resulted in a distinct PAH chemical signature at all exposure concentrations. This chemical signature was not present in any of the 2008 field collected organisms including tissues from deformed larvae, the sediments or the PEMD. The Trustees offer no explanation for this phenomenon.

Further, the Draft Fish DARP states that the Trustees found no evidence that other factors caused the high mortality rates in the herring embryos. The RP is unaware of any efforts undertaken by the Trustees to consider or investigate the possibility that other environmental factors caused or may have caused the elevated mortality rates. The RP requests that the Trustees include a written description of such efforts to investigate and rule out other factors. Also, please consider and refer to the NewFields Reports (enclosed) that demonstrate that other factors do, in fact, lead to and cause the abnormalities found in the 2008 herring embryo samples.

It seems only fundamental fair that the Draft Fish DARP include details as to why the RP consultants do not agree with the conclusions of the Trustees regarding herring injury. The RP points to the fact that no trace of CBO was found in any of the tissue samples, water samples or sediment samples collected in 2008 from spawning areas. They further point out that other potential causes or factors were not adequately examined or ruled out by the Trustees. Indeed, the RP consultants affirmatively assert that in an environment as dynamic as San Francisco Bay, there could be many potential explanations for the abnormal herring embryos observed in

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2008. The RP also contends that the poor survival of herring embryos observed in intertidal areas in 2008 would not have resulted in decreased herring numbers, since reproductive success in nearly all subtidal areas was normal. Additionally, the RP believes that the Trustees must consider the recent observations of herring numbers in San Francisco Bay for the most recent seasons. For example, preliminary observations of the herring spawning biomass in 2010-2011, indicate that the spawning biomass continues to increase over previous years.

In regards to restoration, the RP concurs with the alternatives proposed by the Trustees. The Trustees should examine the site suitability prior to beginning any restoration program. If this has been done, please provide the RP with that information.