RP Comments on the Herring Injury Quantification

The Herring Injury Quantification attempts to quantify the injury to San Francisco Bay (SFB) herring resulting from the *Cosco Busan* Oil Spill (CBOS). The Trustees approach includes quantification for a high exposure and low exposure scenario. The Trustees' approach does not reasonably account for all factors which may have impacted these herring. More importantly, the approach does not account for the fact that there is no chemical analytical evidence linking the injuries to oil spilled from the *Cosco Busan* (CBO). Additionally, no historical effects are considered and the effects of background mortality on spawn output are not taken into account. Please see RP Comments on the Draft Fish DARP (provided concurrently) for a more complete summary of these issues. Without reasonable consideration of other factors that could easily impact the herring, the Trustees' analysis cannot accurately measure the impact that CBO may have had on Pacific Herring.

For the high exposure scenario, the Trustees estimate that 29.1% of the spawn or 255.9 billion eggs are expected to have been subject to lethal abnormalities derived from the CBOS. For the low exposure scenario, they estimate that 13.5% of the spawn or 118.8 billion eggs are expected to have been subject to lethal abnormalities from the spill. The quantification methodology relies on the estimates of hatching rate and frequencies of larval abnormalities at hatch provided by the investigators at the Bodega Marine Laboratory (BML) working with NOAA. BML's examination of larvae at hatch provides a better and more certain estimate of any untoward effects than does the examination of dechorionated embryos that NOAA performed.

The numbers of herring eggs in various areas of SFB are estimated from CDFG data. These data are more detailed than those which were previously provided to the RP. The biomass is estimated first and the numbers of eggs are estimated presumably from data on the fecundity of females observed at the time of spawning. The total spawning biomass in the Herring Injury Quantification appendix is 9,989 tons while that in the Annual EIS is 10,429 short tons. The Herring Injury Quantification estimate is less by 440 tons or about 4%. The RP had difficulty in aligning the spawn data in the Herring Injury Quantification with the spawn data in the annual herring EIS on a location by location basis. Please provide additional information on how this was performed.

The spawn distribution is estimated for three habitats: shoreline, rocks and vegetation; submerged vegetation; and, vertical structures. The percentage of spawn was estimated for shallow and deeper exposure within two scenarios: high and low exposure. These percentages were assigned by a GIS analysis for the submerged vegetation. The basic assumptions appear to be that all the eggs within an oiled area were exposed except that deeper areas of submerged vegetation and deeper locations on vertical structures have less exposure. The assumptions are, however, in direct conflict with NOAA's own NRDA regulations; exposure does not

equate to injury. The Trustee assumptions over estimate exposure and therefore over state the injury to Pacific Herring due to CBO.

The injury estimate is based on the frequencies of mortalities and larval abnormalities taken from the 2008 NOAA Report and used to establish the potential bounds of impact for three components of the 2007/2008 deposited herring eggs. These components are:

1. Naturally spawned (NS) eggs from the intertidal zone: From Table 3-4, the total impact (mortality plus abnormalities in live hatched larvae) has been calculated assuming 95% (mortality and live abnormalities) for oiled locations and 26% for reference areas.
2. Artificially spawned (AS) embryos deployed in the subtidal zone, High end scenario: From Figure 3-13, the total impact (mortality plus abnormalities in live hatched larvae) has been calculated assuming 15.9% (mortality and live abnormalities) for oiled locations and 9.4% for reference areas.
3. Artificially spawned (AS) embryos deployed in the subtidal zone, Low end scenario: From presumably the BML data supporting the 2008 NOAA Report, the impact manifested as edema has been calculated assuming 1.6% for oiled locations and 0% (zero) for reference areas.

The difference between oiled and reference areas is significant for the natural spawn (1 above). However, it is important to note that this difference is not statistically significant for the overall mortalities and abnormalities in the artificial spawn (2 above) or for the edema in the artificial spawn (3 above).

In summary, the main issue we find is that the attribution of injury to all the eggs within the oiled area is inappropriate when the exposure pathway was not and cannot be demonstrated. Moreover, there are credible alternative explanations.

The points that are not addressed by the Trustees include:

- There was no CBO signature.
- The signature present in the eggs from 2008 was either from urban runoff or creosote.
- For the caged embryos, the percentages between oiled and reference are not significantly different.
- For edema in the caged embryos, the 1.6% in the oiled areas is within expected background based the frequencies found in the controls and reference areas of other studies.
- The potential for creosote exposure is entirely ignored, especially for the San Francisco waterfront. (BML wrote the initial scientific paper demonstrating

that creosote in pilings is toxic to herring eggs. Almost 50% of the spawn was along the San Francisco waterfront.)

- The caveat that recognizes the presence of other factors operating but then ignores such factors is not scientifically credible.

The conclusion that between 13.5% and 29.1% of the herring eggs spawned in 2008 were subject to lethal abnormalities attributable to the CBOS is not supported by an examination of the all the available data and information. Additionally, the operation of natural factors in the production of mortalities and abnormalities cannot be ignored from a scientific perspective.