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Summary Comments from Peer Review of Athos Aquatic Injury and Shoreline Injury Reports (including Trustee responses to RP concerns)

Shoreline Injury Report (including responses to RP concerns)

General Comments

On the whole, this injury assessment is a highly professional job, based upon extensive SCAT surveys, Athos oil chemistry and physical characteristics, and well informed expectations of degree of injury to ecosystem services and their rates of recovery as a function of habitat type and oiling. The knowledge of results of quantitative assessments of critical ecosystem services, notably metrics of plant biomass and benthic invertebrate biomass, following analogous oil spills in the past is used effectively to justify expectations of degree of injury and rates of recovery in the Athos spill. In other words, the absence of extensive and expensive quantification of reduction in vascular plant production, secondary production by benthic invertebrates, and vertebrate use of shoreline habitats after the Athos spill does not prevent the Trustees from developing a credible and convincing estimation of quantitative injury of shoreline ecosystem services. I also agree with the habitat equivalency ratios applied to convert time-discounted cumulative injuries in various habitat types to marsh DSAYs (Discounted Service Acre-Years) in contemplation of compensatory restoration.

Specific Comments

- (1) Given that most of the injury to ecosystem services of shoreline habitats is assumed to have occurred through physical effects of smothering by this heavy crude, it is important to include (probably just in as Appendices in the Aquatic Injury report, where it can be cited here in the Shoreline Injury report) more complete data summaries from the amphipod sediment toxicity testing that was done both as part of the Harwell study of pre-existing service degradation in this industrialized river system and then also on multiple dates and places by Greene

- after the Athos spill. This information is critical to two issues. First, it identifies clearly and quantitatively that despite industrialization and past levels of contamination in this region of the Delaware River, ecosystem services by this metric of sediment toxicity were only depressed by 10% before the spill. Second, these toxicity results reveal that the presence of abundant Athos oil on the bottom resulted in substantial further toxicity despite concentrations of PAHs that would not be expected to elicit much or any acute toxicity. This is the basis on which the reasonable and compelling judgment is made that the physical smothering/fouling plus some unknown degree of toxicity from the unresolved mixture components of the oil is the major cause of mortality and ecosystem service loss from the Athos oil.
- (2) Although re-distribution of the oil from high on the shoreline to the flats below them during hotsy cleaning almost certainly does not result in the same level of oiling and thus injury to these subtidal flats as documented for the initially oiled zone, I did wonder about the basis for assuming a two-level step-down in oiling intensity. Evidence from the Bouchard and perhaps other previous spills might be highlighted more strongly in support of the two-level step-down.
 - (3) When oil penetrates into sediments to depth, there is potential for very long-term injury and slow recovery over multiple decades, as demonstrated especially in the oiled marshes of Buzzard's Bay after the barge Florida spill (Teal and Howarth 1984: Environmental Management Vol. 8). It might be appropriate in this Shoreline Injury document to acknowledge that potential but to emphasize the field work done here after the Athos that demonstrated no oil penetration to depth in the marsh sediments. This set of excavations represents the basis for concluding that recovery of marsh services after heavy oiling from Athos would be complete after 4 years as opposed to a far longer time trajectory.
 - (4) Based on many publications following the long-term impacts of the Exxon Valdez oil spill, it is clear that if oil is sequestered in sediments under conditions where physical, photolytic, chemical, and biological degradation is inhibited that long-term exposure can occur and cause chronic mortality from exposure to multi-ringed PAH compounds. Thus, the lower molecular-weight PAHs are not required to induce important levels of toxicity. Fish eggs and crustacean eggs that rest on the bottom are especially at risk of this type of chronic injury. In this context, I am not fully convinced that the shallow subtidal channels in oiled tributaries might not be sites of some chronic exposure and injury not now contemplated or included in the Shoreline Injury report. This system is now assumed to be fully recovered in 1 year. I would suggest mentioning this possibility of some chronic injury to fish or crustacean eggs as a counter-response to the RP's concern that injuries are over-estimated in the tributaries.
 - (5) I am particularly impressed by the careful QA/QC procedures used in this injury assessment.
 - (6) I also am impressed by the comprehensive nature of the SCAT surveys covering shorelines of 3 states and providing detailed documentation of extent and degree of oiling by habitat.
 - (7) There may be relevant data that could be cited in work sponsored by Allan Mearns of NOAA Hazmat after the Exxon Valdez oil spill to assess impacts of

- injury to shoreline organisms (on both hard and soft substrata) from pressurized hot-water clean-up. Dennis Lees was the principal scientist involved in the research on the soft-sediment organisms. Citation of this work could add support for assumptions about the duration, extent, and intensity of injury to benthic invertebrates from hotsy operations on (for Shoreline injury) and maybe below (for Aquatic injury) soft-sediment intertidal shores. Some publications are included in the American Fisheries Society Volume on the Exxon Valdez oil spill. Annual reports were also compiled and should be available from Dr. Mearns.
- (8) Trustee responses to issues raised by RP comments are professionally prepared and compelling. I am particularly compelled by the examples of careful computations done to assess how big an issue some of the RP concerns might be and the demonstrations that the concerns raised, even if valid, would not modify total injury computations substantially.
 - (9) On rare occasion, some of the Trustee responses to RP concerns essentially state that certain decisions that are now challenged were jointly made by Trustee and RP representatives without complaint or dissent. That is indeed an important part of the response. However, such responses should also be expanded, where appropriate, to include the logical scientific grounds on which that choice was initially made.
 - (10) Table 4 might clarify that birds don't nest on intertidal sand flats: they may loaf there when tide is out and nest on higher ground.

Aquatic Injury Report (including Trustee responses to RP concerns)

General Comments

On the whole, this aquatic injury report is an impressive, highly professional job, based upon extensive VSORS and other bottom observations, amphipod sediment bioassays, chemical analyses and physical characteristics of the Athos oil, SCAT surveys of shorelines, and integrated knowledge of impacts of past analogous oil spills. The estimation of injury to aquatic ecosystem services represented a challenge, and one that was met successfully, in the absence of more extensive field sampling of the biota. Concluding little or no injury to the water-column biota because of the relatively very low concentrations of MAHs and lighter PAHs in Athos oil and the propensity of the heavy oil to sink seems well justified. Concluding relatively modest and short-lasting impacts to benthic invertebrates, based on low concentrations of toxic components, yet sediment toxicity in amphipod bioassays that disappeared over time, is also compellingly justified. In an ideal situation, sediment toxicity testing would have been conducted over a broader scope of the river bottom, but knowing the reality of the constraints to support field sampling after oil spills, I have nothing but praise for the logical basis on which aquatic injury is inferred and quantified in this report. Although there are some few studies of physically caused mortality of oil through suffocation/fouling and some tests of the toxicity of the unresolved mixture components of petroleum hydrocarbons, more

future study of mechanisms of these pathways of injury will be helpful for assessing injury in incidents similar to the Athos spill.

Specific Comments

- (1) Given that most of the injury to ecosystem services of aquatic habitats is assumed to have occurred through physical effects of smothering bottom organisms by this heavy crude, it is important to include more complete data summaries from the amphipod sediment toxicity testing that was done both as part of the Harwell study of pre-existing service degradation in this industrialized river system and then also on multiple dates and places by Greene after the Athos spill. Specifically, the bioassay reports of Greene should be added as Appendices. This information is critical to two issues. First, it identifies clearly and quantitatively that despite industrialization and past levels of contamination in this region of the Delaware River, ecosystem services by this metric of sediment toxicity to amphipods were only depressed by 10% before the spill. Second, these sediment toxicity results in the sediment triad analyses reveal that the presence of abundant Athos oil on the bottom near Tinicum Island resulted in substantial further toxicity despite concentrations of PAHs that would not be expected to elicit much or any acute toxicity. This is the basis on which the reasonable and compelling judgment is made that the physical smothering/fouling plus some unknown degree of toxicity from the unresolved mixture components of the oil is the major cause of mortality and ecosystem service loss from the Athos oil.
- (2) While reading and examining this aquatic injury report, I became somewhat concerned about the possibility of chronic effects of long-term exposure of especially fish and crustacean eggs to oil in subtidal sediments. I base this concern on demonstrations in the field and laboratory done to test the chronic impacts of Exxon Valdez oil from oiled salmon streams. However, I am largely reassured that this is not a big source of injury in the Athos spill by the results of sampling many depositional areas down-river of the spill. This appropriately targeted sampling failed to demonstrate large contributions of Athos oil or high concentrations of toxic components. Deciding to include this field sampling was an excellent decision so as to dispel any concerns about oil accumulation and chronic exposures.
- (3) It may be appropriate to note that mallards are not representative of all ducks. Michael Fry's research shows that they are extremely hardy relative to other ducks.
- (4) I was concerned initially about use of the 18-ft contour to delimit the oiled area of river bottom when oiling was observed to extend to 22 ft. However, the bathymetric analysis done by the Trustees and included in this report shows clearly that there is relatively little area within this 18-22-ft band and so this approximation does not lead to any appreciable underestimate of oiled area.
- (5) In toto, the Trustee responses to RP concerns are done fairly and with compelling evidence and logic.
- (6) There may be relevant data that could be cited in work sponsored by Allan Mearns of NOAA Hazmat after the Exxon Valdez oil spill to assess impacts of

injury to shoreline organisms (on both hard and soft substrata) from pressurized hot-water clean-up. Dennis Lees was the principal scientist involved in the research on the soft-sediment organisms. Citation of this work could add support for assumptions about the duration, extent, and intensity of injury to benthic invertebrates from hotsy operations on (for Shoreline injury) and maybe below (for Aquatic injury) soft-sediment intertidal shores. Some publications are included in the American Fisheries Society Volume on the Exxon Valdez oil spill. Annual reports were also compiled and should be available from Dr. Mearns.

Submitted by

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