Back to the Future: Use of a Tried-and-True Environmental Monitoring Approach for Contemporary Spill Response

Gary Shigenaka[1] and Laura M. Basirico[2]
[1]National Oceanic and Atmospheric Administration (NOAA)/Emergency Response Division, Seattle WA USA
[2]Louisiana State University, Baton Rouge LA USA
Contact: gary.shigenaka@noaa.gov

EXTENDED ABSTRACT

The concept of using shellfish as "sentinel organisms" is a well-validated approach to assessing contaminants in the marine environment. In the recent *Golden Ray* incident in the US state of Georgia, the potential deployment of native oysters to characterize bioavailable contaminants was incorporated into the response to help define environmental risk.

On September 8, 2019, the 200 m roll-on/roll-off car carrier *Golden Ray* was outbound from St. Simons Sound (Georgia USA) when it was intentionally grounded due to a shipboard casualty and fire. The *Golden Ray* reportedly carried 823 MT of heavy fuel oil and 330 MT of marine gas oil, among other products. There were more than 4,000 automobiles on board the ship. Upon grounding, the ship capsized in 10 m of water, resulting in a release of oil.

The oily mixture spilled was observed to contaminate the surrounding marsh habitat, which is extensive in the region. In early October 2019, the Unified Command (UC) agreed to implement a program of water and sediment sampling to assess whether contamination from the ship was affecting the environment in the vicinity of the ship. On 2 November, the UC sanctioned a proposal from the NOAA scientific support team to augment monitoring to include the use of transplanted native oysters to characterize the contamination in the water inside the grounded vessel.

Native eastern oysters (*Crassostrea virginica*) were collected from an unimpacted marsh area (Umbrella Creek) near the grounding. We subdivided this collection into three groups of oysters, two of which were placed into cages to be placed into separate flooded compartments of the *Golden Ray*, and the third analyzed as a reference sample against which the exposed samples could be compared. On 3 November, the deployment cages were transported to the capsized vessel and placed into two cargo holds aboard the ship by salvage personnel. Original intent was to leave the cages in place for a two-week period, at which they would be recovered and analyzed to determine if chemical contaminants had been accumulated and incorporated into the soft tissues of the oysters.

The potential mix of chemicals present in the water contained within the ship was unknown, which was an important rationale for initiating the assessment project; however, fuel oil and diesel oil were released at the initial ship's casualty, grounding, and hull compromise. Moreover, the car carrier was fully loaded with more than 4,000 new and used automobiles, all containing automotive fluids such as hydraulic oils and brake fluids. Internal shipboard fires also occurred, hampering operations and causing unknown chemical transformations during combustion. As a result, the potential toxicity of the waters in the flooded holds, either due to the mélange of chemicals present, or due to low oxygen content, was unknown and was a concern for the viability of the deployed oysters. Salvage personnel were requested to watch for and report any evidence of extended gaping in the organisms as a possible indicator of animal mortality.

Several days into the deployment period, the NOAA scientific support staff was advised some of the oysters appeared to be gaping. On 10 November, a NOAA team was dispatched to the *Golden Ray* to recover the deployed cages. The recovered oysters were subsequently shipped to the analytical laboratory at Louisiana State University, where they were analyzed for a suite of hydrocarbons, particularly petroleum-associated hydrocarbons.

Despite the shorter than anticipated deployment period, the results of the chemical analysis of oysters provided three general insights:

- Chemical analysis of the transplant stock collected at Umbrella Creek showed little to no sign of contamination from any sources;
- Oysters deployed into the Engine Room space showed a pattern of polynuclear aromatic hydrocarbons typical of fuel oils; and
- Cargo hold oysters did not reflect a fuel oil signature but contained hydrocarbons associated with combustion, which was thought to be related to shipboard fires that occurred in September and October.

We discuss the rationale for proposing and implementing this action in the context of spill response, associated challenges, and the results from the deployment during the *Golden Ray* response. We argue that in a time of increasing technological capability to measure impact from environmental contaminants, some of these tried and true "old school" approaches continue to have a place and relevance in the portfolio of spill impact assessment.