REVIEW OF ATLANTIC TOWING LIMITED'S MONITORING PLAN FOR THE 'SHOVELMASTER' BARGE

Context

DFO Maritimes Science was asked by the Oceans, Habitat and Species at Risk Branch (OHSAR) to review Atlantic Towing Ltd.'s plan to monitor the risk and consequences of oil release from the 'Shovelmaster' barge (Atlantic Towing Ltd. 2009), which sank off Southwest Nova Scotia on 22 November 2008. Specifically, DFO Science was asked to determine:

- if the design of the plan was likely to confirm the conclusions of the proponent's risk assessment, e.g., that there would likely be limited environmental impact of a 70,000 L diesel release from the sunken barge;
- if the assumption that possible toxic effects of oil release from the 'Shovelmaster' would be insignificant in relation to dispersal and natural mortality on lobster eggs and larvae;
- the difficulty of sampling the sediment in the vicinity of the barge without using a remotely operated vehicle (ROV).

A response was requested as soon as possible, given that the possible release of diesel fuel was a Regional Environmental Emergencies Team (REET) issue and DFO Science input into the proposed monitoring plan was required. Given the short timeline to prepare a response, DFO Maritimes Science determined that a Special Science Response Process would be used.

Background

The 'Shovelmaster' barge sank in late 2008 and currently rests upside down in 475 feet of water, approximately 45 nautical miles southwest of the Nova Scotia coast within Lobster Fishing Area 34 (Figure 1). LFA 34 encompasses 21,000 km^2 and has the highest landings of any LFA in Canada, accounting for 40% of Canadian landings and 23% of the world landings of *Homarus* sp. Within LFA 34, lobster larvae spend 40-60 days near the surface before settling to the bottom and seeking shelter with higher temperatures favouring faster development.

Approximately 70,000 L of No. 2 diesel fuel remains onboard. No. 2 diesel fuel is used to fuel cars and trucks and is also known as heating oil.

The proposed monitoring plan includes aerial surveillance, as well as collecting water and tissue samples in the vicinity of the sunken barge.

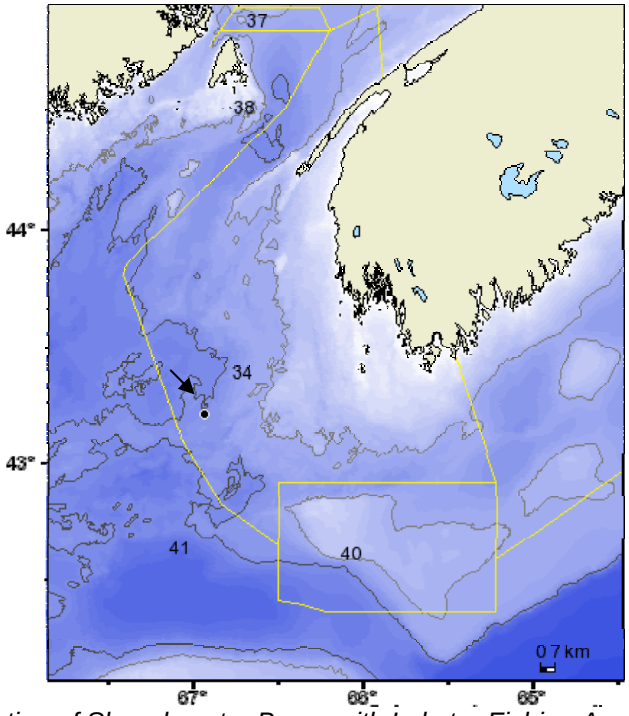

Figure 1. Location of Shovelmaster Barge with Lobster Fishing Areas identified.

Response

Review of Proposed Sampling Program

The proposed sampling program for the Shovelmaster barge was reviewed by DFO Maritimes Science and was found to be inadequate in several areas.

Water Column Sampling

Sampling of the water column is problematic given the low density and volatile nature of diesel fuel. The detection of small amounts of oil leaking from a depth of 500 feet would be very difficult, and a negative finding is probably more dependent on sampling intensity and hydrographic conditions. Sampling of the water column was not seen as good value.

Lobster Sampling

Lobsters were proposed as a sentinel monitoring species. However, given that offshore lobsters undergo extensive migrations (25 – 100 km), the residency of animals captured near the 'Shovelmaster' cannot be determined and would invalidate the results of contaminant analysis. While small lobsters do not migrate to the same extent, they are likely to be uncommon on the type of bottom in question, and obtaining samples of this size range may not be possible.

Lobsters (and other crustaceans) were in part proposed as a sentinel monitoring species on the assumption that they have a limited ability to metabolize contaminants. While this was thought to be the case in the past based on enzyme analysis, research over the past decade has shown otherwise. Bioaccumulation of any contaminates would take place, as well as biotransformation.

The logic of testing post-larval lobster for contaminants was questioned, given that the most likely interaction with the release of diesel fuel would be with larval lobsters near the surface. Testing of this component of the lobster population for contaminants is not mentioned in the proposal.

Hydrocarbon Sampling

The methodology for poly-aromatic hydrocarbon testing outlined in the proposal was questioned. The US Environmental Protection Agency (EPA) 8270D methodology mentioned in the monitoring plan is inappropriate for detecting small molecular weight polycyclic aromatic hydrocarbons (PAH), especially the alkylated PAH that are present in diesel oil (see http://www.epa.gov/wastes/hazard/testmethods/sw846/pdfs/8270d.pdf).

More appropriate methods for determining PAH present in diesel oil are described in many publications, including two easily accessible publications authored by Environment Canada researchers (Wang et al. 1998, 1999).

In addition, more details are required on the guideline methodology proposed to assess total petroleum hydrocarbon samples.

Remotely Operated Vehicle (ROV) Inspection

The proposal to inspect the sunken barge over five year intervals was thought to be inadequate. A more comprehensive 'monitoring program' would require a sustained effort in sampling and inspection, in addition to aerial surveillance. Annual inspections may be more appropriate. As well, the proposal to provide findings of the monitoring program in 'due course' was considered to be too vague. A timeline needs to be specified.

Aerial Surveillance

Several aspects of the aerial surveillance plan are unclear. The degree to which reliable monitoring could be implemented through aerial surveillance was an issue, given that the proposal was to rely on surveillance by Transport Canada, which the proponent has no control over. The dispersal of possible contaminants needs to be considered in this aspect of the monitoring plan, i.e., it was unclear if the proposed area of aerial coverage would capture the zones of exposure dictated by hydrological processes. As well, the timing of the monitoring was questioned. It has been proposed that periods related to early and late lobster spawning would be monitored, although this is different timing compared to the period in which lobster larvae would be in a pelagic phase and hence more vulnerable to oil release.

Proposal for Additional Sampling

Sediment Sampling

OHSAR asked how difficult would it be to get sediment samples from the area around the barge without using an ROV. An ROV is seen as the only effective method for securing geo-referenced sediment samples. As corers and grab samples can only be located by moving the ship, and they have no propulsion, the location of the samples can not be fixed. Adding a trackpoint to the grab could provide a position at which the sample was taken, but one would still not be able to go to a set position with any certainty. To avoid entanglement, the samples

will have to be taken well away from the sunken barge, which could decrease the effectiveness of the sampling program. If Oil Mineral Aggregates (OMA) are formed, they will be lost using standard corers and grabs (and the ROV if the operator is not skilled). This could lead to an underestimate of levels of oil at the sediment water interface. It would be useful to examine sediment cores in the vicinity of the sunken barge, to determine if any weathered oil fractions are present, as well as to detect the presence/absence of water soluble phases of diesel oil, which can be significant. Water soluble phases would probably be diluted out unless there is a constant source.

Sampling of Other Species

Other sentinel species candidates should be considered within the Shovelmaster barge monitoring program. Scallops are one possibility. As a filter-feeding, sedentary species, contaminant levels in individuals sampled near the 'Shovelmaster' should reflect local conditions. However, it would first have to be determined if scallops are present in the vicinity of the sunken barge. Another possibility would be to test indicator organisms collected in association with sediment samples (polychaete worms and/or molluscs, for example). Alternatively, the effects of residual oil in sediments could also be examined by assessing the impacts of sediment samples on amphipods through the use of laboratory bioassays.

Evaluation of Potential Environmental Impact

OHSAR asked whether the design of the Shovelmaster Monitoring Plan is likely to be sufficient to be able to confirm the conclusions of their risk assessment, e.g., that there would likely be limited environmental impact of a 70,000 L diesel release from the sunken barge.

It is not possible to determine the likelihood of a release of diesel from the sunken barge without the ROV assessment and details on possible damage to the barge and fuel tanks. However, should there be a release of diesel from the barge, there are several scenarios that could be evaluated. The first scenario would be a slow release of diesel over time. The second scenario would be a sudden release of a large quantity of the diesel fuel.

Slow Release Scenario

Studies have demonstrated that diesel fuel is toxic to lobster larvae (Reddy and Quinn, 2001), albeit at much higher concentrations than would be anticipated under a slow release scenario. Given the low density of larvae, the limited period they are present (late June to early September), the volatility of diesel fuel, and a high degree of dispersion, the effect of a slow release of diesel fuel from the sunken Shovelmaster barge on the lobster population would not be expected to be significant.

Sudden, Large Scale Release Scenario

If the release was sudden and large, the area affected would be larger and the concentrations of toxic constituents may exceed the toxicity threshold of lobsters. Many of the lower-molecular weight components in diesel fuel are water soluble and rapid evaporation will occur for a large portion of the spilled oil. However, a fraction of higher-molecular weight compounds will not evaporate and are highly persistent within the environment. Physical oil droplets may also become entrained within the water column.

If toxic constituents were present in higher concentrations for days or weeks, then the numbers of lobster larvae affected would be larger, though trying to quantify the impacts on larval

numbers and resulting impact on the population would be difficult. Total impact would depend on larval densities during the time period, larval stages present (different depth preferences), the exposure time, and likely settling area as larvae in some areas have low survival naturally (i.e., settle on poor bottom, or circulation takes them off the shelf and thus lost from the system).

The evaluation of effects on cetaceans is limited. The migratory nature of most whales and potential movement away from an impacted area makes determination problematic. Deleterious effects could be physiological in nature and may include toxic effects and secondary organ dysfunction due to ingestion, damaged lungs and/or airways, and stress due to oil exposure and behavioural changes. The nature of the oil and how it has weathered are important factors in determining the impacts on whales. Whether or not this would be a concern in this case would depend on the size and duration of the slick, neither of which are known with certainty.

Mechanical Mixing

OHSAR asked if mechanical mixing is an appropriate response option and whether it would vary depending on which larval species may be present. The physical and chemical characteristics of the diesel fuel limit the available response options. While the report is based on the loss of fuel from evaporation, the water soluble fraction would cause the most harm to fisheries. Larvae when present are generally in the upper 1 m of the water column, though some stages show wider vertical distribution and indications of vertical migrations. Mechanical mixing could increase their exposure; however, this would have to be weighted against the likely numbers present and the proportion of the total population this would represent. The efficiency of this procedure is questionable due to the high possibility of recoalescence of oil droplets, unless natural physical dispersion processes are extremely high. If there are larvae within the water column, it may be better to let the oil evaporate on the surface than to mix it into the water column.

Conclusions

The purpose of the 'Shovelmaster' Monitoring Plan is to determine if earlier conclusions on the likelihood and nature of possible releases of oil from the sunken barge remain valid. In general, the proposal is a responsive monitoring plan, designed to verify the absence of a problem and to assess impacts in the near term, rather than a precautionary approach designed to evaluate the risk of a future spill and identify remedial action. The plan to monitor oil on the surface seems viable, with modifications to timing and dependant on the availability of over flights. On the other hand, the collection and analysis of water samples would be expensive and likely unsuccessful in detecting release of the diesel fuel.

It is not possible to determine the likelihood of a release of diesel from the sunken barge without the ROV assessment and details on possible damage to the barge and fuel tanks. However, should there be a release of diesel from the barge, both slow release and fast release scenarios should be evaluated. Given the low density of lobster larvae, the limited period they are present, the volatility of diesel fuel, and a high degree of dispersion, the effect of a slow release of diesel fuel from the sunken Shovelmaster barge on the lobster population would not be expected to be significant. If the release was sudden and large, the area affected would be larger and the concentrations of toxic constituents may exceed the toxicity threshold of lobsters. Total impact on lobster populations would depend on larval densities during the time period, larval stages present (different depth preferences), the exposure time, and likely settling area.

Use of adult lobsters as a sentinel monitoring species will not provide useful information on contamination in the area of the sunken barge, primarily due to extensive migration. A more sedentary species should be considered, although testing larval lobsters sampled at the surface for oil contamination might be useful.

An ROV is seen as the only effective method for securing geo-referenced sediment samples.

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Sources of Information

Atlantic Towing Ltd. 2009. Shovelmaster Monitoring Plan.

Reddy, C.M., and J.G. Quinn. 2001. The North Cape Oil Spill: Hydrocarbons in Rhode Island Coastal Waters and Point Judith Pond. Marine Environmental Research 52(5):445-461

Wang, Z., M. Fingas, and D.S. Page. 1999. Oil spill Identification. Journal of Chromatography A 843: 369-411.

Wang, Z., M. Fingas, S. Blenkinsopp, G. Sergy, M. Landriault, L. Sigouin, J. Foght, K. Semple, and D.W.S. Westlake. 1998. Comparison of Oil Composition Changes due to Biodegradation and Physical Weathering in Different Oils. Journal of Chromatography A 809: 89-107.

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