OIL SPILL EMERGENCY RESPONSE -
MONITORING THE USE OF DISPERSANTS

Characterization of Ecological Receptors – Toxicity

About

Dispersants are chemical agents used to break up oil into smaller droplets throughout the water column. Dispersants are applied to surface oil floating on water, or below the surface closer to an uncontrolled release of crude oil from a well blowout source. This series of fact sheets details monitoring requirements and how to apply the collected data to inform the use of dispersants under **Subpart J of the National Contingency Plan (NCP)**.

Ecological Receptor Characterization

Ecological receptor characterization identifies potential hazards and impacts to ecological receptors, including species-specific toxicity of oil, dispersant, and dispersed oil. The goal is to answer the question "What might be affected by the oil plume and in what way?" Ecological receptors include aquatic species, wildlife, and other resources and habitats that organisms rely upon for survival, growth, and reproduction.

There are two elements to characterizing ecological receptors (1) identifying their habitats and (2) identifying toxicity concerns. This fact sheet focuses on identifying toxicity concerns using existing information and resources. A companion fact sheet focuses on identifying the habitats and species of concern (find the link under Additional Resources).

Description of the Requirement

The responsible party must characterize ecological receptors that may be exposed to the oil that is not dispersed, the dispersed oil, and the dispersant alone (Figure 1). The responsible party must also estimate an acute toxicity level of concern for the dispersed oil using available dose-response information relevant to potentially exposed species following a species sensitivity distribution. Refer to the regulatory requirement in the Code of Federal Regulations (CFR): **40 CFR 300.913(d)**.

Acute Toxicity

There is concern for the aquatic toxicity of oil components (e.g., total petroleum hydrocarbons [TPH]), the dispersant, and the dispersed oil. To inform a response, acute toxicity is determined for selected species that are representative of the sensitivity for a wider range of species in the given aquatic habitat or ecosystem.

Relevant Terminology

Toxicity is defined as the disruption of normal biological functioning by a foreign chemical or mixture of chemicals (e.g., crude oil or dispersant).

Acute toxicity is a measure of the lethal amount of a chemical for a given species within a short period of time.

Exposure pathways are the ways that a species or habitat may come into contact with dispersant, oil, or dispersed oil. Species may be exposed directly through their environment; for example, water-column-dwelling species present in the oil plume, sediment-dwelling species encountering marine snow, or seabirds walking on oily rocks or diving during foraging. Species may also be exposed through food sources or incidental ingestion; for example, by directly consuming oiled foods or through preening behavior (seabirds), and secondarily through bioaccumulation.

Decision Points for Responders

The On-Scene Coordinator should consider the toxicity information in conjunction with other ecological receptor and habitat information. If the water column sampling concentration for TPHs or other chemicals of interest meets or approaches an established EB, the On-Scene Coordinator in consultation with subject matter experts, should reevaluate whether dispersant application should begin, continue, continue with modifications, or cease.

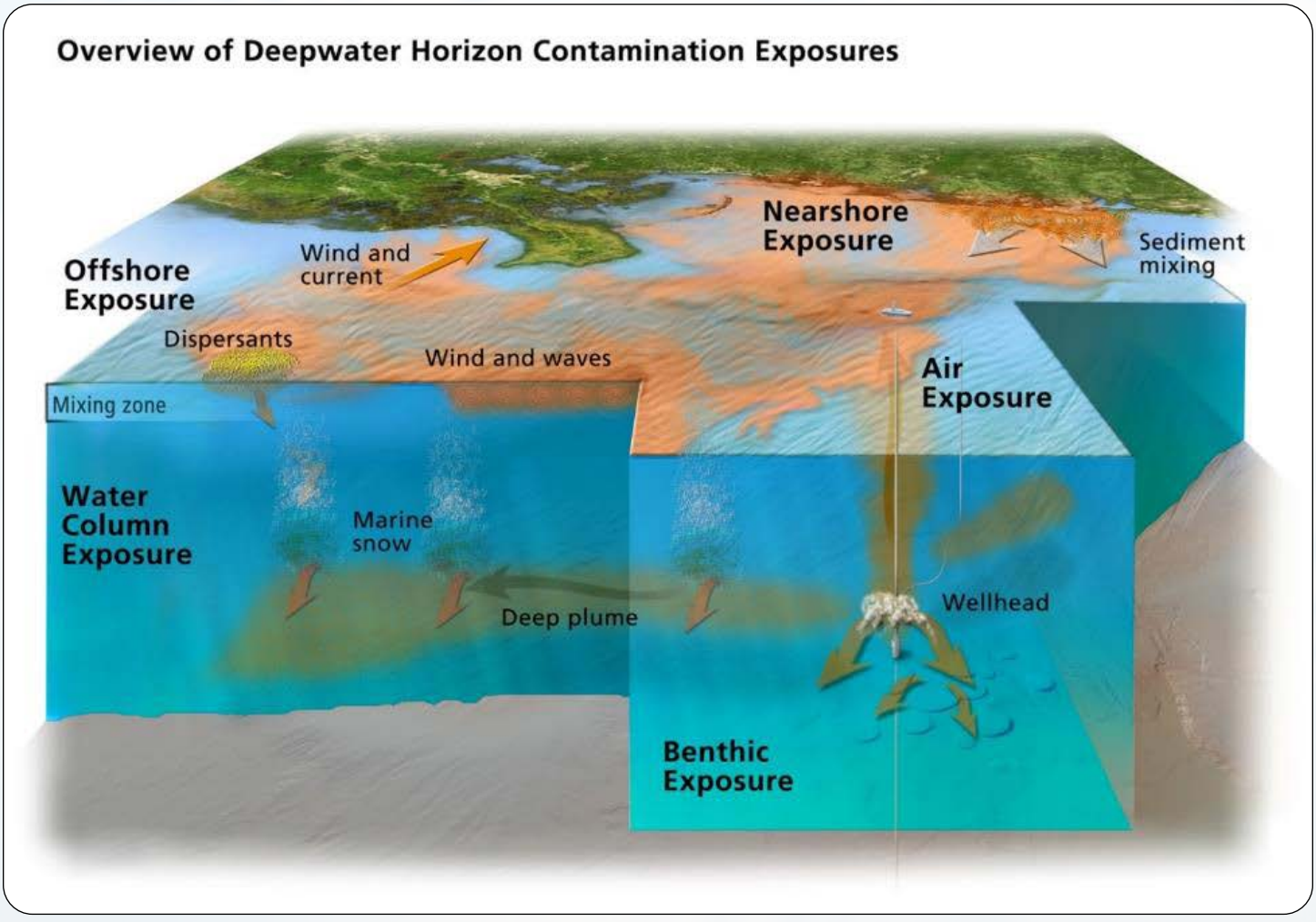
Measuring and Reporting Acute Toxicity

Laboratory toxicity analyses expose organisms to different concentrations of a chemical and record toxic effects, including death. Acute toxicity data are generally reported as a lethal concentration (LC) or lethal dose (LD). For example, an LC50 for a fish species represents the concentration of the chemical in water that is lethal to 50 percent of the individuals in laboratory testing over a specific period of time (e.g., 96 hours). The data are generally reported as mass/volume (e.g., mg/L) or as a proportion (e.g., parts per million or parts per billion).

These assessments provide baseline acute toxicity data that can be used to estimate an ecotoxicity benchmark (EB) for the tested species. EBs may then be combined with field data.

In the field, the water column is monitored for acutely toxic concentrations of substances – generally looking at TPH, including certain individual constituents.

Figure 1: Marine ecological receptor habitats.



Credit: Deepwater Horizon Natural Resource Damage Assessment Trustees

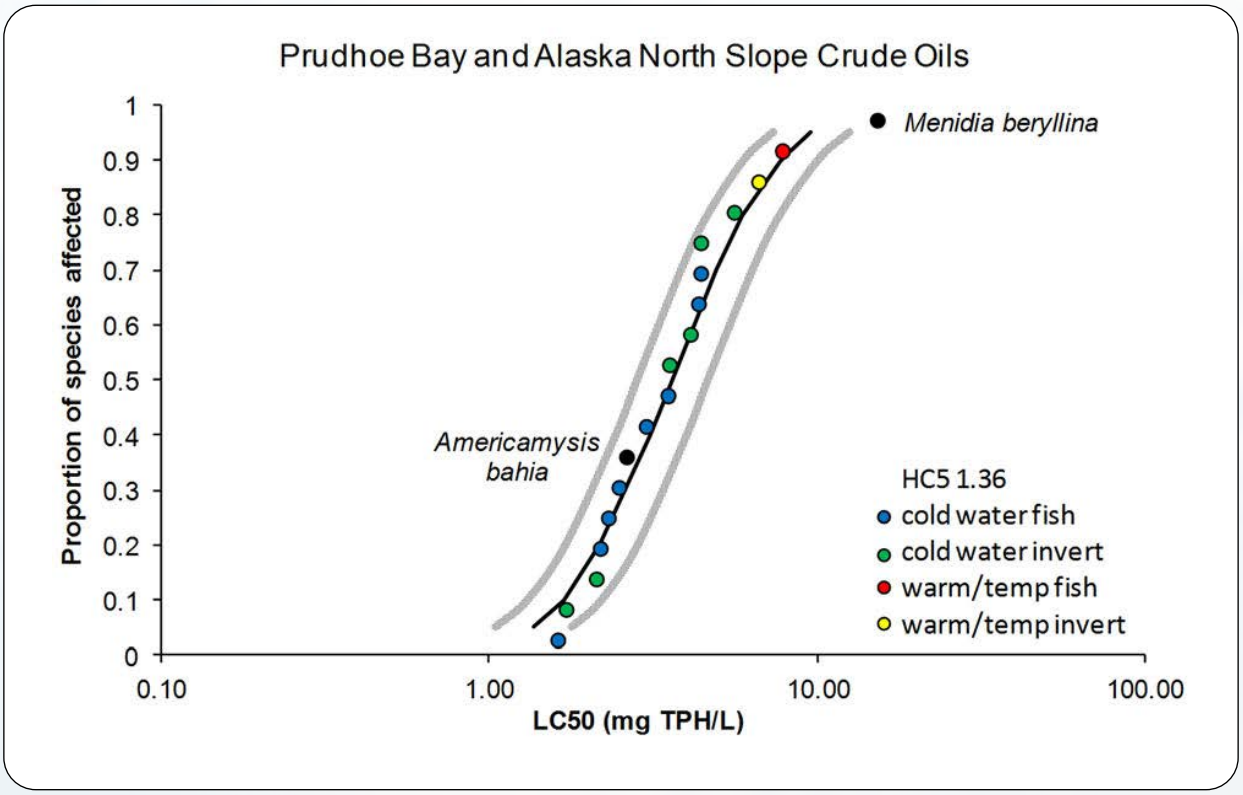
Using Acute Toxicity Data

Measures of acute toxicity from exposures to oil, dispersed oil, and dispersants provide responders with information on how a species may respond to specific exposures or doses. Toxicity data combined with dose-response information available for potentially exposed species can help inform the level of concern for the response.

- **TPH concentrations** in samples from the water column can be compared with TPH-based EBs to support operational decisions. Sampling data from areas without dispersant application can help in distinguishing toxicity associated with physically dispersed oil from that of chemically dispersed oil.
- **Species sensitivity distribution (SSD)** is a statistical approach to estimate the concentration of a chemical that is hazardous to a percentage of all species. It can also estimate the proportion of species potentially affected by a given concentration of a chemical. SSDs are developed using existing acute toxicity data from at least eight representative species relevant to the incident, with a particular point on an SSD curve selected as an EB (Figure 2). Most often the point chosen is where only five percent of the species' organisms are predicted to be acutely affected; this fifth percentile hazard concentration (HC5) benchmark is a generally accepted practice. Chronic toxicity EBs can also be derived by applying safety factors to the acute toxicity EBs.

Ultimately, adverse effects on ecological receptors from exposures to dispersant use depend on the length of time and concentration of the exposure. For an oil spill, exposure times and concentrations are dependent on the transport of the dispersed oil, and on the sensitivity of the species to the oil, the dispersed oil, and the dispersant. Additionally, toxic effects from exposure to multiple chemicals can be synergistic.

Figure 2: Example species sensitivity distribution.



Credit: Barron et al. (2013)

Toxicity Information

Existing information resources identify toxicity values for potentially affected species and ecological habitats.

- **Environmental assessments** included in, for example, exploration plans, development and production plans, development operations coordination documents, and facility and vessel response plans.
- **Federal contingency plans** such as coastal Area Contingency Plans and associated Fish and Wildlife and Sensitive Environments Annexes.
- **Federal and state environmental databases**
  - National Coastal Condition Assessment (EPA)
  - Environmental Sensitivity Indices (NOAA)
  - Chemical Aquatic Fate and Effects Database (NOAA)
  - Southeast Area Monitoring and Assessment Program (NOAA)
- **University or other research-oriented institution studies**
- **NCP Product Schedule Technical Notebook**

Additional Resources

NCP Product Schedule

Lists dispersant products and data submitted to EPA as required by NCP Subpart J.

NCP Product Schedule Technical Notebook

A compilation of product bulletins summarizing data requirements and test results for dispersant products listed in EPA's NCP Product Schedule. The Technical Notebook includes information on dispersant application methods, toxicity and effectiveness data, and physical properties.

Oil Spill Emergency Response – Monitoring the Use of Dispersants Fact Sheets

- Characterization of Ecological Receptors – Habitats
- Total Petroleum Hydrocarbons
- Deepwater Horizon Natural Resource Damage Assessment Trustees – Comprehensive Restoration Plan*

* Subpart J requirements do not directly pertain to the Natural Resource Damage Assessment process; however, past assessments can serve to inform future response operations.

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Barron et al, 2013. "Development of Aquatic Toxicity Benchmarks for Oil Products Using Species Sensitivity Distributions." Integrated Environmental Assessment and Management 9: 610-615. Copyright 2013. Adapted with permission from John Wiley & Sons.