

# The effects of the Deepwater Horizon oil spill on marine algae – comparison of species sensitivity

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## *Isochrysis galbana* is more sensitive to source oil from the Deepwater Horizon oil spill than other marine algae

### Introduction

- Understanding effects of oil spills on marine environments requires a better understanding of their effect on primary producers. Oil toxicity data for algae is limited and available results are not always comparable because of different data evaluation methods.

### Materials and Methods

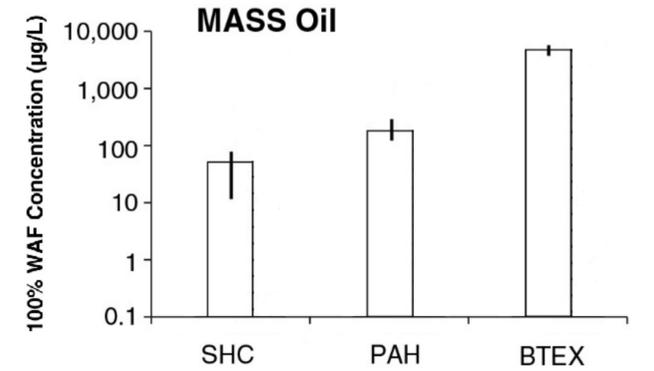
- Two diatoms (*Skeletonema costatum*, *Thalassiosira pseudonana*), a green alga (*Dunaliella tertiolecta*), a flagellate (*Isochrysis galbana*), and a filamentous brown alga (*Ectocarpus siliculosus*) were tested using source oil (MASS) collected from the barge Massachusetts at the DWH spill site. Nominal loading rate of 1000 mg oil/L was stirred overnight with algal medium then separated to remove the WAF. Solutions were prepared per variable dilution method based on procedures developed for aqueous testing of petroleum products. Tests were conducted based on standard testing protocols with modifications for ECS (OCSP 850.4500 and 850.4400).
- Samples collected for analysis of oil composition were evaluated for volatile organic compounds (BTEX), parent and alkylated polycyclic aromatic hydrocarbons (PAH), and saturated hydrocarbons (SHC). Results were reported as measured group totals, with chemical analysis data normalized on the basis of whole oil dissolved toxic units ( $\Sigma$ TUs) to provide a comprehensive assessment. A combined oil solubility and toxicity model (Petrotox) determined  $\Sigma$ TUs. Petrotox incorporates the Target Lipid Model (TLM) and theory of additive toxicity, estimating toxicity of dissolved phase components in each dilution.
- Biological effects were determined from average specific growth rates calculated from 96-hour cell density or 14-day dry weight biomass data and No-Observed Effect Concentrations (NOEC) based on % WAF and  $\Sigma$ TUs.

### Results

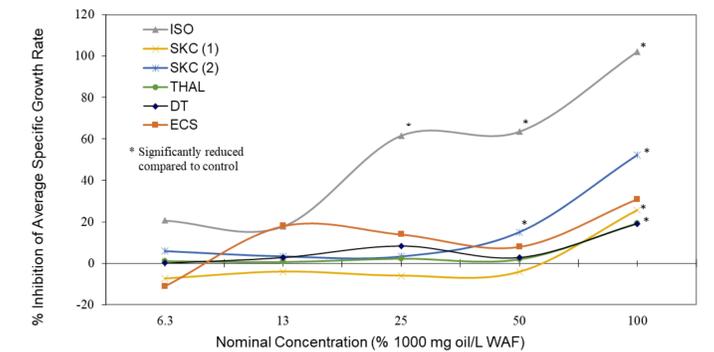
- Analytical results generally were consistent between exposures. Detectable BTEX concentrations were expected since MASS is a source (versus weathered) oil sample. Average total SHC, PAH, and BTEX concentrations = 83, 240, and 5100  $\mu$ g/L.  $\Sigma$ TUs for the 100% WAF solutions ranged from 0.90 to 2.08.  $\Sigma$ TUs were not determined for ECS due to substantial differences in terms of duration, dosing and renewal scheme.
- Biological data showed 3 of 5 algae tested had statistically significant ( $p < 0.05$ ) adverse effects. No significant effects were detected for DT, however, based on the inhibition observed at the highest treatment level a more conservative NOEC is the test level with <10% inhibition (50% WAF;  $\Sigma$ TU = 1.7). ECS was not significantly affected, but data is more variable than for microalgae likely due to the filamentous nature and challenges of providing as precise and uniform an inoculum than can be achieved for microalgae.

### Discussion

- The sensitivity of SKC as compared to the other algae tested confirms its appropriateness as the recommended marine algae species for toxicity testing, since it is neither the most nor the least sensitive species, but is representative of median algal sensitivity. Future evaluation should determine if the sensitivity of ISO is representative for class Coccolithophyceae in order to better assess toxicity to marine algae generally and the impact of future oil spills on primary producers.



Vertical lines represent the range of minimum/maximum values.



Species	NOEC Values for MASS oil	
	Based on Nominal % WAF	Based on $\Sigma$ TUs
<i>Isochrysis galbana</i> (ISO)	13	1.2
<i>Skeletonema costatum</i> (SKC)	50 / 25 <sup>a</sup>	1.7 / 1.5 <sup>a</sup>
<i>Thalassiosira pseudonana</i> (THAL)	50	1.8
<i>Ectocarpus siliculosus</i> (ECS)	100	NA <sup>b</sup>
<i>Dunaliella tertiolecta</i> (DT)	50	1.7

<sup>a</sup> Results presented for initial exposure / confirmatory exposure.

<sup>b</sup> NA = Not applicable. Results based on  $\Sigma$ TUs were not determined.

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