

# Effects of Crude Oil and Clean-up Methods of Dispersant and Burning on Activity and Survival of Grass (*Palaemonetes vulgaris*) and Sand (*Crangon septemspinosa*) Shrimp

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## Introduction

The Deepwater Horizon released ~5 million gal of crude oil into the Gulf of Mexico, creating an ecological disaster unprecedented in United States history. Crude oil is pervasive and persistent in the environment, and even small amounts can have serious effects on active swimmers such as shrimp, disrupting movement and metabolic functions.

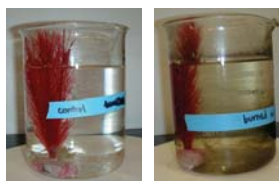
The use of chemical dispersants along with some controlled burning as clean up methods was controversial. Over 200 million gal of the dispersant Corexit 9500 were sprayed in surface waters alone. While burning does not add chemicals to water, it leaves oil residues. We investigated the effects of oiling alone and in combination of clean up methods of Corexit 9500 and burning on activity patterns of two shrimp found in coastal waters, grass shrimp (*Palaemonetes vulgaris*) and sand shrimp (*Crangon septemspinosa*). Notably, grass shrimp are considered to be important bioindicators of anthropogenic impacts such as coastal pollution (Key et al. 2006).



*Palaemonetes vulgaris*



*Crangon septemspinosa*



Control and burned treatments, showing set-up with grass shrimp

## Methods

The experiment was run for 4 days in a darkened growth chamber at 13° C. The treatments (n=3) were control, 50 ppm oil, 50 ppm oil + 2.5 ppm Corexit, and burned oil in 500 mL of seawater. We fully burned 1 mL of crude oil in the beaker prior to adding seawater. There was a thick residue remaining in the beaker following the burn. We added habitat, which was vertical structure or sand, for grass and sand shrimp, respectively. Three shrimp were added to each beaker.

We measured several behaviors, including eating, swimming, resting, and interacting with other shrimp. The shrimp were offered small marine pellets of food at the beginning of each observation and were monitored for 1.5 min per replicate, scoring behaviors of the shrimp. Mortality rates were also determined.

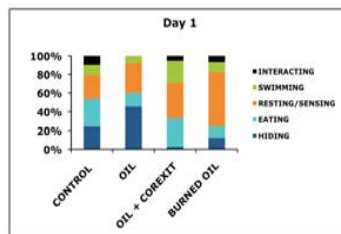


Fig. 1. Activity of grass shrimp on Day 1 under various treatments.

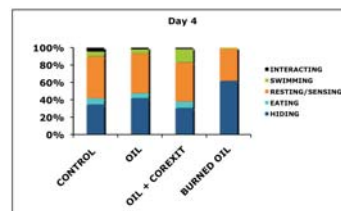


Fig. 2. Activity of grass shrimp on Day 4 under various treatments.

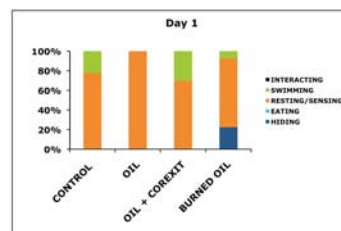


Fig. 3. Activity of sand shrimp on Day 1 under various treatments.

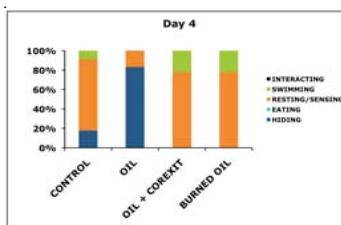


Fig. 4. Activity of sand shrimp on Day 4 under various treatments.

Table 1. Percent mortality (after 4 days) of grass and sand shrimp under various treatment conditions.

	Grass shrimp	Sand shrimp
Control	0	20
50 ppm oil	20	25
50 ppm oil + Corexit	0	30
Burned oil	10	0

## Results & Discussion

We found species differences in mortality rates under various treatment conditions (Table 1). Sand shrimp (*C. septemspinosa*) had higher mortality than grass shrimp (*P. vulgaris*) under most treatments, including controls. Crude oil application alone (50 ppm) resulted in high mortality in both species. No sand shrimp died under the burned oil treatment; grass shrimp had no mortality under oil + Corexit. Thus, clean-up methods of dispersant (Corexit) compared with burning elicited contrasting responses by the two species.

We observed slight decreases in active behaviors, e.g. feeding and swimming with time (comparing days 1 & 4), but especially under burned oil for grass shrimp (Figs. 1 & 2). In contrast to the oil + Corexit treatment, grass shrimp held in the burned oil treatment spent most of their time hiding within the vertical structure. Other oiling treatments varied little from the control treatment, indicating short-term tolerance for the experimental oil concentrations (and dispersant) by grass shrimp. Higher mortality and lower activity under the burned oil treatment suggests that this clean-up method should not be recommended for treating an oil spill that included coastal seagrass areas that are important habitats for grass shrimp.

Sand shrimp spent the majority of their time resting (Figs. 3 & 4); however, under oiling alone, most sand shrimp hid within the sand by the end of the experiment. We observed minimal interacting or eating by sand shrimp across treatments, though swimming was observed in all but the oiled only treatment. This lack of responsiveness across treatments makes sand shrimp a poor choice as a bioindicator species.

## Conclusion

Taken together, observed mortality rates and activity patterns suggest that sand shrimp are more vulnerable to the effects of crude oil than grass shrimp. Sand shrimp showed higher mortality rates and reduced activity under oiling, while grass shrimp maintained eating and swimming behaviors under all but the burned oil treatment. The two species exhibited contrasting responses to clean-up methods, emphasizing the complexity of dealing with an oil spill as it approaches a coastal ecosystem.

## Literature Cited

Key, PB, EF Wirth & MH Fulton. 2006. Environmental Bioindicators 1:115-128.