Health Effects of Crude Oil on Bay Mussels

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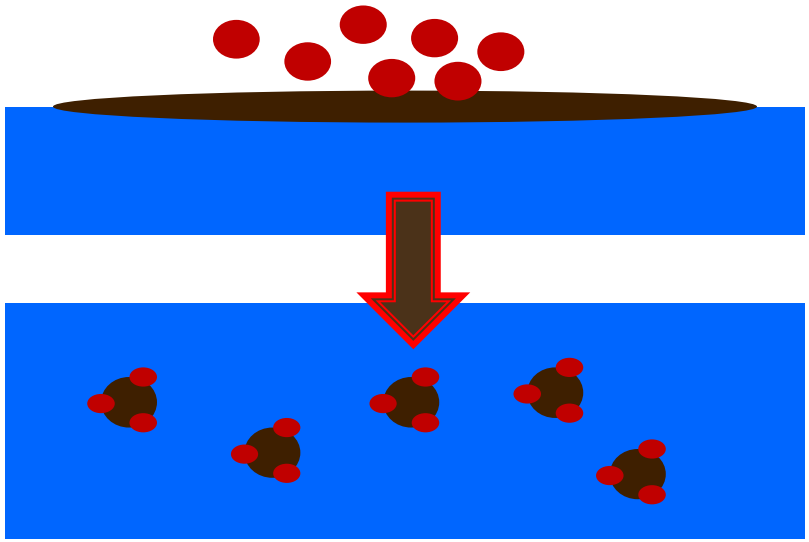
Introduction

- Oil pollution has major effects on the marine environment
- Chemical dispersants can be used to help natural degradation of oil occur more rapidly

Introduction

- Dispersants decrease the hydrophobicity of oil and break it into droplets allowing it to spread through the water column



Introduction

- The decreased hydrophobicity may increase the bioavailability of oil
- Dispersants or dispersed oil may be more toxic than oil alone

Introduction

- The majority of toxicity testing with dispersed oil or dispersant alone have been conducted at temperate conditions, with species not found in Alaska, or with dispersants not approved for use in Alaska

Introduction

- Bay mussels (*Mytilus trossulus*)
  - Distinct species, found in Arctic and subarctic
- Easy to collect and represent local conditions
- Ubiquitous, intertidal, sessile filter-feeders
- Bioaccumulate pollutants

Project Goal

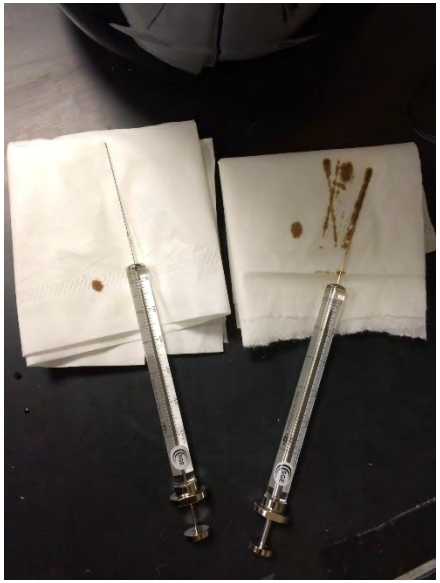
- To understand how and for what duration mussels are effected by oil, dispersant and dispersed oil so they may be used as a monitoring tool to assess recovery of coastal ecosystems in the event of an oil spill

Objectives

1. Conduct spiked exposure tests with bay mussels in seawater with oil, Corexit 9500 or oil dispersed with different concentrations of Corexit 9500
2. Assess various physiological responses of bay mussels to the oil, dispersant and dispersed oil in the spiked exposure tests at different time points
3. Determine the volatile organic compound and polycyclic aromatic hydrocarbon content of the treatments throughout the exposure period

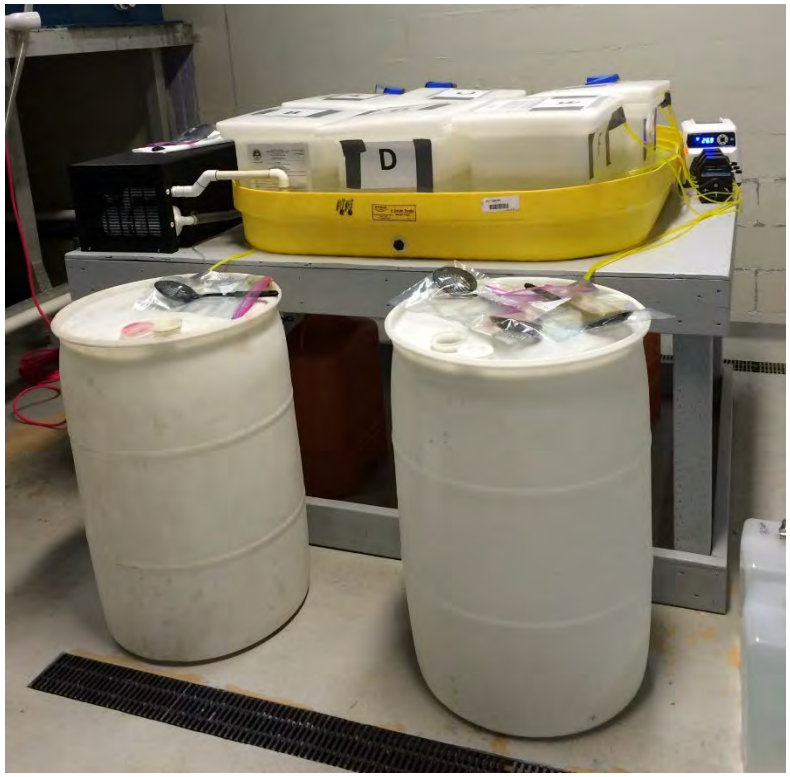
Methods

- Bay mussels were used in spiked exposure toxicity tests at 4°C
- Mussels were exposed to the following treatments for 3 weeks:
  - Seawater
  - 10ppm crude oil
  - 1ppm Corexit 9500
  - 10ppm crude oil + 2ppm Corexit 9500
  - 10ppm crude oil + 1ppm Corexit 9500
  - 10ppm crude oil + 0.5ppm Corexit 9500



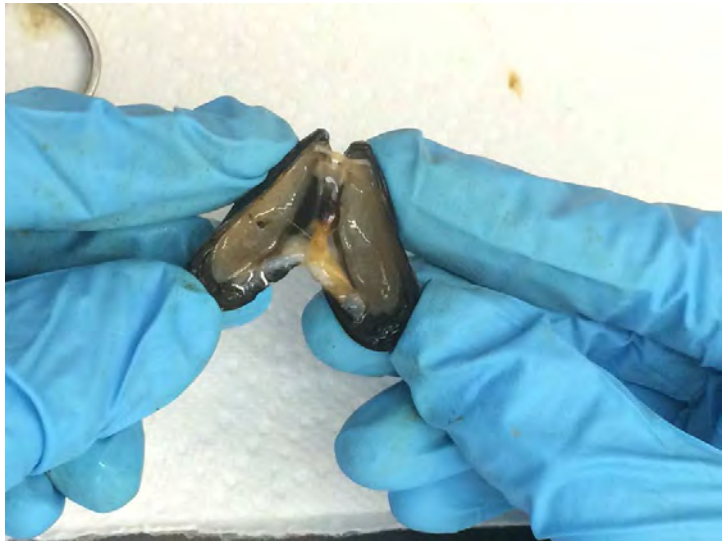
Methods

- Mussels were sampled at 24 hrs, 48 hrs, 96 hrs, 7 days, 10 days, 14 days and 21 days
- Water samples were collected at 0 hrs, 7d, 14d and 21d and tested for polycyclic aromatic hydrocarbons and volatiles



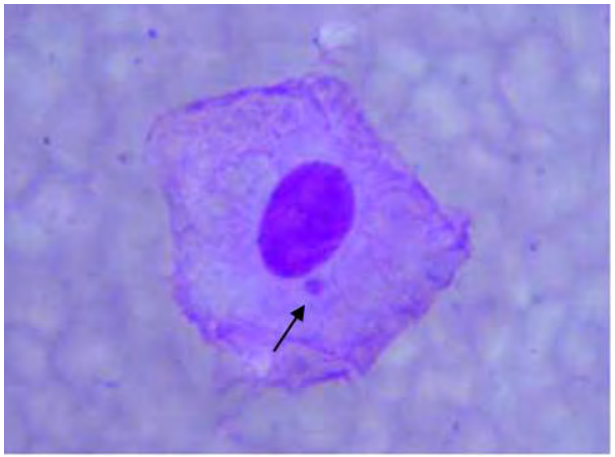
Methods

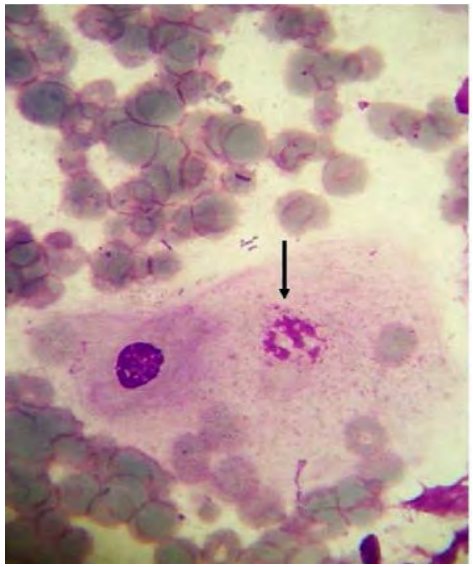
- Mussels were measured, weighed and dissected for use in biomarker assays
  - RNA: DNA ratio
  - Cytochrome P450 activity
  - Heat shock protein levels



Methods

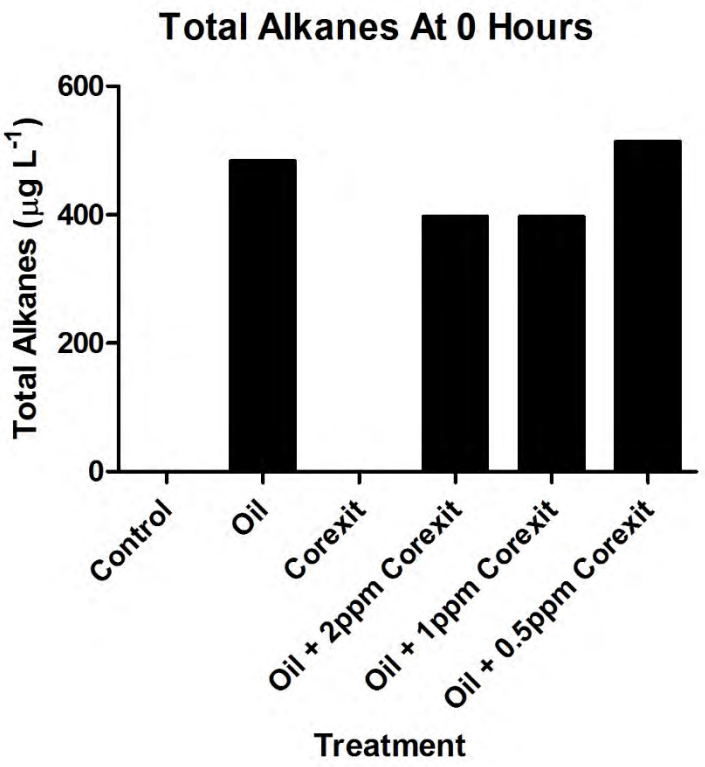
- Biomarker assays
  - Hydrogen peroxide production
  - Superoxide dismutase activity
  - Genetic and cellular damage



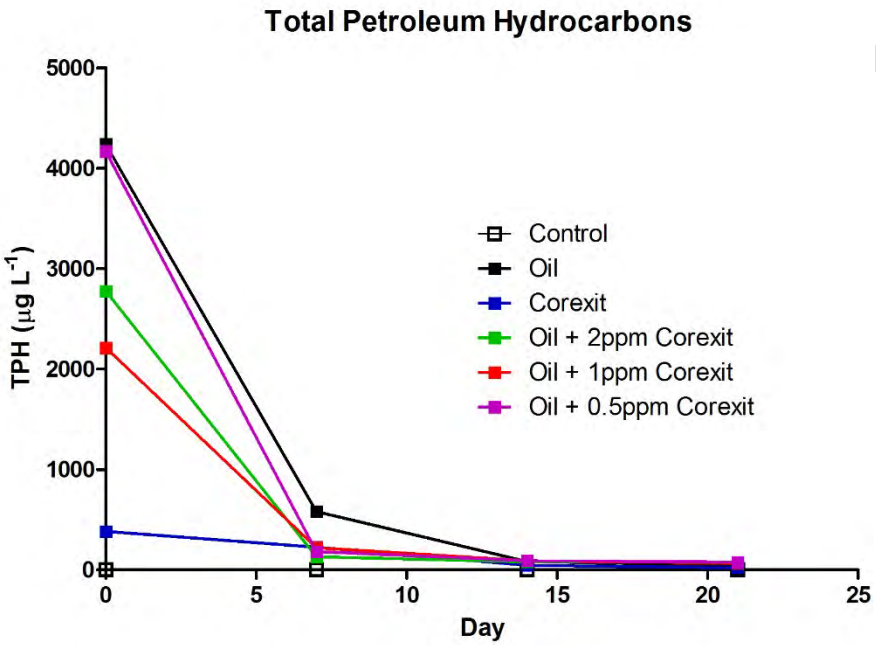


Results & Discussion

- No chemicals were detected in the control
- Alkanes were not detected in the dispersant treatment
- Volatile organics and alkanes were undetectable after 1 week in the oil and dispersed oil treatments



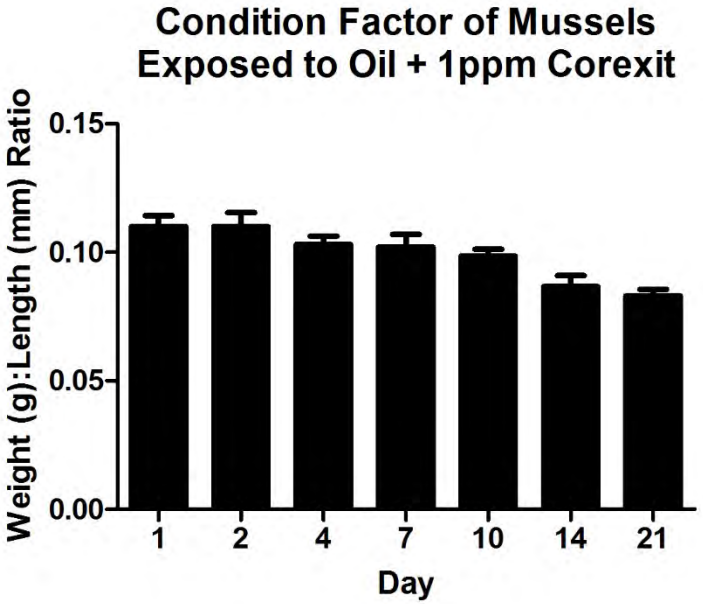
Results & Discussion



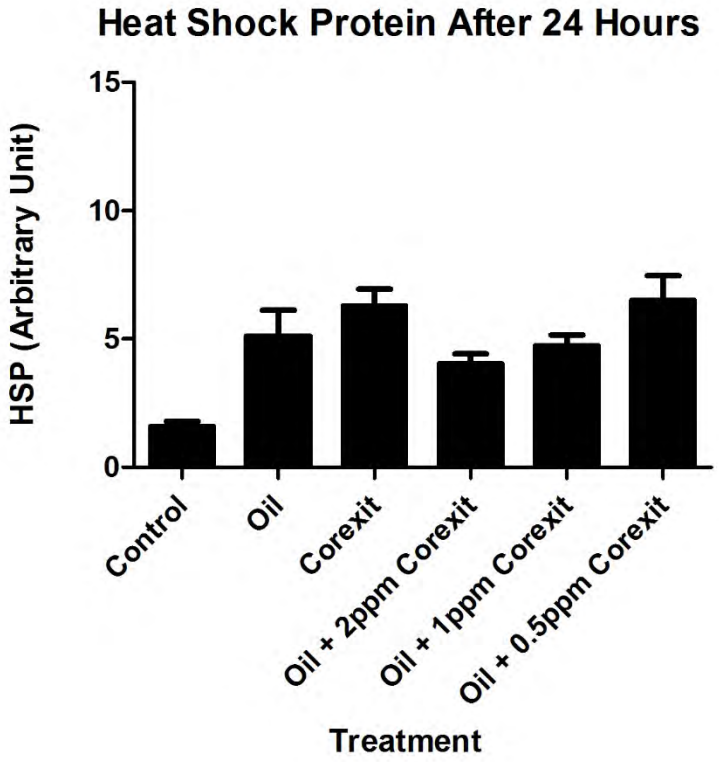
- TPH declined in the dispersant, oil and dispersed oil treatments but were still detectable after 3 weeks

Results & Discussion

- Mortality was low
- The overall condition of mussels declined in all of the treatments and shells thinned over the 3 week exposure



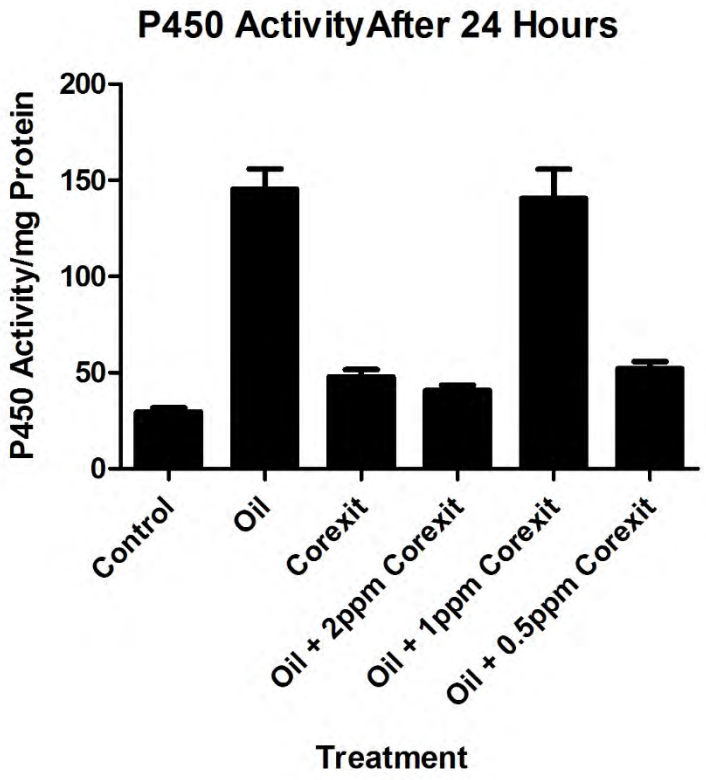
Results & Discussion

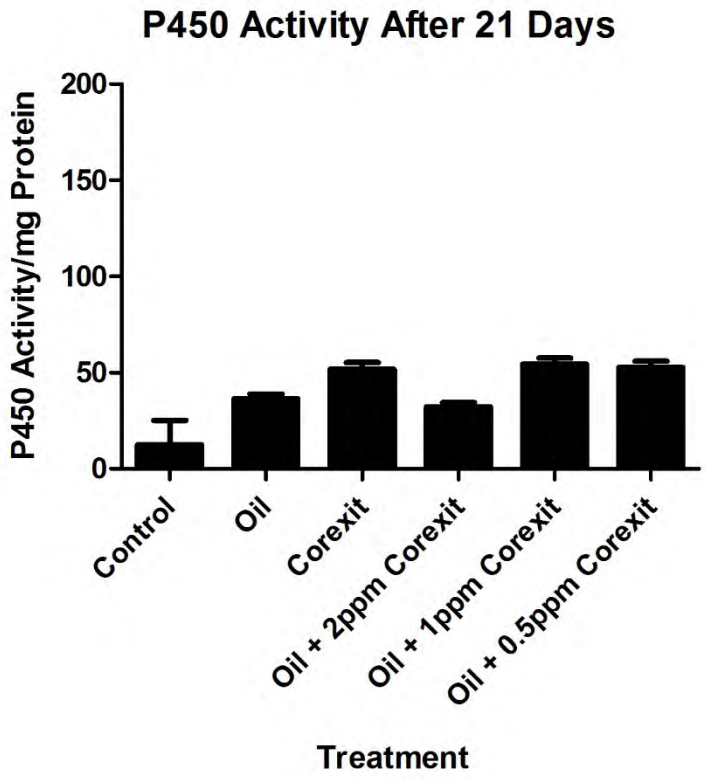


- Heat shock protein levels in the treatments were highest during the first week and remained higher than the control after 21 days

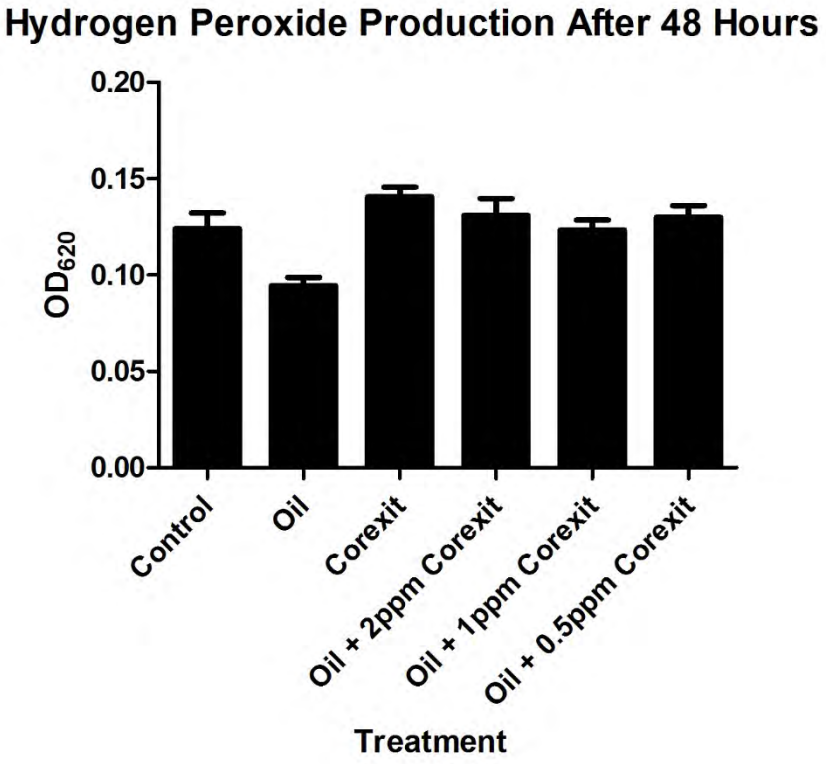
Results & Discussion

- P450 activity was elevated in all treatments throughout the experiment





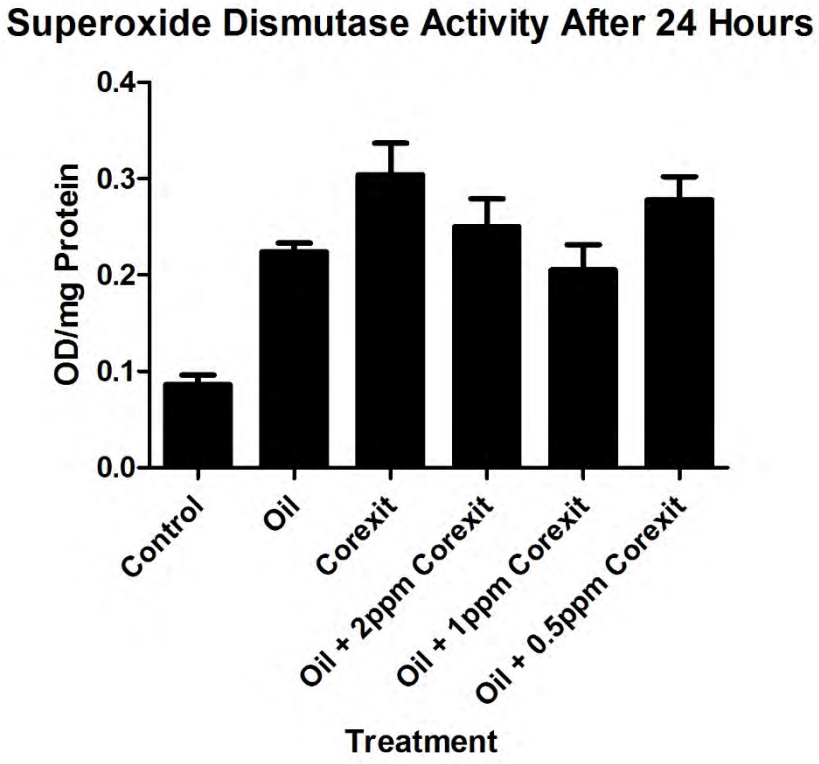
Results & Discussion



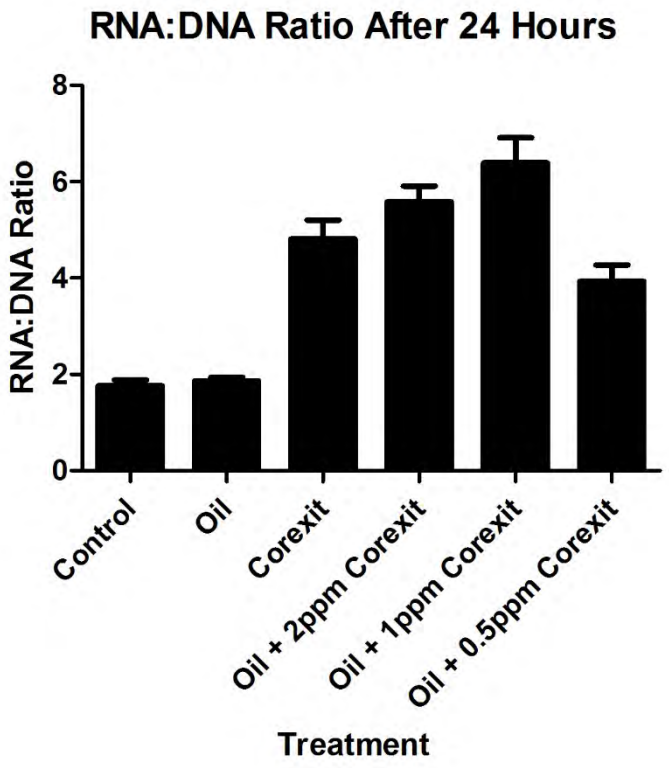
- Immune activity was suppressed in the oil treatment through day 10
- Immune activity in the other treatments was not impacted

Results & Discussion

- Superoxide dismutase activity was significantly elevated for the first 48 hours

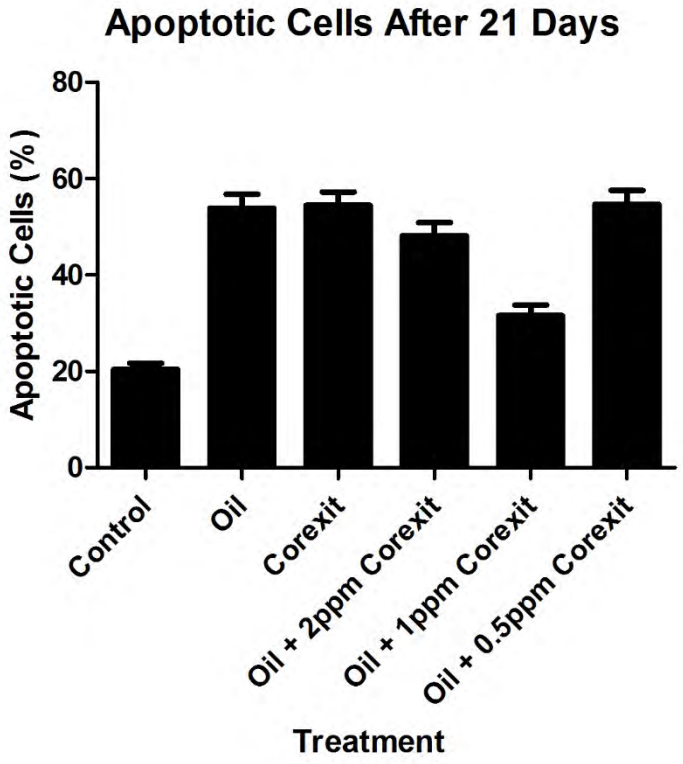


Results & Discussion



- RNA production was significantly higher in the dispersant and dispersed oil treatments for 96 hours
- Increased RNA production was delayed in the oil treatment for first 48 hours

Results & Discussion



- The treatments had significantly more apoptotic cells than the control beginning at 96 hours and continuing through day 21

Summary

- Overall, mortality was low
- Most physiological effects were observed during the first week of exposure
  - Cytochrome P450, SOD and HSP40 levels were highest during this time
- Immune function and transcription was suppressed in oil exposed mussels during the first 96 hours

Summary

- After 21 days, the condition of mussels was reduced and genetic damage, a stress response and P450 activity were observed
- A continued stress response can exacerbate tissue loss and lead to failed reproduction and mortality
- Additional research is needed to determine the persistence of the effects

Acknowledgements

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