Acute and population level effects of exposure to dispersant, oil and dispersed oil on multiple life history stages of *Eurytemora affinis*

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Experimental Objectives

- **Evaluate the relationship between laboratory toxicity tests, expected field exposures and possible population level effects of dispersant, oil and dispersed oil**
  - **Use multiple life history stages**
  - **Use a ubiquitous, easily cultured planktonic species**
  - **Use realistic exposure regimes**
  - **Use protocols which allow comparisons to existing data sets**

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Experimental Test Organism

- *Eurytemora affinis*
  - Estuarine copepod
  - Can tolerate a wide range of salinity/temperature combinations
  - Easily cultured in the lab
  - Short life history
  - Some relevant toxicity data is available for comparison

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Experimental Design
Phase I

- **Determine Acute Toxicity Impacts**
- **Obtain 24 and 48-hour LC50 values for nauplii, copepodites, and mature adults**
  - **Dispersant alone**
  - **Water Accommodated Fraction (WAF) of weathered Alaskan North Slope (ANS) crude oil**
  - **Chemically enhanced WAF (dispersed oil or CE-WAF) of weathered ANS crude oil**

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Experimental Design
Phase 2

- Examine multi-generational impacts from short-term exposure
- Expose nauplii to the LC50 concentration for 24 hours
- Transfer surviving organisms to grow-out culture chambers (in clean culture water) and observe through multiple generations (f2 or more)
  - 40 chambers (20 treatment, 20 control)
  - Examine life history stage in five chambers at T=12d, 19d, 26d, and 33d

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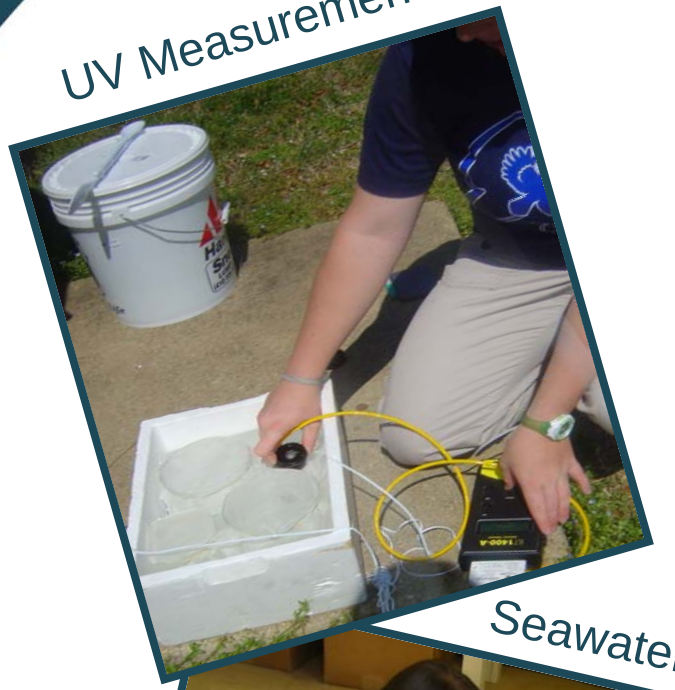
Experimental Design
Phase 3

- Examine impacts from UV exposure
- Multi-generational grow out experiments using Phase 2 experimental design
- Animals are exposed to UV light for several hours after toxicant exposure
- Determine if photo-enhanced toxicity impacts exist

UV Measurement

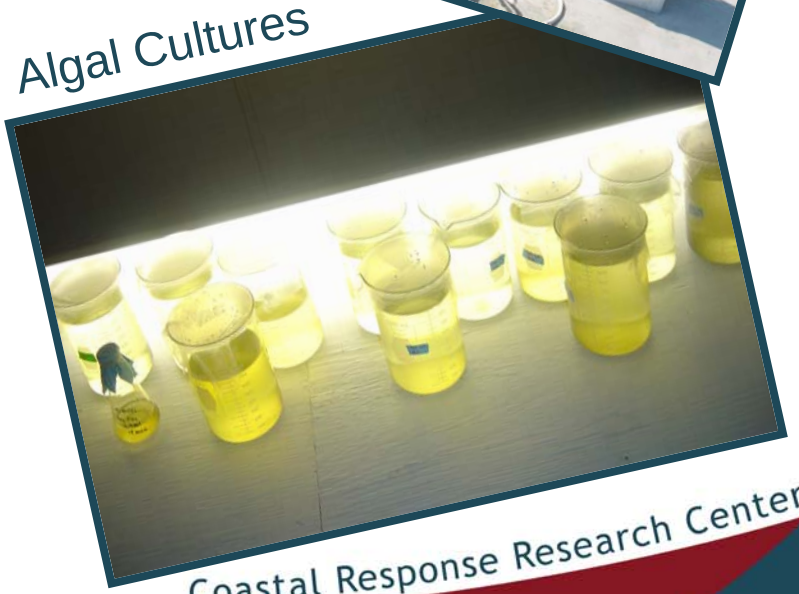


Water Retrieval

Water Retrieval

Seawater Filtration

Algal Cultures



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Results to Date: Pitfalls

- Early *Eurytemora affinis* life history stages cannot be used in the CROSERF chambers
- An attempt to devise a static spiked-exposure protocol approximating the CROSERF exposure through dilution was unsuccessful
- The CROSERF chambers are not compatible with UV exposure requirements

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Results to Date: Successes

- **Redesigned exposure regime**
  - **Adopted a static 24 and 48 hour exposure protocol**
  - **Results will not be linked to previous CROSERF data**
- **Used new protocol to obtain LC50s for**
  - **Dispersant**
  - **Water-Accommodated Fraction (WAF) of weathered oil**
  - **Chemically-enhanced WAF (CE-WAF) of weathered oil**
- **Began preliminary multi-generational grow-out experiments**

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Results to Date:
Constant Static 24 Hour and 48 Hour Exposure LC50s (C9500 & weathered ANS)

Actual LC50 (C9500 & TPH)			
	Copepods	**Copepodites**	**Nauplii**
C9500			
24 HR	19 ppm	14 ppm	5.2 ppm
48 HR	15 ppm	9.6 ppm	6.3 ppm
WAF			
24 HR	TBD	TBD	incalculable
48 HR	incalculable	499 ppb	51 ppb
CE-WAF			
24 HR	299 ppb	1651 ppb	incalculable
48 HR	351 ppb	846 & 1969 ppb	30 ppb
96 HR	216 ppb	1806 ppb	

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Results to Date:
Constant Static 24 Hour and 48 Hour Loading Rate LC50s (C9500 & weathered ANS)

Associated Oil Loading Rates LC50			
	Copepods	**Copepodites**	**Nauplii**
C9500			
24 HR	19 ppm	14 ppm	5.2 ppm
48 HR	15 ppm	9.6 ppm	6.3 ppm
WAF			
24 HR	TBD	TBD	1456 ppm
48 HR	1849 ppm	2616 ppm	1117 ppm
CE-WAF			
24 HR	41 ppm	64 ppm	7.6 ppm
48 HR	51 ppm	52 & 54 ppm	7.7 ppm
96 HR	44 ppm	73 ppm	

Results to Date:
Grow Out Study

- **Basic Life History Studies**
  - Nauplii used for toxicant and UV exposure (most sensitive life stage)
  - Exposed for 24 hours at the previously determined naupliar LC50
  - 10 nauplii per beaker for grow out
- **UV Exposure Grow Out**
  - Source - Solar (heat/chiller bath at 21C)
  - Intensity – Based on March 30, 2007, 10 cm below surface
    - UVA 2400 $\mu W/cm^2$ (33% of Surface Irradiance)
    - UVB 20 $\mu W/cm^2$ (57% of Surface Irradiance)
  - Duration – Peak hours 1000 to 1400

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Results to Date:

Grow Out Study

Expt 58 - Dispersant Grow Out (5.18 ppm)				
	Control		Toxicant	
Count	Total	*Std. Dev.*	Total	*Std. Dev.*
T=12	685	*28*	652	*46*
T=19	813	*206*	788	*193*
T=26	416	*48*	433	*183*
T=33	123	*37*	184	*67*

Expt 61 - Dispersant Grow Out (6.9 ppm)				
	Control		Toxicant	
Count	Total	*Std. Dev.*	Total	*Std. Dev.*
T=12	770	*57*	842	*354*
T=19	395	*120*	447	*193*
T=26	TBD	*TBD*	TBD	*TBD*
T=33	TBD	*TBD*	TBD	*TBD*

- **Expt 62 – Dispersant Grow Out (6.19 ppm) with UV Exposure**
  - **T=12 count 4/15/07**

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Application of Results

- Results should provide a better estimate of the long-term consequences of dispersing oil into the water column
- Spill response community (decision makers, emergency responders, etc.) will be able to make more informed decisions about the use of dispersants, particularly in near-shore environments

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