Examining the impacts of ultraviolet (UV) light and surface oil sheens on the survival, growth, and development of red drum (Sciaenops ocellatus)

Danielle Beers
Graduate Program in Marine Biology, University of Charleston, SC

Background
- The Deepwater Horizon oil spill occurred in April 2010 and released ~5 million barrels of oil to the Gulf of Mexico which affected 2100 km of coastline.
- Petroleum contains polycyclic aromatic hydrocarbons (PAHs), compounds shown to cause negative effects such as reduced cardiac function, decreased growth rates, developmental deformities, and impaired physiological and immune functions.
- PAHs can become photomodified in the presence of UV light and cause greater toxicity.
- Early life stages of organisms are especially susceptible to photoenhanced oil toxicity due to less developed detoxification mechanisms, lack of pigmentation, and increased metabolic rates.
- Red drum are a coastal fish species that is commercially, recreationally, and ecologically important. Red drum spawn near shore but larval fish develop within estuaries.
- It is important to understand how chemical contaminant toxicity is influenced by abiotic factors. Multi-stressor impacts might affect the overall fitness of the species and therefore, human use of them. Results of this study will be used to support NOAA’s oil spill response and restoration efforts.

Objectives
1. Understand how the early life stages of red drum are influenced by toxic oil sheens in the presence and absence of UV light.
2. Address knowledge gaps that pertain to a coastal oil spill scenario as directed by NOAA’s Office of Response and Restoration.

Hypotheses
1. There will be a significant effect of oil exposure on larval and juvenile red drum survival, growth, and development.
2. Oil toxicity will be significantly enhanced under UV light exposure and therefore, there will be greater mortality and decreased growth rates and impaired development of larval and juvenile red drum.

Methods
- **Step 1:** ~12 hpf red drum will be obtained from the SCDNR Mariculture Section of the MRRI.
- **Step 2:** At 2 dph, 10 larvae loaded into crystallizing dishes; 4 treatments (control, 0.5 µm, 1.0 µm, and 2.0 µm oil sheen); 5 replicates each.
- **Step 3:** Dishes placed in one of three incubators: UV light or no UV light. UV = 2 h UV; 0 µm = 14 h fluorescent light; 8 h dark.
- **Step 4:** Water samples of the initial sheen chemically analyzed for total PAH exposure.

Step 5: After 30 d, length, width, diameter, and wet weight determined. Fish frozen for biomarker assay.

Step 6: Mortality assessed after 24 h and surviving fish transferred to clean seawater and grown out for 30 d.

Anticipated Results
- Survival, growth, and developmental rates of fish exposed to oil will be significantly less than those exposed to no oil.
- Survival, growth and developmental rates of fish exposed to UV-light-oil combination will be significantly less than those exposed to oil alone.

Benefits & Significance
- Answer specific questions NOAA’s Office of Response and Restoration had regarding UV light enhanced toxicity of thin sheens post-Deepwater Horizon.
- Provide novel information on how early life stages of red drum might be impacted by the interactive effects of oil contaminants and abiotic factors.
- Provide information for fisheries management to understand how coastal pollutants might impact the early development of red drum.

Acknowledgements
Thank you to my major advisor, Dr. Marie DeLorenzo, and thesis committee members Dr. Aaron Watson, Dr. Pete Key, and Dr. Gorka Sancho for continued guidance on this project. Thanks also to staff in NOAA’s NCCOS Ecotoxicology branch and SCDNR Mariculture section for technical assistance and resources. This research was supported in part by a grant from the Slocum Lutz Foundation. Lastly, for the support of my family, friends, fellow classmates, and GPMB staff and faculty.

Literature Cited