NOAA Technical Report: Fiddler Crab Meta-Analysis

Scott Zengel[1*], Steven C. Pennings[2], Brian Silliman[3], Clay Montague[4], Jennifer Weaver[5]

1. Research Planning, Inc. (RPI), Tallahassee, Florida 32303, United States

2. Department of Biology and Biochemistry, University of Houston, Houston, Texas 77204, United States

3. Duke University Marine Laboratory, Beaufort, North Carolina 28516, United States

4. Department of Environmental Engineering Sciences, University of Florida, Gainesville, Florida 32611, United States

5. Research Planning, Inc. (RPI), Columbia, South Carolina 29201, United States

*email: szengel@researchplanning.com

Abstract

Deepwater Horizon was the largest marine oil spill in U.S. waters, oiling large expanses of shoreline occupied by coastal wetland fauna. To examine impacts of the spill on salt marsh fiddler crabs (*Uca* spp.), an important ecosystem engineer and prey species, we conducted a meta-analysis using published studies and unpublished data from the Natural Resources Damage Assessment (NRDA) for this spill. Our analyses provide the most comprehensive assessment to date of how the *Deepwater Horizon* oil spill affected fiddler crabs. We tested the hypotheses that the oil spill affected fiddler crab burrow density (a known proxy for crab abundance), burrow diameter (crab size), and species composition. Results of all three hypothesis tests were consistent with a negative effect of the *Deepwater Horizon* oil spill on fiddler crab populations in areas with heavy oiling. Fiddler crab burrow densities were reduced an average of 41% in oiled sites (95% lower confidence bound = 25% reduction), with persistent impacts observed from 2010-2014. Fiddler crab burrow diameters were reduced initially by 21-44%, but appeared to have recovered by 2012. Fiddler crab species composition was altered, and only returned to reference conditions where the marsh vegetation had recovered. Full fiddler crab recovery is unlikely unless and until the marsh vegetation recovers; in addition, fiddler crab recovery may lag behind vegetation recovery. Residual oiling in marsh soils could also slow fiddler crab recovery. Where heavily oiled marshes experienced accelerated erosion as a result of the spill, these habitat losses would represent additional losses of fiddler crabs not accounted for in our analyses. Fiddler crab impacts caused by the oil spill may have affected other ecosystem processes and attributes, including marsh vegetation productivity and many species that depend on fiddler crabs as prey.

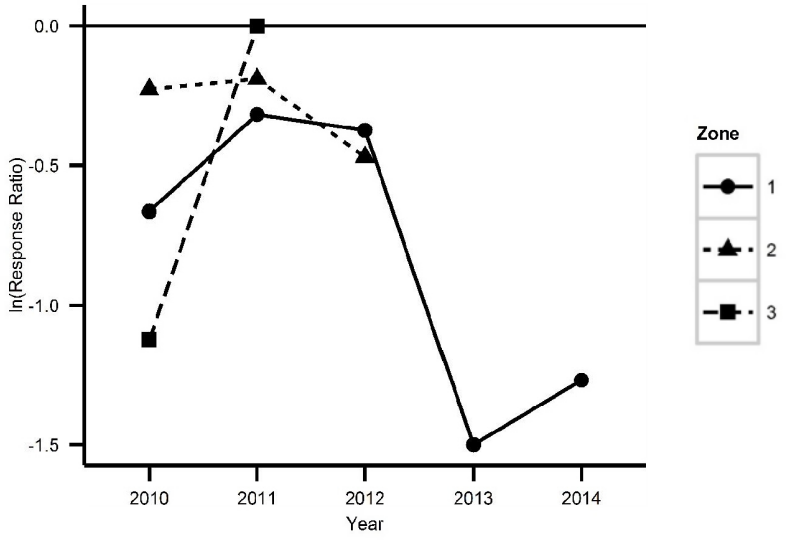

Figure 1. Log response ratios (oiled : reference) for fiddler crab burrow density by zone and year. Where more than one study contributed data for any zone-by-year combination, average values were plotted. Values less than zero indicate lower burrow densities for oiled versus reference sites. Log response ratios were significantly lower than zero for the combined analysis across all study-zone-by-year observations (t-test, $p < 0.01$; Wilcoxon signed ranked test, $p < 0.01$).

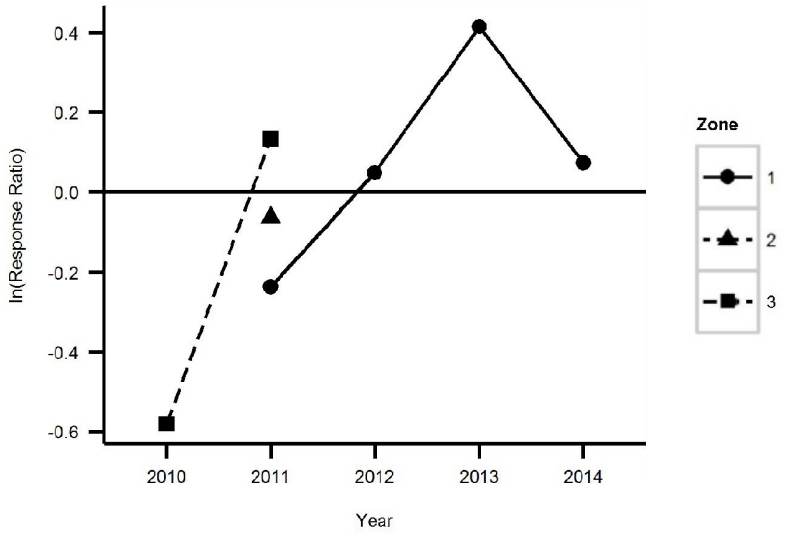

Figure 2. Log response ratios (oiled : reference) for fiddler crab burrow diameter by zone and year. Values less than zero indicate smaller burrow diameters for oiled versus reference sites. Log response ratios were not significantly lower than zero for the combined analysis across all study-zone-by-year observations (t-test, p = 0.40; Wilcoxon signed ranked test, p = 0.53).

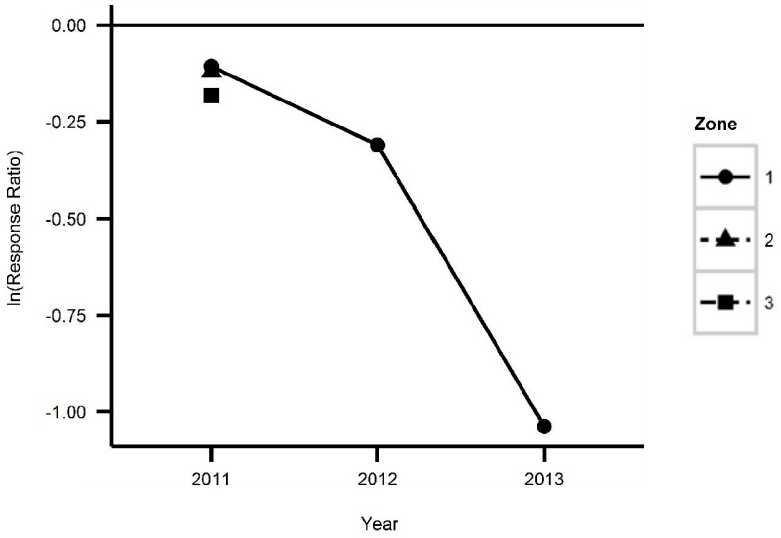

Figure 3. Log response ratios (oiled : reference) for fiddler crab species composition by zone and year. Values less than zero indicate reduced *U. longisignalis* dominance (and increased relative abundance of *U. spinicarpa*) for oiled versus reference sites. Log response ratios were significantly lower than zero for the combined analysis across all study-zone-by-year observations (t-test, p = 0.06; Wilcoxon signed rank test, p = 0.03).