RPI

**Adriana C. Bejarano** **Research Planning, Inc.**

Senior Aquatic Eco-Toxicologist

Dr. Bejarano is an environmental scientist with broad experience in applied ecology and aquatic eco-toxicology. Previous to joining RPI, she conducted extensive toxicity testing of pesticides and assisted with several pesticide risk assessments. She has studied the ecological and toxicological effects of organic pollutants on marine and estuarine invertebrates, and has developed skills in applied ecology, modeling, and ecological risk assessments of contaminated sediments and complex contaminant mixtures, and statistical data analysis.

Since joining RPI, has supported several projects aimed at quantifying and characterizing ecological and toxicological effects resulting from chemical exposure. Her work at RPI includes performing toxicological analyses of contaminated water and sediments; characterizing biological responses to contaminant body burdens in benthic estuarine and marine invertebrates; and responding to chemical and oil spills in aquatic habitats by assessing ecological risks to biological resources based on available toxicity data. Dr. Bejarano is an Adjunct Professor at the Department of Environmental Health Sciences at the University of South Carolina, an active member of the Society of Environmental Toxicology and Chemistry, and a reviewer of numerous scientific journals. She has written several articles in peer-review journals, as well as book chapters and technical documents.

## EDUCATION

PhD., Aquatic Toxicology, Department of Environmental Health Sciences, Arnold School of Public health, University of South Carolina (2004)
Dissertation Title: Toxicological evaluation of urban-related contaminants in estuarine ecosystems: 1. Effects of contaminants on the development and reproduction of the estuarine copepod *Amphiascus tenuiremis*; and 2. the role of sediment constituents on pesticide bioavailability to the estuarine bivalve *Mercenaria mercenaria*.

M.Sc., Marine Science Program, College of Arts and Sciences, University of South Carolina (2000)
Thesis Title: Uptake and fate of Trichloroethylene (TCE) in *Spartina alterniflora* Loisel.

B.Sc., Marine Biology, Department of Biology, Universidad del Valle, Colombia (1997)

## PROFESSIONAL EXPERIENCE

2008 to Present: Environmental Toxicologist and Marine Ecologist, Research Planning, Inc., Columbia, SC

2005 to 2007: Ecological Risk Analyst- Postdoctoral Researcher, NOAA/NOS, Charleston, SC, USA

2005: Visiting Scientist, Department of Applied Environmental Science (ITM), Stockholm University, Stockholm, Sweden

2004 to 2005: Research Associate, University of South Carolina, Columbia, SC

1998 to 2004: Graduate Research Assistant, University of South Carolina, Columbia, SC

Dr. Bejarano's experience is outlined separately on the following pages in five main areas:

1) Oil and Hazardous Material Spill Response/Assessment
2) Environmental Damage Assessment
3) Ecological Risk Assessment

4) Climate Change Vulnerability Assessment
5) Literature Synthesis and Environmental Assessments

## OIL AND HAZARDOUS MATERIALS SPILL RESPONSE/ASSESSMENT

Emergency Response: Dr. Bejarano has been part of the Scientific Support Team to the U.S. Coast Guard provided by the National Oceanic and Atmospheric Administration's Emergency Response Division (NOAA-ERD) for oil and chemical spills since 2008. She has provided on-site and off-site emergency consultation and scientific support related to the potential environmental consequences associated with oil and hazardous chemical incidents, including risk characterization and potential toxicological effects to aquatic receptors, and quantitative reports and analyses of potential levels of concern. As part of this work, Dr. Bejarano actively participates in routine oil and hazardous chemical spills drills and related exercises, and has contributed to the strengthening of NOAA-ERD's risk assessment tools. In 2010, she provided on-scene support for NOAA-ERD during the *Deepwater Horizon* oil spill as a team member of Shoreline Cleanup Assessment Technique (SCAT) assessments. She also served as a member of a special team that characterized the impacts of oil residues on beaches. She developed the ecological framework of this assessments and wrote the chapters on weathering and depletion of oil, and the toxicological impacts to terrestrial mammals, aquatic invertebrates and fish. She also led data analyses on the potential toxicological impacts of surface dispersant use to aquatic organisms, and co-author the final report to the USCG. She is the lead toxicologist of ERD's Chemical Aquatic Fate and Effects database.

Technical and Scientific Support Consultations: Dr. Bejarano has provided technical and scientific support to the Environmental Protection Agency for the Enbridge Pipeline oil spill in the Kalamazoo River, MI since 2011. She played a key role in the development of a Net Environmental Benefit Analysis (NEBA) framework for oil recovery in the River, a process that involved consultations with local experts. Dr. Bejarano conducted data analyses and interpretation, and helped in the preparation of reports summarizing methods, findings and recommendations. The NEBA document has guided the 2012-2013 oil recovery strategies in tactical areas of the Kalamazoo River with persistent oiling conditions.

Biological Assessment for the Preauthorization of Federal Actions within Regional Response Team Areas: In 2015, Dr. Bejarano was the lead toxicologist, and assisted in the preparation and editing of the Biological Assessment for the RRT9 Preauthorization Plan for Dispersant Use. In 2016, she was also the lead toxicologist, and assisted in the preparation and editing of the Biological Assessment for the RRT4 Preauthorization Plan for Dispersant Use and In-Situ Burning. She modeled the environmental concentrations of several oil spill scenarios (RRT4 only), and wrote on chapters on the toxicity and impacts of dispersed oil (RRT9 and RRT4) and in situ burning (RRT4 only) on listed species and EFH/EFH-HAPC, including direct, indirect and cumulative impacts. She also wrote the determinations section (RRT9 and RRT4).

## ENVIRONMENTAL DAMAGE ASSESSMENT

Natural Resource Damage Assessments: Since 2009, Dr. Bejarano has supported NOAA's Assessment and Restoration Division (ARD) as well as other federal agencies. Dr. Bejarano has provided technical support for preliminary assessment of the ecological damages associated with several oil spills, including:

*Deepwater Horizon* oil spill, Gulf of Mexico.
Silvertip oil spill in the Yellowstone River, Billings, MT.
M/V *Cosco Busan* oil spill, San Francisco, CA.
M/V *Selendang Ayu* grounding, Unalaska Island, AK.

Dr. Bejarano played major roles in developing damage assessment metrics, and assisted with data compilation, analysis and interpretation, and preparation of reports summarizing methods, findings and recommendations.

Sand Beach Injury Assessment for the Deep Water Horizon oil spill: In 2011 and 2016, Dr. Bejarano was the lead scientists and editor of a comprehensive literature review of a report on the effects of oil, shoreline treatment, and physical disturbance on sand beach habitats. She authored the chapters on the impacts from oil, oil spills and physical disturbance on sand beaches.

Deepwater Horizon Long-Term Restoration Planning: Between 2014 and 2016, Dr. Bejarano provided technical support to the marine mammal long-term restoration group, part of restoration efforts following the *Deepwater Horizon* oil spill. She served as a key scientists leading discussion on restoration alternatives for marine mammal populations, wrote several technical memos, and contributed to the preparation of the Comprehensive Restoration Plan for the Gulf of Mexico, part of the Final Programmatic Damage Assessment and Restoration Plan.

Guidelines for Ephemeral Data Collection in the Arctic: In 2004, Dr. Bejarano was the toxicologist leading the development of high priority ephemeral data collection methods used by NOAA, trustees, and others needed to support injury assessment in the Arctic. These guidelines covered methods for 8 environmental media, 7 habitats and associated communities, and 2 biological resources. She drafted, reviewed and finalized all sampling guidelines, and was responsible for the preparation of the final report.

## ECOLOGICAL RISK ASSESSMENT

Dr. Bejarano has extensive experience in developing site-specific ecological risk assessments.

Brookley AFB Landfill: 2011 Dr. Bejarano prepared for The Louis Berger Group, Inc. a preliminary ecological risk assessment for the Brookley AFB Landfill. As part of this assessment, she characterized the risk to aquatic invertebrates, fish, and other aquatic wildlife species from exposures to chemicals of potential ecological concern found in surface water and sediments.

Richard P. Kane Mitigation Bank: In 2009 Dr. Bejarano prepared for The Louis Berger Group, Inc. and EarthMark NJ Kane Mitigation, LLC, a baseline ecological risk assessment of methylmercury at a wetland mitigation bank, with emphasis on acute and chronic risks to avian and mammalian receptors, New Jersey Meadowlands, NY.

Burton Island Ash Landfill: In 2008 Dr. Bejarano performed a toxicity assessment of metal mixtures from landfill sources on benthic estuarine and marine invertebrates, and helped develop preliminary damage assessment and Habitat Equivalency Analysis for Burton Island Ash, DE.

## CLIMATE CHANGE VULNERABILITY ASSESSMENT

Dr. Bejarano has extensive experience in assisting assessments focus on coastal vulnerabilities to anthropogenic and environmental factors. She has combined geo-reference information and site specific knowledge of physical and ecological processes in the coastal zone to develop coastal vulnerability indices.

Development of a Climate Change Vulnerability Tool for Corales del Rosario y San Bernardo National Natural Park, Colombia: In 2015 Dr. Bejarano, in partnership with the international branch of the National Park Service, coordinated the development of an interactive tool that assesses the vulnerability of one of the National Parks of Colombian to impacts associated with climate change (e.g., sea level rise, storm surge). Dr. Bejarano's contributions to this project include coordination with national and international partners, gathering of spatial and other relevant data, developing vulnerability indices for key biological and socioeconomic resources, and facilitating bilingual communications with our partners.

Abu Dhabi- Habitat Vulnerability: In 2011 Dr. Bejarano and other RPI scientists identified and collected information on resources at risk in coastal and marine ecosystems, and developed a stressor-receptor based vulnerability index for habitats in the Emirate of Abu Dhabi. This index evaluated threats from a wide range of factors including chemical and oil spills, sea level rise and other climate change stressors, coastal development and dredging, and harmful algal blooms. This information was later integrated into the Abu Dhabi Coastal Resource Atlas and Vulnerability Index for the Environmental Agency of the Emirate of Abu Dhabi, a tool that supports coastal management and planning in the region. Dr. Bejarano also contributed to the preparation of draft and final reports related to this project.

Climate Assessment and Proactive Response Initiative (CAPRI), Puget Sound, NOAA-ARD: In 2009-2010 Dr. Bejarano was a key contributor to the development and implementation of the interdisciplinary CAPRI project. Her primary role included the coordination and collection of spatial, chemical hazards (e.g., waste sites, chemical storage tanks, and oil storage facilities and pipelines) and biological data (e.g., sensitive habitats, and species of concern), and the development of contaminant and site-specific hazard assessments. These data were used to develop a vulnerability index of coastal and marine resources to a range of regionalized climate change scenarios (e.g., sea level rise). Dr. Bejarano also contributed to the preparation of draft and final reports related to this project.

## LITERATURE SYNTHESES AND ENVIRONMENTAL ASSESSMENTS

Dr. Bejarano has extensive experience identifying, collecting, reviewing and interpreting information in support of environmental assessments.

Wind Turbines on the Atlantic Outer Continental Shelf: In 2013, Dr. Bejarano worked with a team of RPI and outside experts on an analysis of the environmental risks, fate, and effects of chemicals associated with wind turbines on the Atlantic Outer Continental Shelf (OCS) for the Bureau of Safety and Environmental Enforcement. Her primary role is to conduct a toxicological assessment of the effects of accidental releases of chemicals used in offshore wind turbines on marine resources, and to develop threshold levels of concern for selected chemicals. This information will be used in environmental assessments related to wind farms.

Worldwide Synthesis of the Impacts of Offshore Sand Resources: In 2012-2013 Dr. Bejarano worked with a team of RPI and outside experts on a synthesis of the state of knowledge of the impacts of offshore sand dredging on biological resources for the Bureau of Ocean Energy Management. Her primary role was to conduct a comprehensive synthesis on the effects of these activities on fish and habitats in this area. She also contributed to the identification of data gaps and helped develop recommendations for future studies.

Lake Wabamun Spill: In 2008, Dr. Bejarano wrote a comprehensive literature review in support of assessments undertaken by Environment Canada, Fisheries and Oceans Canada in response to the 2005 Bunker C spill in Wabamun Lake, AB, Canada. This synthesis focused on the toxicity of bunker oil to freshwater fish species and fish communities in sub-arctic lotic systems.

## SELECTED PUBLICATIONS

Bejarano, AC, Raimondo, S and Barron, MG. 2017. Framework for Optimizing Selection of Interspecies Correlation Estimation Models to Address Species Diversity and Toxicity Gaps in an Aquatic Database. Environmental Science and Technology. 51(14): 8158-8165.

Bejarano AC, Gardiner WW, Barron MG, Word JQ. 2017. Relative sensitivity of Arctic species to physically and chemically dispersed oil determined from three hydrocarbon measures of aquatic toxicity. Marine Pollution Bulletin. 122(1-2): 316-22.

Bejarano AC and J Michel. 2016. Oil Spills and their Impacts on Sand Beaches: A Literature Review. Environmental Pollution. 218: 709-722.

Bejarano AC, Toline CA, Horsman JL, Zarza-González E, Cogollo K. 2016. A Climate Change Vulnerability Framework for Corales del Rosario y San Bernardo National Natural Park, Colombia. Climate Research. 70: 1-18.

Bejarano AC, Farr JK, Jenne P, Chu V, Hielscher A. 2016. The chemical aquatic fate and effects database (CAFE), a tool that supports assessments of chemical spills in aquatic environments. Environmental Toxicology and Chemistry. 35 (6): 1576-1586.

Bejarano AC, Barron MG. 2016. Aqueous and tissue residue-based interspecies correlation estimation models provide conservative hazard estimates for aromatic compounds. Environmental Toxicology and Chemistry 35 (1): 56-64.

Bejarano AC and Mearns A. 2015. Improving environmental assessments by integrating Species Sensitivity Distributions into environmental modeling: examples with two hypothetical oil spills. Marine Pollution Bulletin. 93(1-2):172-182.

Bejarano AC, Barron MG. 2014. Development and practical application of petroleum and dispersant interspecies correlation models for aquatic species, Environmental Science and Technology. 48 (8): 4564–4572.

Bejarano AC, Clark J, Coelho, J.M. 2014. Issues and challenges with oil toxicity data and implications for their use in decision making: a quantitative review. Environmental Toxicology and Chemistry. 33 (4): 732–742.

Bejarano AC, Levine E, Mearns A. 2013. Effectiveness and potential ecological effects of offshore surface dispersant use during the Deepwater Horizon oil spill: a retrospective analysis of monitoring data. Environmental Monitoring and Assessment. 185: 10281-10295.

Bejarano, AC and JK Farr. 2013. Development of short acute exposure hazard estimates: a tool for assessing the effects of chemical spills in aquatic environments. Environmental Toxicology and Chemistry. 32 (8): 1918-1927.

Bejarano AC and J Michel. 2010. Large-scale risk assessment of polycyclic aromatic hydrocarbons in shoreline sediments from Saudi Arabia: Environmental legacy after twelve years the Gulf War oil spill. Environmental Pollution. 158 (5): 1561-1569.

Bejarano AC, FM Gulland, J St Leger, M Hunter, LH Schwacke, TK Rowles and FM VanDolah. 2008. Temporal and spatial signature of the biotoxin domoic acid in California sea lion (*Zalophus californianus*) stranding records. Marine Mammal Science. 24(4): 899-912

Bejarano AC, LH Schwacke, FM Gulland, TK Rowles and FM VanDolah. 2008. Production and toxicity of the marine biotoxin domoic acid and its effects on wildlife: a review. Human and Ecological Risk Assessment. 14 (3): 544- 567.

Bejarano, AC, FM VanDolah, FM Gulland and LH Schwacke. 2007. Exposure assessment of the biotoxin domoic acid in California sea lions: application of a bioenergetic model. Marine Ecology Progress Series. 345:293-304

Bejarano, AC, GT Chandler, L He, TL Cary and J Ferry. 2006. Risk assessment of the NIST petroleum crude oil standard water accommodated fractions (WAFs) on a meiobenthic copepod: Further application of a copepod-based full life-cycle bioassay. Environmental Toxicology and Chemistry. 25 (7): 1953-1960.

Bejarano, AC, GT Chandler, L He and BC Coull. 2006. Individual to population effects of South Louisiana crude oil water hydrocarbon accommodated fraction (WAFs) on a marine meiobenthic copepod. Journal of Experimental Marine Biology and Ecology 332: 49-59.

Bejarano, AC, PL Pennington, ME DeLorenzo and GT, Chandler. 2005. Atrazine effects on the meiobenthic assemblage of a modular estuarine mesocosm. Marine Pollution Bulletin 50 (11): 1398-1404

Bejarano AC, GT Chandler and AW Decho. 2005. Influence of natural Dissolved Organic Matter (DOM) on acute and chronic toxicity of the pesticides chlorothalonil, chlorpyrifos and fipronil to the meiobenthic estuarine copepod *Amphiascus tenuiremis*. Journal of Experimental Marine Biology and Ecology. 321 (1): 43-57.

Bejarano AC, AW Decho and GT Chandler. 2005. The role of different forms of dissolved organic matter (DOM) on chlorpyrifos bioavailability to the suspension-feeding estuarine bivalve *Mercenaria mercenaria*. Marine Environmental Research. 60 (1): 111-130.

Chandler, GT, TL Cary, AC Bejarano, J Pender, and JL Ferry. 2004. Population consequences of fipronil and degradates to copepods at environmental concentrations: An integration of lifecycle testing with Leslie-matrix population modeling. Environmental Science and Technology. 38 (23): 6407-6414.

Bejarano, AC, Maruya KA, Chandler GT. 2004. Toxicity assessment of sediments associated with various land-uses in coastal South Carolina, USA, using a meiobenthic copepod bioassay Marine Pollution Bulletin. 49 (1-2): 23-32.

## SELECTED NON PEER-REVIEWED PUBLICATIONS

Fitzpatrick, FA, Boufadel, MC, Johnson, R, Lee, KW, Graan, TP, Bejarano, AC, Zhu, Z, Waterman, D, Capone, DM, Hayter, E and Hamilton, SK, 2015. Oil-particle interactions and submergence from crude oil spills in marine and freshwater environments: review of the science and future research needs (No. 2015-1076). US Geological Survey.

Bejarano, AC, J Michel and SA Allan. 2014. Guidelines for Collecting High Priority Ephemeral Data for Oil Spills in the Arctic in Support of Natural Resource Damage Assessments. Office of Response and Restoration, National Oceanic and Atmospheric Administration. 272 pp.

Bejarano AC, 2014 DTox: a Worldwide Quantitative Database of the Toxicity of Dispersants and Chemically Dispersed Oil. NOAA/UNH Coastal Response Research Center, Grant Number: No. 13-034. 65 pp.

Bejarano, AC, J Michel, J Rowe, Z Li, D French McCay, L McStay and DS Etkin. 2013. Environmental Risks, Fate and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2013-213. 181 pp.

Michel, J, AC Bejarano, CH Peterson, and C Voss. 2013. Review of Biological and Biophysical Impacts from Dredging and Handling of Offshore Sand. U.S. Department of the Interior, Bureau of Ocean Energy Management, Herndon, VA. OCS Study BOEM 2013-0119. 236 pp.

Bejarano, AC. 2013. Fish and Fish Habitats. In: South Atlantic Information Resources: Data Search and Literature Synthesis. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. Michel, J. (Ed.). June, 2013.

Levine E, A Mearns, G Shigenaka, S Miles S, AC Bejarano, B Magdasy, K Bond. 2012. Review of SMART Data for Aerial Dispersant Operations. Prepared for the US Coast Guard Federal On-Scene Coordinator Deepwater Horizon MC252. January, 2012.

Tjeerdema, R, AC Bejarano, S Edge S. 2012. Biological Effects of Dispersants and Dispersed Oil on Surface and Deep Ocean Species. In: The Future of Dispersant Use in Oil Spill Response Initiative. Coastal Response Research Center, Research Planning, Inc., National Oceanic and Atmospheric Administration. February, 2012.