

## Overview

Dr. Christopher Lewis specializes in the field of Natural Resource Damage Assessment (NRDA), environmental science and policy, and risk assessment, leveraging expertise in inorganic aquatic chemistry and exposure and risk analysis, and experience in the fields of Environmental Science and Environmental Epidemiology. He draws on a suite of analytical laboratory and field sampling experience and a multi-disciplinary background to provide analysis and evaluation of environmental data and information, technical advice on scientific studies, and technical and NRDA case support. Dr. Lewis has served clients on all aspects of NRDA, including assistance with information compilation and analysis in the preassessment phase, assessment planning, the implementation of assessments, and restoration identification and scaling. Dr. Lewis also has experience applying his analytical skills in the context of more broadly focused economic analysis, including valuation of natural resources and numerical modeling. Dr. Lewis lives and works in Denver, CO.

## Education

Doctor of Science in Environmental Health, concentrating in Environmental Science and Engineering, Harvard University School of Public Health. (2006)

Master of Science in Environmental Health, concentrating in Environmental Science and Engineering, Harvard University School of Public Health. (2003)

Bachelor of Arts in Biology, Middlebury College. (1998)

While attending Harvard as a doctoral student, Dr. Lewis also served on the disciplinary committee and assisted in the teaching of a course on Water Pollution. His dissertation was titled "Assessment of Spatial and Temporal Variability of Heavy Metal Speciation in Aquatic Environments." Dr. Lewis is a member of the professional Society of Environmental Toxicology and Chemistry (SETAC).

## Selected Project Experience

For the **U.S. DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE**, Dr. Lewis is assisting state and Federal Trustees in the assessment of damages related to the Houston Ship Channel Texas City Y Oil Spill NRDA. Assistance has revolved around shoreline and avian injury determination and quantification, data management, quality assurance and quality control, data evaluation, and case strategy and technical support.

For the **STATE OF ARKANSAS GAME AND FISH COMMISSION**, Dr. Lewis is assisting in the preassessment of damages related to the Mayflower Oil Spill in Dawson Cove in Lake Conway. This effort includes the evaluation of existing data and information on resource injury and preliminary evaluation of potential restoration projects and estimation of damages.

For the **U.S. DEPARTMENT OF ENERGY**, Dr. Lewis is serving as the Lead Environmental Scientist on the implementation of the NRDA for the Los Alamos National Laboratory (LANL) and surrounding areas. Dr. Lewis previously helped lead the development of the Damage Assessment Plan for the LANL NRDA Trustee Council, consisting of the Department of Energy, the State of New Mexico, the Forest Service, the Santa Clara Pueblo, Jemez Pueblo, and the Pueblo de San Ildefonso. This included the assimilation of information on historical site operations and contamination of environmental media with hazardous substances, including heavy metals, explosives, and radionuclides, into a report designed to guide future assessment activities at

the site. Dr. Lewis also previously drafted the Pre-Assessment Screen (PAS) document for the Los Alamos National Laboratory NRDA.

For the **U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE**, Dr. Lewis is serving as the Lead Environmental Scientist on the Idaho Phosphate Mining Area NRDA, in southern Idaho. For this project, Dr. Lewis has provided internal technical support related to injury determination and quantification.

For the **U.S. DEPARTMENT OF JUSTICE**, and the **U.S. DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE**, Dr. Lewis is serving as an expert consultant on the NRDA of the Sauget Industrial Corridor in Illinois. Dr. Lewis is reviewing site documentation, assisting in the preparation of pathway and injury determination reports, and will assist in settlement discussions and/or litigation.

For the **U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF OCEAN ENERGY MANAGEMENT**, assisted in the development of restoration cost estimates for ecological injuries caused by oil spills resulting from offshore oil and gas development.

For the **U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF SOLID WASTE**, Dr. Lewis has managed expert peer reviews of regulatory risk assessment documents, including evaluations of the human and ecological health risks associated with management of coal combustion waste and the re-use of spent foundry sands.

For the **STATE OF DELAWARE, DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL**, assisted in the modeling of changes in water quality caused by estimated changes in the extent of wetlands over time.

For the **U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE**, Dr. Lewis assisted NRDA efforts for the Buffalo River NRDA, in New York. For this project, Dr. Lewis has drafted a number of deliverables, including a preliminary estimate of damages, fact sheets, and injury reports; and provided technical and strategic support. He also conducted habitat equivalency analyses for injured aquatic and terrestrial resources.

For the **STATE OF MISSOURI, DEPARTMENT OF NATURAL RESOURCES**, Dr. Lewis assisted with the development of several recent groundwater NRDA claims in the context of a bankruptcy. Dr. Lewis previously collected and synthesized information on groundwater resources, contaminated groundwater sites, baseline groundwater quality, and damage assessment approaches used in other states to develop a technical approach to pursuing groundwater NRDA claims for Missouri.

For the **NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION**, Dr. Lewis served as the Technical Work Group Lead for the Deepwater Benthic Communities Technical Work Group for the MS Canyon 252 Deepwater Horizon Oil Spill. Efforts included organization and planning of environmental sampling, drafting and review of research cruise plans, work group facilitation, and the provision of technical, strategic, and case support. As part of this effort, Dr. Lewis drafted the Benthos Chapter of the Programmatic Damage Assessment Restoration Plan.

For the **U.S. DEPARTMENT OF THE INTERIOR**, Dr. Lewis assisted the **BUREAU OF LAND MANAGEMENT** and the **FISH AND WILDLIFE SERVICE** conduct a preassessment for a petroleum spill into West Creek, near Grand Junction, CO. As part of this effort, Dr. Lewis conducted a habitat equivalency analysis for natural resource injuries resulting from the spill, and assisted in settlement negotiations with the responsible party. The case was settled at the end of preassessment for approximately \$100,000.

For the **U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE**, conducted a resource equivalency analysis to scale restoration required to compensate for avian wildlife killed as a result of the Suncor petroleum spill into a wetland and Sand Creek, in Denver, CO. This process included working with U.S. Fish and Wildlife personnel to develop life history parameters for affected avian species, and identify and scale appropriate restoration options. Dr. Lewis assisted in settlement negotiations for this case, which settled for

approximately \$1.9 Million. Dr. Lewis subsequently assisted the **STATE OF COLORADO** with post-settlement filings associated with the case.

For the **U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE**, Dr. Lewis assisted with NRDA efforts related to a petroleum spill in the Upper Missouri River in the Bakken region of North Dakota. Dr. Lewis previously provided support on the oil spill response effort for this spill.

For the **NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION**, participated in NRDA efforts related to the Enbridge Pipeline Oil Spill in the Kalamazoo River. Efforts included drafting assessment work plans and assisting in the drafting of Shoreline Cleanup Assessment Team (SCAT) forms for use in the context of NRDAR.

For the **COMMONWEALTH OF MASSACHUSETTS, EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS**, provided technical support related to NRDA, including drafting of technical memoranda related specifically to damages assessment at oil spill sites and in wetlands.

For the **STATE OF NEW JERSEY, OFFICE OF THE ATTORNEY GENERAL**, Dr. Lewis has assisted in the evaluation and quantification of natural resource injuries to groundwater at over 10 contaminated sites. These evaluations supported the development of expert reports and damage claims in litigation against potentially responsible parties.

For the **NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION**, managed the field collection and laboratory analysis of sediment and biota samples to support a NRDA at a confidential site and the surrounding marsh ecosystem. As part of this effort, Dr. Lewis participated in sample processing activities in the field, assisted in drafting a Field Sampling Report, and coordinated communications with multiple analytical laboratories.

For the **ST. REGIS MOHAWK TRIBE, ENVIRONMENT DIVISION**, developed a series of data reports describing the results of contaminant analyses of various environmental media, including review and critical evaluation of data quality, statistical analysis of contaminant concentration trends, and comparison of results with those from other, relevant datasets. This work was conducted in the context of the larger St. Lawrence River NRDA.

For the **U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE**, helped to manage an expert peer review of a waterfowl sampling plan. This review was conducted as part of a larger, confidential, NRDA effort for a river contaminated with polychlorinated biphenyls (PCBs).

For the **ST. REGIS MOHAWK TRIBE, ENVIRONMENT DIVISION**, prepared a fact sheet for public dissemination detailing the risks associated with the presence of polychlorinated biphenyls (PCBs) in garden soils. This fact sheet also summarized a report prepared by Dr. Lewis presenting the results of a community-wide study into PCB concentrations in garden soils. This work was conducted in the context of the larger St. Lawrence River NRDA.

For the **ENVIRONMENTAL DEPARTMENTS OF THE STATES OF MISSOURI, KANSAS, AND OKLAHOMA**, assessed ecological injury to surface water and groundwater stemming from heavy metal contamination attributable to mine waste as part of the ASARCO bankruptcy.

For the **U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF POLLUTION PREVENTION AND TOXIC SUBSTANCES**, assisted in the preparation of a Report to the U.S. Congress on the "Potential Export of Mercury Compounds from the United States for Conversion to Elemental Mercury," as required by the 2008 Mercury Export Ban Act.

For the **STATE OF ILLINOIS, OFFICE OF THE ATTORNEY GENERAL**, quantified anticipated changes in water quality in the Chicago Area Waterway System (CAWS) attributable to potential changes in the regulatory use designations of river reaches.

For the **U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF SUPERFUND REMEDIATION AND TECHNOLOGY INNOVATION AND THE OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE**, Dr. Lewis has provided a range of risk assessment support, including assessment of inhalation risks associated with exposures to volatile organic contaminants (VOCs) stemming from domestic water use. This effort included a review of analytical approaches and the equations and parameters used in those approaches for estimating inhalation risk.

For the **U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF SUPERFUND REMEDIATION AND TECHNOLOGY INNOVATION**, contributed to an evaluation of a draft guidance document on clean-up strategies for soils at Superfund sites. This draft guidance document provides information about alternative approaches for identifying contaminated soil for removal (area-averaging versus not-to-exceed thresholds).

For the **U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF POLLUTION PREVENTION AND TOXICS**, evaluated and mathematically modeled the U.S. and global elemental mercury markets. Dr. Lewis also assisted in compiling the results of this analysis to support a stakeholder panel for managing domestic stocks of commodity-grade mercury, and helped to prepare responses to inquiries by the Committee on Energy and Commerce of the U.S. House of Representatives.

For **HEALTH CANADA, AIR HEALTH EFFECTS DIVISION OF THE WATER, AIR, AND CLIMATE CHANGE BUREAU**, assisted in the conduct of literature reviews focusing on quantifying the economic benefits of health improvements associated with reductions in air pollution-related asthma prevalence and incidence, and reduced indoor mould exposure.

For the **U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF AIR QUALITY PLANNING AND STANDARDS**, conducted a literature review of recent publications pertaining to the relationship between blood lead concentrations and ambient lead concentrations. This review contributed to the benefits assessment presented in the Regulatory Impact Analysis for the revised National Ambient Air Quality Standard (NAAQS) for lead.

## Selected Peer-Reviewed Publications

Reuscher, M.G., Baguley, J.G., Conrad-Forrest, N., Cooksey, C., Hyland, J.L., Lewis, C., Montagna, P.A., Ricker, R.W., Rohal, M., and T. Washburn. 2017. *Temporal patterns of Deepwater Horizon impacts on the benthic infauna of the northern Gulf of Mexico continental slope*. PLoS ONE 12(6): e0179923. <https://doi.org/10.1371/journal.pone.0179923>.

Balthis, W., Hyland, J., Cooksey, C., Montagna, P., Baguley, J., Ricker, R., and C. Lewis. 2017. *Sediment Quality Benchmarks for Assessing Oil-Related Impacts to the Deep-Sea Benthos*. Integrated Environmental Assessment and Management doi:10.1002/ieam.1898

Stout, S.A., Rouhani, S., Liu, B., Oehrig, J., Ricker, R.W., Baker, G., and C. Lewis. 2017. *Assessing the footprint and volume of oil deposited in deep-sea sediments following the Deepwater Horizon oil spill*. Marine Pollution Bulletin 114: 327-342.

Stout, S.A., Payne, J.R., Ricker, R.W., Baker, G., and C. Lewis. 2016. *Macondo oil in deep-sea sediments: Part 2 – Distribution and distinction from background and natural oil seeps*. Marine Pollution Bulletin 111:381-401.

Dong, Z., C.G. Lewis, R.M. Burgess, B. Coull, and J.P. Shine. 2016. *Statistical evaluation of biogeochemical variables affecting spatiotemporal distributions of multiple free metal ion concentrations in an urban estuary*. Chemosphere 150:202-210.

Dong, Z., C.G. Lewis, R.M. Burgess, and J.P. Shine. 2015. *The Gellyfish: An in situ equilibrium-based sampler for determining multiple free metal ion concentrations in marine ecosystems*. Environmental Toxicology and Chemistry 34:983–992. doi: 10.1002/etc.2893

Drimal, M., C. Lewis, and E. Fabianova. 2010. *Health Risk Assessment of Environmental Exposure to Malodorous Sulfur Compounds in Central Slovakia (Ruzomberok Area)*. Carpathian Journal of Earth and Environmental Science. 5(1):119-126.

Senn, D.B., S.B. Griscom, C.G. Lewis, J.P. Galvin, M.W. Chang, and J.P. Shine. 2004. *Equilibrium-Based Sampler for Determining Cu<sup>2+</sup> Concentrations in Aquatic Ecosystems*. Environmental Science and Technology 38(12):3381-3386.

### **Selected Memoranda, Reports, and Presentations**

Lewis, C. and C. Arthur. 2016. *Sauget Industrial Corridor Sites Natural Resource Damage Assessment Pathway Report for Terrestrial and Aquatic Resources*. Prepared for the Department of Interior Fish and Wildlife Service. July 15.

Lewis, C. and E. Horsch. 2014. *Considerations for a Successful Transition from Remediation/Response to NRDA*. Presentation at the 2014 ASTSWMO State Superfund and Brownfields Joint Managers Symposium. Denver, CO. June 12.

Lewis, C., D. Henry, C. Foley, and R. Unsworth. 2014. *Buffalo River Natural Resource Damage Assessment: Groundwater Injury Determination at Selected Sites Adjacent to the Buffalo River*. April 14.

Los Alamos National Laboratory Natural Resource Trustee Council. 2014. *Final Natural Resource Damage Assessment Plan for Los Alamos National Laboratory*. Report for the U.S. Fish and Wildlife Service. February.

Lewis, C., D. Henry, and R. Unsworth. 2011. *Buffalo River Natural Resource Damage Assessment: Fish Consumption Advisory Injury Determination*. Report for the U.S. Fish and Wildlife Service. December 12.

Los Alamos National Laboratory Natural Resource Trustee Council. 2010. *Preassessment Screen for Los Alamos National Laboratory*. January.

Onondaga Lake Natural Resource Damage Assessment and Restoration Trustee Council. 2010. *Fact Sheet: Onondaga Lake Natural Resource Damage Assessment*. February.

Lewis, C. 2009. *Groundwater NRDA in Missouri*. Presentation at 2009 Great Lakes NRDA and Restoration Roundtable. Lansing, MI.

Lewis, C. 2009. *Use of Resource Equivalency Analysis (REA) to Scale Compensatory Groundwater Restoration Actions*. Presentation at 2009 Massachusetts Water Resources Research Center Conference. Amherst, MA.

U.S. Environmental Protection Agency. 2009. *Potential Export of Mercury Compounds from the United States for Conversion to Elemental Mercury*. Report prepared for the Office of Pollution Prevention and Toxic Substances. October.

Gentile, M., C. Lewis, and H. Roman. 2009. *Memorandum re: Literature Review: Economic Valuation of the Social Welfare Impacts of Residential Mould Exposure*. Prepared for Health Canada, Air Health Effects Division of the Water, Air, and Climate Change Bureau. September.

Gentile, M., C. Lewis, and H. Roman. 2009. *Memorandum re: Literature Review: Economic Valuation of the Social Welfare Impacts from Asthma*. Prepared for Health Canada, Air Health Effects Division of the Water, Air, and Climate Change Bureau. March.

- Lewis, C. 2008. *Use of Resource Equivalency Analysis in Restoration of Interim Lost Services at Mining Sites*. Presentation at 2008 Central and Eastern European Conference on Health and the Environment. Cluj-Napoca, Romania.
- Lewis, C. and M. Ewen. 2008. *Memorandum re: Peer review of "Draft Human and Ecological Risk Assessment of Coal Combustion Wastes."* Prepared for the U.S. Environmental Protection Agency, Office of Solid Waste. September.
- Lewis, C., H. Roman, and E. Ruder. 2007. *Assessment of Inhalation Risk to Volatile Organic Compounds as Incorporated into Calculations of Preliminary Remediation Goals Using EPA Region 9 Methodology and the Inhalation Dosimetry Approach*. Prepared for the U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation and the Office of Solid Waste and Emergency Response. November.
- Lewis, C., H. Roman, and E. Ruder. 2007. *Memorandum re: Scientific Basis for Uptake Fraction Estimates Used In Inhalation Risk Assessment*. Prepared for the U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation and the Office of Solid Waste and Emergency Response. August.
- Lewis, C., B. Coull, and J. Shine. *Spatial and Temporal Variability of Free Ion Copper in Boston Harbor*. Presentation at Society of Environmental Toxicology and Chemistry 2005 Annual Meeting. Baltimore, MD.
- Lewis, C., S. Griscom, D. Senn, and J. Shine. 2004. *Use of an Equilibrium-Based Sampler for Determining Free Ion Concentrations in Environmental Samples*. Presentation at Society of Environmental Toxicology and Chemistry 2004 Annual Meeting. Portland, OR.
- Lewis, C. 2004. *Development of an Equilibrium-Based Free Ion Metal Sampler*. Presentation at 2004 Central and Eastern European Conference on Health and the Environment. Prague, Czech Republic.