THEODORE WICKWIRE, M.F.S.

Senior Environmental Scientist

Qualifications Summary

- 20+ years of Experience in environmental assessment and management
- Ecological risk assessment and risk management in freshwater, marine, estuarine and terrestrial environments
- Ecological risk assessment method development
- Field program design and management
- Causal analysis application and method development
- Vulnerability assessment
- Relative risk modeling
- Multiple stressor analysis
- Risk communication
- Spatially explicit exposure assessment
- Guidance development
- Litigation support
- Long-term biomonitoring program design and implementation
- Forest ecology and watershed management
- Project Management

Professional Affliations

North Atlantic Chapter of the Society of Environmental Toxicology and Chemistry (Past President, current member)
Society of Environmental Toxicology and Chemistry

Fields of Expertise

Mr. Wickwire focuses on solving complex environmental problems using risk assessment, casual analysis, vulnerability assessment and weight-of-evidence approaches. He has applied his expertise to evaluating spills, legacy contamination, claims of loss or damage, environmental stressors and developing new methods to advance the evaluations. Mr. Wickwire has prepared numerous aquatic and terrestrial ecological and human health risk assessments in New England and around the United States. He has managed the development of models that incorporate wildlife behaviors and habitat suitability to increase the realism of exposure modeling. Using multiple types of evidence, he applies the causal analysis framework to provide a transparent and defensible path to identifying a probable cause and ultimately managing it to reduce impact. Mr. Wickwire also uses relative risk model approaches to understand the potential vulnerabilities of different alternative approaches to environmental management. These methods are applicable to diverse environmental challenges such as introduction of species or climate change vulnerabilities.

Higher Education

M.F.S., Forest Science, Yale University School of Forestry and Environmental Studies (1996)
A.B., Biology and Environmental Sciences, Bowdoin College (*summa cum laude*) (1992) Phi Beta Kappa; James Bowdoin Scholar

Employment History

2011-2015	Managing Scientist, Exponent
2006-2011	Senior Scientist, Exponent
1997–2006	Senior Scientist and Project Manager, Menzie-Cura & Associates, Inc,

Employment History (continued)

1997–2002 Technology Manager, Menzie-Cura & Associates, Inc.
Summer 1995 Field Ecologist (through Student Conservation Association), United States Forest Service, Alaska Region,
1992–1994 Research Assistant, ICF Kaiser International, Inc., Clement International, Ecotoxicological Services,

Key Projects

Sea Turtle Multiple Stressor Analysis, Confidential - Co-Technical Lead
For a confidential client, Mr. Wickwire developed an assessment of multiple stressors potentially influencing three species of sea turtles. The assessment included developing a conceptual model of potential stressor interactions, research on the time varying influence of each stressor on turtles, evaluation of the implications of stressor impacts on populations and review of potential restoration actions.

Causal Assessment of Fruit Tree Stress, Yemen – Project Manager
He managed a project that used causal analysis to evaluate observed stress to fruit trees in a desert habitat. This case was particularly challenging because it required the team to separate stressors common to desert habitats from potential stress due to pollution. Using causal analysis, Mr. Wickwire and the team reviewed the weight-of-evidence. The work demonstrated that farming practices caused the vegetation stress. This was an important international case in a unique and challenging desert environment.

Causal Assessment of Eutrophication, Uruguay - Project Manager
Provided technical support on a litigation case in South America. Evaluated current habitat conditions and probable future habitat conditions in a large river system. The analysis focused on understanding current conditions and how those current conditions might change based on new development. Analysis focused on evaluating water parameters with respect to the characteristics of eutrophic systems. The analysis helped demonstrate that current conditions were unlikely to change and the any ecosystem stressors were not related to the subject project.

NPDES Permit Renewal, Confidential – Project Manager
In a National Pollutant Discharge Elimination System (NPDES) Permit Renewal litigation case Mr. Wickwire managed a team evaluating whether a discharge canal could be regulated as a natural waterbody or was considered a manufactured discharge structure. Detailed review of historic aerial photographic evidence as well as consideration of water quality data and historic precedent were all considered in the evaluation of permit applicability.

Salem MGP Plant Risk Assessments and Biomonitoring, Salem, MA – Project Manager and Lead Ecological Risk Assessor
Managed a comprehensive assessment at a former manufactured gas plant in Salem, Massachusetts. The project began with the design and implementation of a multi-year sediment monitoring program to evaluate changes in the benthic community over time. Additional assessment was completed under the Massachusetts Contingency Plan and included the

Key Projects (continued)

development of a scope of work, design and completion of a multi-media field program, research for toxicological benchmarks and toxicity reference values, employment of terrestrial and aquatic bioaccumulation models, completion of food chain models, interpretation of benthic community studies and completion of the ecological risk assessment report. Applied a weight-of-evidence approach to integrate multiple lines of evidence. The project included both a terrestrial and aquatic component. Managed the completion of the human health risk characterization. After completion of the risk assessment, worked closely with the client to evaluate remedial alternatives with a specific focus on bioavailability of remnant historic coal tars and weathered PAHs. Developed and implemented a biomonitoring program to assist client in testing treatment approaches.

Beverly MGP Plant Risk Assessment, Beverly, MA – Project Manager, Ecological Risk Assessor, Field Program Lead
Managed and completed the ecological risk assessment for a manufactured gas plant in Beverly, Massachusetts. The work included the design of a field program to collect sediment, surface water and biota for analysis. He developed the scope of work and led the field team. In addition, he managed the analysis and integration of data and biological studies using a weight-of-evidence approach, and the completion of the ecological risk assessment report. He worked closely with the site engineer to apply findings to the remedial strategy.

Mississippi River Ecological Risk Assessment, Illinois – Project Manager, Ecological Risk Assessor, Field Program Lead
Served as project manager on an aquatic risk assessment focusing on a site within the Mississippi River. This included developing a screening assessment to evaluate site conditions and designing a comprehensive field program to determine the extent of analysis and evaluate the ecological conditions within the area of influence. As project manager, identified experienced river captains to provide a platform for sediment, surface water and fish collection in the high flow waters of the Mississippi River. Working under extremely difficult conditions, the team adapted standard still water methods to the high flow waters. Managed the data evaluation and authored the risk assessment report.

Paintshop Pond Human Health and Ecological Risk Assessment, Wellesley, MA – Human Health and Ecological Risk Assessment Scientist
Assisted in the completion of a human health and ecological risk assessment according to Massachusetts Contingency Plan (MCP) guidance for a property on which a former paint pigment factory was located. Elevated levels of lead and chromium were found in upland and wetland soils, sediments of Paintshop Pond, Waban Brook, and Lake Waban, and in groundwater. He co-authored the terrestrial ecological risk assessment and assisted with the development of the human health risk assessment. As part of the project team, coordinated closely with the client, the client's engineers, and with the Massachusetts Department of Environmental Protection (MADEP) to prepare Scopes of Work for human health and ecological risk assessment that were acceptable to all parties. Helped to develop the human health risk characterization based on acute and chronic exposures to chromium and lead through pathways encountered as a result of recreational activity at the site. Mr. Wickwire was an integral member of the field team as well. The work included the collection of hundreds of soil, biota and

Key Projects (continued)

sediment samples to characterize potential exposure. Ecological risk characterizations were performed on the pond, lake, wetlands and terrestrial environment surrounding these areas. The results of the human health and ecological risk assessments were used to develop air monitoring thresholds protective of the public during subsequent remediation and cleanup goals for soil and sediment. Currently overseeing the assessment of conditions in an adjacent waterbody.

Dredge Material Disposal Comparative Risk Assessment, NY Harbor, NY – Project Scientist

Served as a Project Scientist on a large comparative risk assessment for the Army Corps of Engineers in NY Harbor. The project involved the development of a screening-level human health and ecological assessment that compared risks associated with various dredged material management and disposal alternatives. This project developed models that predicted the fate and transport of metals, PCBs, pesticides, PAHs, and dioxins from five types of disposal facilities. The ecological risk assessment employed a steady state food-chain biomagnification model to estimate exposure of higher trophic-level organisms to contaminants. The human health risk assessment examined exposure to a variety of potential receptors, including dredge workers and recreational anglers. Role included data management, calculation of human health risks, support of the ecological risk assessment, preparation of report sections describing dredging technologies, preparation of the human health subchapters and development of process figures. The project was unusual in its presentation of a qualitative comparative risk matrix that provided Army Corps managers with a framework for choosing among disposal alternatives. Additional work included the examination of two new dredged material treatment technologies: Manufactured soil and sediment solidification. Mr. Wickwire was the second author of a Human and Ecological Risk Assessment publication that was awarded the HERA Integrated Risk Assessment Paper of the Year in 2002.

Big Sunflower River Maintenance Project, Southern US – Risk Assessor

Developed the ecological risk assessment for the Big Sunflower River Maintenance Project (BSRMP). Worked with the project team to prepare a comparative risk assessment for the potential aquatic ecological and human health effects from exposures to DDT, DDD, and DDE originating from sediments of the Big Sunflower River Basin. The risk assessment estimated and compared potential exposure and risk under two general long-term conditions (approximately 40 years) with a No Dredging scenario and a Dredging scenario. The probabilistic FISHRAND model was used to model bioaccumulation into aquatic species under both the No Dredging and Dredging scenarios. Ecological receptors included benthic invertebrates, warm water fish species, mallard duck, and mink. Prepared the ecological risk assessment.

Spatial Explicit Exposure Model (SEEM) Development – Project Manager

For over 10 years, Mr. Wickwire has been project manager for development of a wildlife exposure model for the US Army, working closely with the programmer to design, implement and test the spatially explicit exposure model (SEEM). This population model provides a more realistic evaluation of terrestrial wildlife exposure by including the influence of species-specific foraging behaviors and habitat suitabilities in determining exposure. Through the model individuals of a population forage across a landscape with the probability of foraging in any

Key Projects (continued)

given location influenced by habitat suitabilities. Mr. Wickwire has published and presented this model to numerous audiences and developed the companion guidance. The model continues to be updated as platforms change and new approaches are explored.

Bat Vulnerability Assessment Tool (BVAT)– Project Manager
Mr. Wickwire was the project leader focusing on the development of the Bat Vulnerability Assessment Tool (BVAT). Under contract to the Department of Energy, Mr. Wickwire worked with a programmer to develop a model to evaluate bat interactions with wind turbines. Based on the general rule-based movement approach applied in the SEEM Model (described below), the team developed a tool that models individual bat movements across a user-defined landscape. The model outputs can be used to evaluate different wind farm locations, orientation of the individual turbines and the size of the turbines in order to minimize adverse bat interactions. The tool was developed to aid in the screening step of wind farm development, e.g. site selection and site layout.

Guidance Development (Various Projects)– Project Manager
Assisted the *Science Advisory Board for Contaminated Sites (SAB), in British Columbia*, Canada with the development of a Screening Risk Assessment (SRA-Level 1) Guidance. British Columbia was charged with developing a tiered site assessment approach. As part of this modification, the SAB was charged with writing a prescriptive, qualitative screening guidance for application by Licensed Environmental Professionals (LEPs). The document focuses on determining whether further assessment is required at a site at which contaminant concentrations exceed screening standards. Specifically, the guidance focuses on determining whether any complete exposure pathways and/or receptors are present on the site and require further review. The guidance uses a decision-tree approach. In addition to providing the SRA1 guidance, prepared a document describing the assembly of conceptual models.

Provided input to the *US Environmental Protection Agency (EPA), National Center for Environmental Assessment (NCEA)* design team for Causal Analysis/Diagnosis Decision Information System (CADDIS) regarding the development of a conceptual modeling tool. He participated in a number of reviews and discussions regarding key components of the program.

For the *USEPA NCEA*, rewrote a guidance document for the Wildlife Scenario Builder (a wildlife exposure model). This required thorough testing of the software and the translation of complex software inputs to a user-friendly guidance document. He also updated the internal help guide.

Authored portions of the *Army Corps of Engineers Upland Testing Manual (UTM).* Developed a case study demonstrating the key concepts within each chapter of the manual. In addition, developed figures for the document and organized and reviewed the piece.

Publications

Menzie, C.A., J.H. Salatas, and T.W. Wickwire. 2013. Ecological risks associated with oyster restoration options for Chesapeake Bay. Human and Ecological Risk Assessment 2013; 19(5):1204–1233

Salatas, J.H., N.W. Gard, T.W. Wickwire, and C.A. Menzie. 2013. Stressor analysis approaches for endangered species assessments. Natural Science 2013; 5:27–35.

Menzie, C.A., T. Deardorff, P. Booth, and T. Wickwire. 2012. Refocusing on nature: Holistic assessment of ecosystem services. Integrated Environmental Assessment and Management, 2012; 8(3):401-411.

Wickwire, T., M.S. Johnson, B.K. Hope and M.S. Greenberg. 2011. Spatially explicit ecological exposure models: A rationale for and path toward their increased acceptance and use. Integrated Environmental Assessment and Management 2011; 7(2):158-168.

Hope, B.K., T. Wickwire, and M.S. Johnson. 2011. The need for increased acceptance and use of spatially explicit wildlife exposure models. Integrated Environmental Assessment and Management 2011; 7(2):156-157.

Wickwire T. and C.A. Menzie. 2010. The causal analysis framework: Refining approaches and expanding multidisciplinary applications. Human and Ecological Risk Assessment 2010; 16(1). (Editor of HERA Series on Causal Analysis)

Johnson M.S., W.T. Wickwire, M.J. Quinn, D.J. Ziolkowski, D. Burmistrov, C.A. Menzie, C. Geraghty, M. Minnich, and P.J. Parsons. 2007. Are songbirds at risk from lead at small arms ranges? An Application of the Spatially Explicit Exposure Model (SEEM). Environmental Toxicology and Chemistry 2007; 26(10):2215–2225.

von Stackelberg K, W.T. Wickwire, and D. Burmistrov. 2005. Spatially-explicit exposure modeling tools for use in human health and ecological risk assessment: SEEM and FISHRAND-Migration. pp. 279–288. In: Environmental Exposure and Health, 2005. Aral MM, Brebbia CA, Maslia MLand Sinks T (eds), United Kingdom: WIT Press.

Wickwire, W.T., C.A. Menzie, D. Burmistrov, and B.K. Hope. 2004. Incorporating spatial data into ecological risk assessments: the Spatially Explicit Exposure Model (SEEM) for ARAMS. Landscape Ecology and Wildlife Habitat Evaluation: Critical Information for Ecological Risk Assessment, Land-Use Management Activities, and Biodiversity Enhancement Practices 2004; ASTM STP 1458. Kapustka LA, Galbraith H, Luxon M, and Biddinger GR (eds), ASTM International, West Conshohocken, PA.

Kulmatiski, A, D.J. Vogt, T.G. Siccama, J.P. Tilley, K. Kolesinskas, T. Wickwire and B.C. Larson. 2004. Landscape determinants of soil carbon and nitrogen storage in Southern New England. Soil Science of America Journal, Division S-7 - Forest & Range Soils, 2004; 68:2014-2022.

Publications (continued)

Wickwire, W.T. and C.A. Menzie. 2003. New approaches in ecological risk assessment: Expanding scales, increasing realism, and enhancing causal analysis. Hum Ecol Risk Asses 2003; 9:1411–1414.

Wickwire,W.T., and D.E. Halberg. 2002. Developing a community-based silvicultural system: The Chalchijapa case study. In: Community-based approaches to community forest management: A comparison of two communities in Oaxaca, Mexico. Asbjornsen H and Ashton MS (eds), Journal of Sustainability 2002; 15(1):51–66.

Kane Driscoll S.B., W.T. Wickwire, J.J. Cura, D.J. Vorhees, C.L. Butler, D.W. Moore, and T.S.Bridges. 2002. A comparative screening-level ecological and human health risk assessment for dredged material management alternatives in New York/New Jersey Harbor. Hum Ecol Risk Asses 2002; 8(3):603–626. HERA "Integrated Risk Assessment Paper of Year."

Menzie, C.A. and W.T. Wickwire. 2001. Defining populations: A key step in identifying spatial and temporal scales. Toxicology & Industrial Health 2001; 17:223–229.

Presentations

Wickwire, W.T. 2015. What Is Causing Environmental Harm? Lessons Learned From Application Of A Causal Analysis Approach. North Atlantic Chapter, Society of Environmental Toxicology and Chemistry, 2015 Annual Meeting, Freeport, Maine, June 10-12, 2015.

Roberts, M.A., T.L. Morse, W.T. Wickwire, and R.W. Whittlesey. 2015. Navigating Wind Energy Challenges. Exponent Webinar. April 29, 2015.

Quinn, M., M.S. Johnson, and T. Wickwire. 2012. Kicking the tires: corroboration of model output with field data of the spatially-explicit exposure model (SEEM). Society of Environmental Toxicology and Chemistry (SETAC) 33rd Annual Meeting, Long Beach, CA, November 11-15, 2012.

Johnson, M.S., B.K. Hope, and T. Wickwire. 2012. Spatially Explicit Wildlife Exposure Models (PANEL): Moving Toward Their Increased Acceptance and Use. Society of Environmental Toxicology and Chemistry (SETAC) 33rd Annual Meeting, Long Beach, CA, November 11-15, 2012.

Johnson, M.S., M. Quinn, and T. Wickwire. 2012. Improving risk predictions through the integration of space and habitat suitability: an application of the spatially-explicit exposure model (SEEM). Society of Environmental Toxicology and Chemistry (SETAC) 33rd Annual Meeting, Long Beach, CA, November 11-15, 2012.

Presentations (continued)

Wickwire W.T., M.S. Johnson, P.J. Parsons, D. Burmistrov, and. C.A. Menzie. 2006. Considering habitat, behaviors and spatial interactions within terrestrial ecological exposure assessment: A case study application of the Spatially Explicit Exposure Model (Seem). North Atlantic Chapter, Society of Environmental Toxicology and Chemistry (NACSETAC) 2006 Annual Meeting, Portland, ME, June 7–9, 2006

Continuing Education

Communicating Risk, NACSETAC Annual Meeting Short Course.

ArcGIS Online: Interactive Web Mapping and Problem Solving for Environmental Professionals, NACSETAC Annual Meeting Short Course.

An Introduction to Emerging Technologies for Environmental Data Monitoring: Loggers to Sensor, Networks to the Cloud, NACSETAC Annual Meeting Short Course.

Causal Analysis/Stressor Identification, NACSETAC Annual Meeting Short Course.

Nanotechnology, NACSETAC Annual Meeting Short Course.

Population Modeling for Environmental Scientists, NACSETAC Annual Meeting Short Course.

GIS for Environmental Professionals, NACSETAC Annual Meeting Short Course.

Applied Statistics for Environmental Professionals.

Geographic Information Systems, Geostatistics and Risk Management Decisions: The Stories Pictures Tell, Society of Environmental Toxicology and Chemistry.

Practical Aspects of Ecological Risk Assessment, North Atlantic Chapter of the Society of Environmental Toxicology and Chemistry.

Using Bayesian Monte Carlo Analysis in Ecological Risk Assessments, North Atlantic Chapter of the Society of Environmental Toxicology and Chemistry.

Understanding Network Fundamentals. Compumaster.

Habitat Evaluation Procedures, Virginia Polytechnic Institute and State University, Division of Continuing Education.

OSHA Certified 40-Hour Training in Personnel Protection and Safety for Hazardous Waste Site Activities, 1998. OHSA Certified, Eight-Hour HAZWOPER Annual Refresher Training annually.

American Petroleum Institute Short Course: Hands-On Risk Assessment and Modeling Training.

Graduate of Dale Carnegie Management Course.