ESSA

Education
M.Sc., Zoology, University of British Columbia, 1983

B.E.S. (Honours), Man-Environment Studies and Mathematics, University of Waterloo, 1975

Years of Experience
40

David R. Marmorek

Mr. Marmorek combines technical tools of Adaptive Management (AM) with innovative methods of facilitation and leadership to tackle complex environmental problems. These problems include the design and evaluation of large scale restoration programs, regional scale ecological risk assessments, and development of monitoring plans and management experiments. He is an internationally recognized expert in AM, having applied these methods in North America, South America and Southeast Asia. He has been an invited speaker on AM in locales around the world and served on eight esteemed peer review panels dealing with ecosystem restoration, species recovery and AM. He is particularly interested in conducting research that combines his group leadership and facilitation skills with his knowledge of scientific methods (aquatic ecology, data analysis, modelling, experimental design, monitoring, adaptive management, decision analysis).

Professional Experience

2016 - present	**Lead Scientist and Senior Partner,** ESSA Technologies Ltd.
2002 - 2016	**President,** ESSA Technologies Ltd.
1993 - 2002	**Director,** ESSA Technologies Ltd.
1991 - now	**Adjunct Professor,** School of Resource and Environment Management, Simon Fraser University
1981 - 1993	**Systems Ecologist / Director** (after 1983)**,** ESSA Environmental and Social Systems Analysts Ltd.
1975 - 1978	**Applied Ecologist/Urban Planner,** Proctor and Redfern Ltd.

Awards

- Environmental Protection Agency - Bronze Medal for Commendable Service, 1987.
- University of British Columbia Graduate Scholarship, 1980.
- Natural Science & Engineering Research Council - Post-Graduate Scholarship, 1979.
- Rene Descartes Mathematics Bursary, University of Waterloo.
- Ontario Scholarship, York Mills Collegiate, Toronto.

Major Accomplishments

Acidic Deposition:

- Major role in the collaborative development of regional scale modelling and monitoring approaches to address the aquatic effects of acidic deposition in Canada and the United States (1981-1990), providing the technical foundation for Canada-U.S. negotiations on emission reductions.
- During 1987-1990, co-ordinated the activities of twenty watershed scientists and biologists working on the National Acid Precipitation Assessment Program (NAPAP), interacting with policy advisors developing regulatory decisions to reduce sulphur emissions, and developing the 1990 NAPAP Report to Congress.
- Major role in the collaborative development of the U.S. EPA's research on acidic deposition - over $50 million in programs to survey the status surface waters, and understand their responses on episodic to decadal time scales (awarded the Bronze Medal for Commendable Service by the U.S. Environmental Protection Agency).
- Published significant technical advances in modelling the chemical and biological effects of acidic deposition, understanding lake acidification pathways, applying the concept of critical loads, and using zooplankton in a biomonitoring program.
- Designed monitoring programs and applied steady state models to evaluate acidification risks from a lignite-burning generating station in Northern Thailand (1990-1992) and an expanded smelter in Kitimat, BC (2012-2020)

Suite 600, 2695 Granville St, Vancouver, BC V6H 3H4
Ph. (604) 733-2996; Fax (604) 733-4657; email dmarmorek@essa.com

Adaptive Management, Ecological Risk Assessment and Ecosystem Restoration:

- Internationally recognized expert in AM and ecological risk assessment; invited expert at AM meetings in B.C., Ontario, California, Oregon, Washington, Washington DC, Spain and Germany
- Applied decision analysis and AM to the collaborative design of strategies for flow management, ecosystem restoration, and species recovery in the Columbia Basin (U.S. and Canadian portions), British Columbia (Cheakamus and Okanagan Rivers), the Platte River (Nebraska and Colorado), Northern California (Clear Creek, Trinity River, Sacramento River, the Russian River), Puget Sound, the Middle Rio Grande, and the Missouri River Basin.
- Led a 12-agency team of modellers, managers and policy makers in applying decision analysis to endangered chinook salmon stocks in the U.S. Columbia River, known as the PATH process (Plan for Analyzing and Testing Hypotheses). The results of PATH (1995 to 2000) were presented to decision makers in the Pacific Northwest and Washington DC.
- Served on eight peer review panels dealing with ecosystem restoration, species recovery and AM: Oregon forest management (2006), Platte River species recovery (2005-2006, 2009-2020), Florida Everglades restoration (2008, 2010), Puget Sound ecosystem restoration (2008-12), Fraser River sockeye (2010-2012), Southern Resident Killer Whales (2011-12), Southern BC Chinook (2013), and coastal restoration and protection of coastal Louisiana (2013).
- Co-led an AM experiment that successfully re-introduced sockeye into Skaha Lake, and successful implementation of multi-agency, adaptive, in-season management of water releases from Okanagan Lake.
- Applied AM and ecological risk assessment to the effects of forestry on fish (Ontario and B.C.); avoiding ecological impacts from oil and gas exploration and production (Beaufort Sea and Florida); pest management in eastern forests; the impacts of cattle grazing in Nevada; and the impacts of power plants on the Hudson and Delaware Rivers.
- Managed twenty Canadian and Vietnamese professionals in the Environmental Monitoring component of the Vietnam Canada Environment Project — a 15-year, $40-million CIDA project to implement environmental assessment, monitoring and management of industrial and urban pollution in Vietnam's national government and nine provincial governments.

Refereed Journal Articles and Book Chapters

Marmorek, D., M. Nelitz, J. Eyzaguirre, C. Murray, and C. Alexander. 2019. Adaptive Management and Climate Change Adaptation: Two Mutually Beneficial Areas of Practice. Journal of the American Water Resources Association 55 (4): 881–905. https://doi.org/10.1111/1752-1688.12774

Williston, P., Aherne, J., Watmough, S., Marmorek, D., Hall, A., de la Cueva Bueno, P., Murray, C., Henolson, A., & Laurence, J. A. 2016. Critical levels and loads and the regulation of industrial emissions in northwest British Columbia, Canada. *Atmospheric Environment*, 146, 311-323.

Murray, C.L., D. Marmorek and L. Greig. 2015. Adaptive Management Today: A Practitioners' Perspective. Chapter 10, in: Adaptive Management of Social-Ecological Systems. Allen, C., A. Garmestani and C. Smith (Eds.). Springer.

Greig, L. A., D. R. Marmorek, C. Murray and D. C. E. Robinson. 2013. Insight into Enabling Adaptive Management. Ecology and Society 18 (3): 24. URL: http://www.ecologyandsociety.org/vol18/iss3/art24/

Alexander, C.A.D., C.N. Peters, D.R. Marmorek and P. Higgins. 2006. A decision analysis of flow management experiments for Columbia River mountain whitefish management. Can. J. Fish. Aquat. Sci. 63: 1142-1156.

C. Murray and D.R. Marmorek. 2003. Adaptive Management and Ecological Restoration. *In* Ecological Restoration of Southwestern Ponderosa Pine Forests. P. Friederici, ed. Ecological Restoration Institute, Flagstaff, AZ. p. 417-428.

Marmorek, David R. and Calvin Peters. 2001. Finding a PATH towards scientific collaboration: insights from the Columbia River Basin. Conservation Ecology 5(2): 8. [online] URL: http://www.consecol.org/vol5/iss2/art8

Deriso, R.B., Marmorek, D.R., and Parnell, I.J. 2001. Retrospective Patterns of Differential Mortality and Common Year Effects Experienced by Spring Chinook of the Columbia River. Can. J. Fish. Aquat. Sci. 58(12) 2419-2430

Peters, C.N. and Marmorek, D.R. 2001. Application of decision analysis to evaluate recovery actions for threatened Snake River spring and summer chinook salmon (Oncorhynchus tshawytscha). Can. J. Fish. Aquat. Sci. 58(12):2431-2446.

Peters, C.N., Marmorek, D.R., and Deriso, R.B. 2001. Application of decision analysis to evaluate recovery actions for threatened Snake River fall chinook salmon (Oncorhynchus tshawytscha). Can. J. Fish. Aquat. Sci. 58(12):2447-2458.

Marmorek, D.R., G. Lacroix, J. Korman, I. Parnell, and W.D. Watt. 1998. Modelling the effects of acidification on Atlantic salmon: a simple model of stream chemistry. Can. J. Fish. Aquat. Sci. 55(9): 2117-2126.

Marmorek, D.R., R.M. MacQueen, C.H.R. Wedeles, J. Korman, P.J. Blancher, and D.K. McNicol. 1996. Improving pH and alkalinity estimates for regional scale acidification models: incorporation of dissolved organic carbon. Can. J. Fish. Aquat. Sci. 53: 1602-1608.

Korman, J., D.R. Marmorek, G. Lacroix, P.G. Amiro, J.A. Ritter, W.D. Watt, R.E. Cutting, D.C.E. Robinson. 1994. Development and evaluation of a biological model to assess regional scale effects of acidification on Atlantic salmon. Can. J. Fish. Aquat. Sci. 51:662-680.

Marmorek, D.R. and J. Korman. 1993. The use of zooplankton in a biomonitoring program to detect lake acidification and recovery. Water, Air, and Soil Pollution 69: 223-241.

Sullivan, T.J., R.S. Turner, D.F. Charles, B.F. Cumming, J.P. Smol, C.L. Schofield, C.T. Driscoll, B.J. Cosby, H.J.B. Birks, A.J. Uutala, J.C. Kingston, S.S. Dixit, J.A. Bernert, P.F. Ryan, and D.R. Marmorek. 1992. Use of historical assessment for evaluation of process-based model projections of future environmental change: lake acidification in the Adirondack Mountains, New York, U.S.A. Environ. Pollut. 77: 253-262.

Turner, R.S., P.F. Ryan, D.R. Marmorek, K.W. Thornton, T.J. Sullivan, J.P. Baker, S.W. Christensen, and M.J. Sale. 1992. Sensitivity to change for low-ANC eastern U.S. lakes and streams and brook trout populations under alternative sulfate deposition scenarios. Environ. Pollut. 77: 269-277.

Holdren, G., J. Cosby, D. Marmorek, R. Santore, C. Hunsaker, D. Bernard, J. Aber, C. Driscoll, and R. Turner. 1992. A national critical loads framework for establishing pollutant loading standards: IV. Model selection, application, and critical loads mapping. Environmental Management. Volume 17:

Jones, M.L., C.K. Minns, D.R. Marmorek, and K.J. Heltcher. 1991. Assessing the potential extent of damage to inland lakes in eastern Canada due to acidic deposition. IV. Uncertainty analysis of a regional model. Can. J. Fish. Aquat. 48(4): 599-606.

Baker, J.P., D.P. Bernard, S.W. Christensen, M.J. Sale, J. Freda, K.J. Heltcher, D.R. Marmorek, L. Rowe, P.F. Scanlon, G.W. Suter II, W.J. Warren-Hicks, and P.M. Welbourn. 1990. NAPAP Report 13: Biological Effects of Changes in Surface Water Acid-base Chemistry. 392 pp. and appendices.

Jones, M.L., C.K. Minns, D.R. Marmorek, and F.C. Elder. 1990. Assessing the potential extent of damage to inland lakes in eastern Canada due to acidic deposition. II. Application of the regional model. Can. J. Fish. Aquat. Sci. 47: 67-80.

Marmorek, D.R. and D.P. Bernard. 1990. Response to K.C. Krug and W.L. Warnick's comments on: A protocol for determining lake acidification pathways. Wat. Air and Soil Poll. 50: 209-213.

Marmorek, D.R., M.L. Jones, C.K. Minns, and F.C. Elder. 1990. Assessing the potential extent of damage to inland lakes in eastern Canada due to acidic deposition. I. Development and evaluation of a simple "site" model. Can. J. Fish. Aquat. Sci. 47: 55-66.

Thornton, K., D. Marmorek, P. Ryan, K. Heltcher, and D. Robinson. 1990. Methods for projecting future changes in surface water acid-base chemistry. State-of Science/Technology Report 14. Prepared for National Acid Precipitation Assessment Program. 271 pp.

Marmorek, D.R., D.P. Bernard, C.H.R. Wedeles, G.D. Sutherland, J.A. Malanchuk, and W.E. Fallon. 1989. A protocol for determining lake acidification pathways. Wat. Air and Soil Poll. 44: 235-257.

Marmorek, D.R., M.L. Jones, C.K. Minns, and F.C. Elder. 1989. Assessing the potential extent of damage to inland fisheries in eastern Canada due to acidic deposition: I. development and evaluation of a simple "site" model. Can. J. Fish. Aq. Sci 47(1): 55-66.

Marmorek, D.R. 1984. Changes in the Temporal Behavior and Size Structure of Plankton Systems in Acid Lakes. In: Early Biotic Responses to Advancing Lake Acidification. G.R. Hendrey (ed.), Butterworth Publishers, pp. 23-41.

Marmorek, D.R. 1983. Effects of Lake Acidification on Zooplankton Community Structure and Phytoplankton-Zooplankton Interactions: An Experimental Approach. M.Sc. Thesis, University of British Columbia, 397 pp.

Refereed Technical Reports and Conference Proceedings

Fischenich, J.C., K.E. Buenau, J.L. Bonneau, C.A. Fleming, D.R. Marmorek, M.A. Nelitz, C. L. Murray, B.O. Ma, G. Long and C.J. Schwarz. 2018. Missouri River Recover Program: Science and Adaptive Management Plan. Report prepared for the U.S. Army Corps of Engineers, Washington, DC. 503 pp. https://www.nwo.usace.army.mil/mrrp/mgmt-plan/

Marmorek, D., I. Parnell, T. Webb, M. ZGraggen, W. Kurz, and J. Korman. 1998. The Fish/Forestry Interaction Program Simulation Model (FFIPS). In: D.L. Hogan, P.J. Tschaplinski, and S. Chatwin (eds.). Carnation Creek and Queen Charlotte Islands Fish/Forestry Workshop: Applying 20 Years of Coast Research to Management Solutions BC Ministry of Forests, Research Branch, Victoria, BC. Land Management Handbook No. 41. pp. 231-243.

Baker L.A., J.P. Baker, A.T. Herlihy, P.R. Kaufmann, D.H. Landers, D.R. Marmorek, M.J. Sale, T.J. Sullivan, K.W. Thornton, and P.J. Wiggington. 1990. NAPAP Integrated Assessment. Question 1 - Aquatic Effects of Concern and the Relationship between Acidic Deposition and Aquatic Effects. 57 pp.

Knapp, C.M., D.R. Marmorek, J.P. Baker, K.W. Thornton, J.M. Klopatek, and C.P. Charles. 1990. The indicator development strategy for the environmental monitoring and assessment program. U.S. Environmental Protection Agency. 78 pp.

NAPAP. 1990. Integrated Assessment: Questions 4 & 5: Results and Comparisons of Illustrative Future Scenarios. External review draft, September 1990. The National Acid Precipitation Assessment Program, Washington, D.C.

Turner R.S., P.F. Ryan, J.P. Baker, S.W. Christensen, D.R. Marmorek, M.J. Sale, T.J. Sullivan, and K.W. Thornton. 1990. NAPAP Integrated Assessment. Question 3 - Sensitivity of Aquatic Effects to Changes in Future Acidic Deposition. 75 pp.

Bernard, D.P., D.B. Hunsaker Jr., and D.R. Marmorek. 1989. Tools for improving predictive capabilities of environmental impact assessments: structured hypotheses, audits, and monitoring. In: The Scientific Challenges of NEPA: future directions based on 20 years of experience. (Eds: S. Hildebrand and J.B. Cannon). Based on the Ninth Oak Ridge National Laboratory, Life Sciences Symposium, Knoxville, TN, October 24-27, 1989. Lewis Publishers. Ann Arbor. pp. 547-564.

Cook, R.B., M.L. Jones, D.R. Marmorek, J.W. Elwood, J.L. Malanchuk, R.S. Turner, J.P. Smol. 1988. The effects of Acidic Deposition on Aquatic Resources in Canada: An Analysis of Past, Present and Future Effects. Oak Ridge National Laboratories. Environmental Sciences Division Publication No. 2894.

Marmorek, D.R., D.P. Bernard, M.L. Jones, L.P. Rattie, and T.J. Sullivan. 1988. The Effects of Mineral Acid Deposition on Concentrations of Dissolved Organic Acids in Surface Waters. Report prepared for U.S. E.P.A., 110 pp.

Thornton, K., J.P. Baker, D.R. Marmorek, D.P. Bernard, M.L. Jones, P.J. McNamee, C.H.R. Wedeles, and K.N. Eshleman. 1988. Episodic Response Project: Research Plan. Prepared for U.S. E.P.A.

Marmorek, D.R., D.P. Bernard, M.L. Jones, C.S. Davis. N.W. Reid, A.R. Fradkin, and R. Caton. 1987. Interim Target Loadings for Acidic Deposition in Western Canada: A Synthesis of Existing Information. Technical Committee for the Long-Range Transport of Atmospheric Pollutants in Western and Northern Canada. Victoria, British Columbia, 214 pp. and appendices.

Marmorek, D.R., D.P. Bernard, M.L. Jones, L.P. Rattie, and T.J. Sullivan. 1987. The Effects of Mineral Acid Deposition on Concentrations of Dissolved Organic Acids in Surface Waters. Final report prepared for U.S. E.P.A., 110 pp.

Jones, M.L., D.R. Marmorek, B.S. Reuber, P.J. McNamee, and L.P. Rattie. 1986. "Brown Waters": Relative Importance of External and Internal Sources of Acidification on Catchment Biota — Review of Existing Knowledge. Report prepared for Environment Canada and Department of Fisheries and Oceans, 85 pp.

Marmorek, D.R., K.W. Thornton, J.P. Baker, D.P. Bernard, and B. Reuber. 1986. Acidic episodes in surface waters: the state of science. Final report for the U.S. E.P.A., Environmental Research Laboratory, Corvallis, Oregon. 232 pp.

Thornton, K.W., D.R. Marmorek, D.P. Bernard, P. Shaffer, D. McKenzie, and J. Malanchuk. 1986. Watershed Manipulation Project: Research Plan. Final report for the U.S. E.P.A., Environmental Research Laboratory, Corvallis, Oregon.

Turner, R.S. J.L. Malanchuk, R.J. Olson, and D.R. Marmorek (eds.). 1986. The Effects of Acidic Deposition on Aquatic Systems: 1985 Assessment. Report prepared for U.S. E.P.A., 161 pp.

Church, R. D.R. Marmorek, K.W. Thornton, M.L. Jones, J. Malanchuk, P. Shaefer, B. Rochelle. 1985. Direct/Delayed Response Project. Long Term Response of Surface Waters to Acidic Deposition: Factors Affecting Response and a Plan for Classifying Response Characteristics on Regional Scales. Report prepared for U.S. E.P.A.

Marmorek, D.R., G.L. Cunningham, M.L. Jones, and P. Bunnell. 1984. Snowmelt Effects Related to Acidic Precipitation: A Structured Review of Existing Knowledge and Current Research Activities. Report prepared for Environment Canada and Department of Fisheries and Oceans, 80 pp.

Poetry

Brown, D. and D. Marmorek. 2018. Passing Through: Mountain Paintings and Poems. https://passing-through.ca/