

# **EUAN D. REAVIE -- CURRICULUM VITAE**

(last updated December 2011)

## **Address:**

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## **Education**

- *December 1998 - October 2000:* Postdoctoral (Geology), University of Toronto  
Paleolimnology in spring and fluvial environments
- November 1994 - October 1997: PhD (Biology), Queen's University  
Thesis: Diatom Ecology and Paleolimnology of the St. Lawrence River.
- September 1992 - October 1994: MSc (Biology), Queen's University  
Thesis: Paleolimnological investigation of post-settlement eutrophication in British Columbia, Canada.
- September 1988 - June 1992: BScH (Biology), Queen's University  
Thesis: Diatom and chrysophyte succession in two lakes with different mixing regimes.

## **Professional Experience**

- April 2004 – Present: Center for Water and the Environment, Natural Resources Research Institute, University of Minnesota Duluth, Ely, Minnesota  
Position: Director, Senior Research Associate (June 2011 - present), Research Associate (April 2004 - May 2011)
- October 2000 – April 2004: Jacobs Engineering Group Inc., Massachusetts Military Reservation Installation Restoration Program, Cape Cod, Massachusetts  
Position: Environmental Scientist
- January 1999 – October 2000: Department of Geology, University of Toronto, Toronto, Ontario  
Position: Researcher, Instructor

## **Membership in Professional Societies and Faculties**

- Water Resources Science graduate faculty, University of Minnesota (nomination and vote)
- Integrated Biosciences graduate faculty, University of Minnesota Duluth (nomination and vote)
- Sigma Xi Scientific Research Society, full member (nomination and vote)
- American Society of Limnology and Oceanography (ASLO) (dues)
- International Association for Great Lakes Research (IAGLR) (dues)
- Society of Canadian Limnologists (SCL) (dues)
- International Association of Geolimnologists (dues)
- International Society for Diatom Research (dues)

**Fellowships and Awards (as primary investigator); total to date = ~\$6,470,000:**

<b>Agency/Source</b>	<b>Amount, where held, period</b>	<b>Project</b>
U.S. Environmental Protection Agency (USEPA) Great Lakes National Program Office (GLNPO)	\$2,000,000, U. Minnesota Duluth, 2011-17	Great Lakes monitoring: phytoplankton + paleolimnology
Minnesota Pollution Control Agency	\$108,000, U. Minnesota Duluth, 2011-13	Paleolimnology of Lake of the Woods
Lake County Soil and Water Conservation District, Minnesota	\$95,000, U. Minnesota Duluth, 2011-14	Paleolimnology of the White Iron Chain of Lakes
Northeast-Midwest Institute, National Oceanic and Atmospheric Administration (NOAA)	\$430,000 (to date), U. Minnesota Duluth, 2006-10	Development of ballast water treatment technologies
Minnesota Sea Grant	\$110,000, U. Minnesota Duluth, 2010-12	Paleolimnology of Lake Superior
U.S. Environmental Protection Agency (USEPA) Great Lakes National Program Office (GLNPO)	\$1,000,000, U. Minnesota Duluth, 2007-12	Great Lakes monitoring: phytoplankton
U.S. Environmental Protection Agency (USEPA)	\$966,822, U. Minnesota Duluth, 2005-10	EMAP-Great Rivers algae indicator development
Itasca County Soil and Water Conservation District, Minnesota	\$38,000, U. Minnesota Duluth, 2006-08	Paleolimnology of Itasca County lakes
Sportsmen Club of Lake Vermilion	\$5,000, U. Minnesota Duluth, 2004-05	Paleolimnology of Lake Vermilion
Soil and Water Conservation District, Lake of the Woods County, Minnesota	\$45,000, U. Minnesota Duluth, 2004-05	Paleolimnology of Zippel Bay, Lake of the Woods
Itasca County Soil and Water Conservation District, Minnesota	\$91,502, U. Minnesota Duluth, 2004-05	Development of a diatom-based model for Minnesota lakes
US Environmental Protection Agency	\$909,229, U. Minnesota Duluth, and NRRI colleagues, 2004-06	Great Lakes environmental indicators (GLEI): diatoms
Natural Sciences and Engineering Research Council of Canada Post-Doctoral Fellowship	\$70,000, U. Toronto, 1999-2000	Environmental history of the St. Mary's River and the Oak Ridges Moraine
Tri-Council (SSHRC, MRC, NSERC)	\$90,000, Queen's U., 1994-97	Paleolimnology of the St. Lawrence River
Queen's Graduate Award	\$9,000, Queen's U., 1996-97	Graduate student funding
Queen's Graduate Award	\$4,000, Queen's U., 1995-96	Graduate student funding
Queen's Graduate Award	\$9,000, Queen's U., 1994-95	Graduate student funding
Queen's Graduate Award	\$9,000, Queen's U., 1993-94	Graduate student funding
Queen's Dean's Award	\$4,000, Queen's U., 1993-94	Graduate student funding
Queen's Fellowship	\$4,000, Queen's U., 1992-93	Graduate student funding

**Other Awards (as collaborating investigator, collaborators listed):**

National Oceanic and Atmospheric Administration (NOAA) Great Lakes Environmental Research Laboratory (GLERL)	\$37,000, U. Minnesota Duluth, and NRRI colleagues, 2011	Near-Term Design of the Great Lakes Coastal Observing System
US Environmental Protection Agency	\$1,650,000 (~\$40,000 for diatoms), U. Minnesota Duluth, and NRRI colleagues, 2010-12	GLEI II: Great Lakes Assessment
Natural Sciences and Engineering Research Council of Canada	\$396,200, Queen's U., with John P. Smol, 1997-98	Diatom indicators for southern Ontario

**Distinctions:**

- 2010-11: “Top-10 most cited” award from the Journal of Great Lakes Research for the period 2006-2011.
- 2009: Honorable Mention in the USEPA’s Scientific and Technological Achievement Award for research publications.
- 2006: “Star Performer” outstanding researcher award; awarded to acknowledge exemplary work in research at the University of Minnesota.
- 1998: Provasoli Award nomination for distinction in phycological research, for “Diatom paleolimnology of two fluvial lakes in the St. Lawrence River: a reconstruction of environmental changes during the last century” (Reavie *et al.* 1998).
- 1993: North American Lake Management Society Technical Excellence Award (presented to PEARL, Queen’s University).

**Field Experience:**

Researcher in Limnological Surveys:

- 2004-2011: Coring and limnological assessments of the Great Lakes, Itasca County lakes (MN), Zippel Bay, Lake of the Woods (MN), Lake Vermilion (MN) and White Iron Chain of Lakes (MN)
- 2007-2011: Evaluation of phytoplankton from the Great Lakes
- 2007-2011: Evaluation of the ballast water treatment facility, Lake Superior
- 2000-2003: Sampling of soils, sediments, surface and groundwater from contaminated freshwater systems on Cape Cod, Massachusetts
- 1991-1999: Coring excursions in the Great Lakes and St. Marys River, Environmental assessment and sediment coring of 64 lakes (southern Ontario), undeveloped lakes (southern Ontario), 50 sites in the St. Lawrence River (Ontario and Quebec); Chemical analyses and sediment coring of St. Lawrence River; analysis of sedimentary materials from 70 British Columbia lake cores

**Research and Environmental Assessment Skills:**

During my appointments at the University of Minnesota Duluth, Queen’s University, the University of Toronto and Jacobs Engineering, I have gained experience in aquatic and geological sciences. Some of these skills include:

Limnology experience:

- thorough understanding of freshwater algae taxonomy and ecology, and associated bioindicators;
- environmental assessment using field techniques, such as the determination of water quality variables using physical, biological and chemical indicators;
- sampling of various habitats (lakes, streams, estuaries, groundwater, wetlands, aquatic plants, rocks, macrophytes, etc.) using a variety of limnological equipment;
- associated laboratory procedures, including light, fluorescent and electron microscopy, sample preparation, chemical measurements, isotopic analyses (radiometric dating), and photography;
- sediment coring for the assessment of historical trends through the analysis of paleoenvironmental indicators (piston coring, gravity coring, etc.).

Analytical experience:

- complex statistical analyses, including multivariate analyses, three-dimensional kriging, regression and calibration techniques;
- computer applications used in statistical and other environmental investigations (e.g. SAS, SPSS, R, WACALIB, CANOCO, C2, NCSS, GMS, ArcView, CAD, LCM, SigmaPlot, Access, Excel).

Modeling experience:

- quantitative modeling of watershed characteristics, including the construction and application of a mass-balance (i.e. contaminant export coefficients) model of contaminant flow to aquatic systems;
- three-dimensional modeling of groundwater contaminant plumes using GMS software;
- modeling of bioindicator responses to organic and inorganic pollution;
- modeling/inference of past, present and future contamination scenarios in aquatic systems.

## Teaching Experience:

### Lecturer

University of Minnesota Duluth:

- Integrated Biosciences Colloquia (IBS 8020); 2006-2010
- Water Resources Science Colloquia (WRS 8100); 2009-2011
- Stream Ecology (guest) (BIOL 5833); 2010

University of Iowa

- Ecology and Systematics of Diatoms (guest) (00L:217); 2011

University of Toronto:

- Confronting Global Change (GLG205F); 1999-2000
- Quaternary Environmental Change (GLG436); 1999

Queen's University:

- Limnology (Biol 335); 1993-1998

Vermilion Community College:

- Miscellaneous guest lectures for aquatic science courses; 2004-2011

Lab demonstrator and tutorial leader (Queen's University):

- Limnology (Biol 335); 1992-1995
- General Ecology (Biol 202); 1992-1993
- Organization for Life: The Cell (Biol 101); 1993, 1994, 1997
- Organization for Life: The Organism (Biol 200); 1993
- Limnology Field Course (Biol 307a); 1994
- Ecology and Evolution Field Course (Biol 307b); 1994
- Ecology and the Environment (Biol 111); 1995

Thesis Supervision (Queen's University, University of Toronto, University of Minnesota Duluth):

- Supervision of PhD, MSc and 4th year honors theses on limnological, phycological and environmental topics (1995-present).

### Students Supervised:

- 2010-present: supervision of Victoria Chraïbi, Water Resources Science Program, University of Minnesota, MSc thesis, "Paleolimnology of Lake Superior"
- 1999-2000: Daniel Selbie, Queen's University, Dept. of Biology, undergraduate thesis, "Net plankton as a biomonitoring tool in southern Ontario lakes"
- 1998-99: Kimberly Neill, Queen's University, Dept. of Biology, undergraduate thesis, "Multiproxy paleolimnological approaches in three temperate lakes: lake management implications"
- 1997-99: Joanne Little, Queen's University, Dept. of Biology, master's thesis, "Paleoenvironmental applications of midge larvae in southern Ontario lakes"
- 1995-96: Jacqueline O'Connell, Queen's University, Dept. of Biology, undergraduate thesis, "Diatom epiphytes on *Cladophora* in the St. Lawrence River"

### Graduate Student committee service:

- 2009-present: Ashley Beranek, University of Minnesota Duluth, Integrated Biosciences Program, master's thesis, "Using sedimentary records to describe long-term changes in Island Lake Reservoir zooplankton populations concurrent with the establishment of *Bythotrephes longimanus*."
- 2004-2010: Claire Serieyssol, Water Resources Science Program, University of Minnesota, PhD thesis, "Investigation of the impacts of regulated water levels on biodiversity of diatoms and chironomids"

## Publications

### Books:

1. **Reavie, E.D.**, J.P. Smol 1998. Freshwater diatoms from the St. Lawrence River. *Bibliotheca Diatomologica* Band 41. J. Cramer, Berlin. 137 pp.
2. **Reavie, E.D.**, A.R. Kireta 2011. Centric, Araphid and Eunotioid Diatoms of the Coastal Laurentian Great Lakes. *Bibliotheca Diatomologica*, J. Cramer, Berlin (in preparation).

### Chapters:

1. **Reavie, E.D.**, M.B. Edlund 2010. Diatoms as indicators of environmental change in rivers, fluvial lakes and impoundments. In: Smol, J.P. & E.F. Stoermer (Eds.), *The Diatoms: Applications for the Environmental and Earth Sciences*, 2<sup>nd</sup> Edition. pp. 86-97.

### Refereed Publications (in review, accepted, in press, and published):

1. Cangelosi, A.A., M. Bain, M.D. Balcer, **E.D. Reavie**, D.M. Reid, N.L. Mays 2011. Comparison of in-line and in-tank ballast sampling methods (in preparation).
2. Kang, M., J.J.H. Ciborowski, J.C. Brazner, R.W. Howe, L.B. Johnson, C.A. Johnston, G.J. Niemi, **E.D. Reavie**, A.S. Trebitz 2011. Native-nonindigenous species biodiversity relationships, and dominance trends of taxonomic groups at Laurentian Great Lakes coastal margins – interaction versus neutral-interaction processes. *Ecological Monographs* (in preparation).
3. Kireta, A.R., **E.D. Reavie**, G.V. Sgro, T.M. Jicha, T.R. Angradi, D.W. Bolgrien, B.H. Hill 2011. Diatom-based stressor indicators for North American great rivers (in review).
4. Kireta, A.R., **E.D. Reavie**, G.V. Sgro, T.M. Jicha, T.R. Angradi, D.W. Bolgrien, B.H. Hill 2011. Planktonic and periphytic diatoms as indicators of human stress on United States great rivers. *Ecological Indicators* (in press).
5. **Reavie, E.D.**, L.E. Allinger 2011. What have diatoms revealed about the ecological history of Lake Superior? *Aquatic Ecosystem Health and Management* 14(4): 396-402.
6. **Reavie, E.D.**, R.P. Barbiero 2011. Recent changes in abundance and cell size of pelagic diatoms in the North American Great Lakes. *Phytotaxa* (in press).
7. **Reavie, E.D.**, S. Juggins 2011. Exploration of sample size and diatom-based indicator performance in three North American phosphorus training sets. *Aquatic Ecology* 45: 529-538.
8. Niemi, G.J., **E.D. Reavie**, G.S. Peterson, J.R. Kelly, C.A. Johnston, L.B. Johnson, R.W. Howe, G.E. Host, T.P. Hollenhorst, N.P. Danz, J.J.H. Ciborowski, T.N. Brown, V.J. Brady, R.P. Axler 2011. An Integrated Approach to Multiple Stressors in Lake Superior. *Aquatic Ecosystem Health and Management* (in press).
9. Angradi, T.R., D.W. Bolgrien, T.M. Jicha, M.S. Pearson, D.L. Taylor, M.F. Moffett, K.A. Blocksom, D.M. Walters, C.M. Elonen, L.E. Anderson, J.M. Lazorchak, **E.D. Reavie**, A.R. Kireta, B.H. Hill 2011. An assessment of Stressor Extent and Biological Condition in the North American Mid-continent Great Rivers (USA). *River Systems* 19(2): 143-163.
10. **Reavie, E.D.**, A.A. Cangelosi, L.E. Allinger 2010. Assessing ballast water treatments: Evaluation of viability methods for ambient freshwater microplankton assemblages. *Journal of Great Lakes Research* 36: 540–547.
11. Sgro, G.V., **E.D. Reavie**, A.R. Kireta, T.M. Jicha, T.R. Angradi, D.W. Bolgrien, B.H. Hill 2010. Comparison of diatom-based indices of water quality in the Upper Mississippi River Basin. *Journal of Environmental Indicators* 5(1): 48-67.
12. **Reavie, E.D.**, T.M. Jicha, T.R. Angradi, D.W. Bolgrien, B.H. Hill 2010. Algal assemblages for large river monitoring: comparison among biovolume, absolute and relative abundance metrics. *Ecological Indicators* 10: 167-177.
13. Finkel, Z.V., A.J. Irwin, C.J. Vaillancourt, **E.D. Reavie** & J.P. Smol 2009. Environmental control of diatom community size structure varies across aquatic ecosystems. *Proceedings of the Royal Society B* 276: 1627-1634.
14. Niemi, G.J., V. Brady, T.N. Brown, J.J.H. Ciborowski, N.P. Danz, D.M. Ghioca, J.M. Hanowski, T.P. Hollenhorst, R.W. Howe, L.B. Johnson, C.A. Johnston, **E.D. Reavie** 2008. Development of ecological indicators for the U.S. Great Lakes coastal region – A summary of applications in Lake Huron. *Aquatic Ecosystem Health*

15. **Reavie, E.D.**, G.V. Sgro, N.P. Danz, R.P. Axler, A.R. Kireta, J.C. Kingston, T.P. Hollenhorst 2008. Comparison of simple and multimetric diatom-based indices for Great Lakes coastline disturbance. *Journal of Phycology* 44(3): 787-802.
16. Morrice, J.A., N.P. Danz, R.R. Regal, J.R. Kelly, G.J. Niemi, **E.D. Reavie**, T. Hollenhorst, R.P. Axler, A.S. Trebitz, A.M. Cotter, G.S. Peterson 2008. Human influences on water quality in Great Lakes coastal wetlands. *Environmental Management* 41: 347-357.
17. **Reavie, E.D.** 2007. A diatom-based water quality index for Great Lakes coastlines. *Journal of Great Lakes Research* 33: 86-92.
18. Kireta, A.R., **E.D. Reavie**, R.P. Axler, G.V. Sgro, J.C. Kingston, T.N. Brown, N.P. Danz, T. Hollenhorst. 2007. Coastal geomorphic variability in the Laurentian Great Lakes: implications for a diatom-based monitoring tool. *Journal of Great Lakes Research* 33: 136-153.
19. Brazner, J.C., N.P. Danz, A.S. Trebitz, G.J. Niemi, R.R. Regal, T. Hollenhorst, G.E. Host, **E.D. Reavie**, T.N. Brown, J.M. Hanowski, C.A. Johnston, L.B. Johnson, R.W. Howe, J.J.H. Ciborowski 2007. Responsiveness of Great Lakes wetland indicators to human disturbances at multiple spatial scales: a multi-assemblage assessment. *Journal of Great Lakes Research* 33: 42-66.
20. **Reavie, E.D.**, N.G. Baratono 2007. Multi-core investigation of a lotic bay of Lake of the Woods (Minnesota, USA) impacted by cultural development. *Journal of Paleolimnology* 38(2): 137-156.
21. Brooks, R.P., G.P. Patil, S. Fei, A.I. Gitelman, W.L. Myers, **E.D. Reavie** 2007. The next generation of ecological indicators of wetland condition. *EcoHealth* 4(2): 176-178.
22. Sgro, G.V., **E.D. Reavie**, J.C. Kingston, A.R. Kireta, M.J. Ferguson, N.P. Danz, J.R. Johansen 2007. A diatom quality index from a diatom-based total phosphorus inference model. *Environmental Bioindicators* 2(1): 15-34.
23. Cangelosi, A.A., N.L. Mays, M.D. Balcer, **E.D. Reavie**, D.M. Reid, R. Sturtevant, X. Gao 2007. The response of zooplankton and phytoplankton from the North American Great Lakes to filtration. *Harmful Algae* 6: 547-566.
24. Brazner, J.C., N.P. Danz, G.J. Niemi, R.R. Regal, A.S. Trebitz, R.W. Howe, J.M. Hanowski, L.B. Johnson, J.J.H. Ciborowski, C.A. Johnston, **E.D. Reavie**, V.J. Brady, G.V. Sgro 2007. Evaluation of geographic, geomorphic and human influences on Great Lakes wetland indicators: a multi-assemblage approach. *Ecological Indicators* 7: 610-635.
25. Ekdahl, E.J., J.L. Teranes, C.A. Wittkop, E.F. Stoermer, **E.D. Reavie**, J.P. Smol 2007. Diatom assemblage response to Iroquoian and Euro-Canadian eutrophication of Crawford Lake, Ontario, Canada. *Journal of Paleolimnology* 37(2): 233-246.
26. **Reavie, E.D.**, R.P. Axler, G.V. Sgro, N.P. Danz, J.C. Kingston, A.R. Kireta, T.N. Brown, T.P. Hollenhorst, M.J. Ferguson 2006. Diatom-based weighted-averaging transfer functions for Great Lakes coastal water quality: relationships to watershed characteristics. *Journal of Great Lakes Research* 32(2): 321-347.
27. **Reavie, E.D.**, K.E. Neill, J.P. Smol, J. Little 2006. Cultural eutrophication trends in three southeastern Ontario lakes: a paleolimnological perspective. *Lake and Reservoir Management* 22(1): 44-58.
28. **Reavie, E.D.**, J.A. Robbins, E.F. Stoermer, M.S.V. Douglas, G.E. Emmert, N.R. Morehead, A. Mudroch 2005. Paleolimnology of a fluvial lake downstream of Lake Superior and the industrialized region of Sault Saint Marie. *Canadian Journal of Fisheries and Aquatic Science* 62: 2586-2608.
29. Forrest, F., **E.D. Reavie**, J.P. Smol 2002. Comparing the trophic impacts of canal construction to other catchment disturbances in four lakes within the Rideau Canal system, Ontario, Canada. *Journal of Limnology* 61: 183-197.
30. **Reavie, E.D.**, J.P. Smol, P.J. Dillon 2002. Inferring long-term nutrient changes in southeastern Ontario lakes: comparing paleolimnological and mass-balance models. *Hydrobiologia* 481: 61-74.
31. Clement, P., D. Ward, **E.D. Reavie**, M. Morris 2002. Optimization of monitoring well networks using spatial winnowing and temporal thinning applied to a contaminant plume at the Massachusetts Military Reservation. *Proceedings of the 95th Annual Air and Waste Management Association Conference and Exhibition, Baltimore, Maryland, U.S.A.*
32. Morris, M., **E.D. Reavie**, P. Clement, D. Ward 2002. Groundwater treatment system impacts on freshwater ecosystems: A Massachusetts Military Reservation case study. *Proceedings of the 95th Annual Air and Waste Management Association Conference and Exhibition, Baltimore, Maryland, U.S.A.*

33. **Reavie, E.D.**, M.S.V. Douglas, N.E. Williams 2001. Paleocology of a groundwater outflow using siliceous microfossils. *Écoscience* 8(2): 239-246.
34. **Reavie, E.D.**, J.P. Smol 2001. Diatom-environmental relationships in 64 alkaline southeastern Ontario (Canada) lakes: a diatom-based model for water quality reconstructions. *Journal of Paleolimnology* 25(1): 25-42.
35. **Reavie, E.D.**, J.P. Smol, I.D. Sharpe, L.A. Westenhofer, A. Roberts 2000. Paleolimnological analyses of cultural eutrophication patterns in British Columbia lakes. *Canadian Journal of Botany* 78: 873-888.
36. **Reavie, E.D.**, J.P. Smol 1998. Diatom epiphytes on macrophytes in the St. Lawrence River (Canada): characterization and relation to environmental conditions. In: *Proceedings of the Fourteenth International Diatom Symposium*, Tokyo, Japan 1996. S. Mayama, M. Idei & I. Koizumi (Eds.), pp. 489-500, Biopress Limited, Bristol.
37. **Reavie, E.D.**, J.P. Smol, R. Carignan, S. Lorrain 1998. Diatom paleolimnology of two fluvial lakes in the St. Lawrence River: a reconstruction of environmental changes during the last century. *Journal of Phycology* 34(3): 446-456.
38. **Reavie, E.D.**, J.P. Smol 1998. Epilithic diatoms from the St. Lawrence River and their relationships to water quality. *Canadian Journal of Botany* 76(2): 251-257.
39. **Reavie, E.D.**, J.P. Smol 1997. Diatom-based model to infer past littoral habitat characteristics in the St. Lawrence River. *Journal of Great Lakes Research* 23(3): 339-348.
40. O'Connell, J.M., **E.D. Reavie**, J.P. Smol 1997. Assessment of water quality using epiphytic diatom assemblages on *Cladophora* from the St. Lawrence River. *Diatom Research* 12(1): 55-70.
41. **Reavie, E.D.**, Hall, R.I., J.P. Smol 1995. An expanded weighted-averaging regression and calibration model for inferring past total phosphorus concentration from diatom assemblages in eutrophic British Columbia (Canada) lakes. *Journal of Paleolimnology* 14(1): 49-67.
42. **Reavie, E.D.**, Smol, J.P., N.B. Carmichael 1995. Post-settlement eutrophication histories of six British Columbia (Canada) lakes. *Canadian Journal of Fisheries and Aquatic Science* 52(11): 2388-2401.
43. Walker, I.R., **E.D. Reavie**, S. Palmer, R.N. Nordin 1994. A palaeoenvironmental assessment of human impact on Wood Lake, Okanagan Valley, British Columbia, Canada. *Quaternary International* 20: 51-70.

#### Technical and Government Reports:

1. Cangelosi, A.A., M.D. Balcer, **E.D. Reavie**, L.E. Allinger, N. Mays, T. Markee, C. Polkinghorne, K. Prihoda, D. Reid, H. Saillard, T. Schwerdt, H. Schaefer, M. TenEyck 2010. Final Report of the Land-Based, Freshwater Testing of the Lye (NaOH) Ballast Water Treatment System. 54 pp.
2. Cangelosi, A.A., M.D. Balcer, **E.D. Reavie**, L.E. Allinger, N. Mays, T. Markee, C. Polkinghorne, K. Prihoda, D. Reid, H. Saillard, T. Schwerdt, H. Schaefer, M. TenEyck 2010. Final Report of the Land-Based, Freshwater Testing of the AlfaWall AB PureBallast® Ballast Water Treatment System. 94 pp.
3. McCollin, T., J. Silke, **E.D. Reavie** et al. (ICES) 2011. Report of the Workshop on harmful phytoplankton that could potentially be transported or introduced by ballast water (WKHABAL). ICES WKHABAL Report 2010, ICES Advisory Committee, ICES CM 2010/ACOM:67, Copenhagen, Denmark. 31 pp.
4. **Reavie, E.D.** 2010. Final Report on Sediment Diatom Reconstructions for Four Itasca County Lakes. Itasca Soil and Water Conservation District technical report, Minnesota.
5. Cangelosi, A.A., M.D. Balcer, **E.D. Reavie**, L.E. Allinger, N. Mays, T. Markee, C. Polkinghorne, K. Prihoda, D. Reid, H. Saillard, T. Schwerdt, H. Schaefer, M. TenEyck 2010. Report of the Land-Based Freshwater Testing of the Siemens SiCURE™ Ballast Water Management System. 58 pp.
6. **Reavie, E.D.** 2009. Mid-Project Data Report: Phytoplankton Monitoring in the Great Lakes. Great Lakes National Program Office, U.S. Environmental Protection Agency. 52 pp.

7. Niemi, G.J., R. Axler, V. Brady, J. Brazner, T. Brown, J.H. Ciborowski, N. Danz, J.M.Hanowski, T. Hollenhorst, R. Howe, L.B. Johnson, C.A. Johnston, **E.D. Reavie**, M. Simcik, D. Swackhamer. 2006. Environmental indicators of the U.S. Great Lakes coastal region. Report NRRI/TR-2006/11 to the U.S. Environmental Protection Agency STAR Program, ver.1. Agreement R82-8675, Washington DC. Prepared by Great Lakes Environmental Indicators Collaboration, Natural Resources Research Institute, University of Minnesota Duluth. 121 pp.
8. **Reavie, E.D.** 2006. Southeast Lake of the Woods TMDL: paleolimnology of Zippel Bay. For the Minnesota Pollution Control Agency and Lake of the Woods Soil and Water Conservation District technical report, Minnesota.
9. **Reavie, E.D.**, J.C. Kingston, M.D. Edlund, M. Peterson 2005. Sediment diatom reconstruction model for Minnesota lakes. Itasca Soil and Water Conservation District technical report, Minnesota. 61 pp.
10. **Reavie, E.D.** 2005. Lake Winnibigoshish diatom paleolimnology. For the department of Geological Sciences, University of Minnesota Duluth, Minnesota.
11. **Reavie, E.D.** 2005. Lake Vermilion elemental paleoecology. For the Sportsmen Club of Lake Vermilion (SCLV), Minnesota.
12. Douglas, M.S.V., **E.D. Reavie**, D. Olding 1999. The role for an algal component in the overall watershed monitoring network. For the Toronto Conservation Authority, Ontario.
13. **Reavie, E.D.**, J.P. Smol 1998. The paleolimnology of Francois, Tchesinkut and Takysie lakes, BC. BC Environment technical report, British Columbia.
14. **Reavie, E.D.**, J.P. Smol 1997. The post-settlement history of Tyhee Lake. BC Environment technical report, British Columbia.
15. **Reavie, E.D.**, J.P. Smol 1995. A reconstruction of environmental changes during the last century in the St. Lawrence River: task 3 of the ecorecovery program. Tri-Council Technical report and CD-ROM, Ministry of Environment and Energy, Ontario.
16. **Reavie, E.D.**, J.P. Smol 1993. The paleolimnology of six British Columbia Lakes. BC Ministry of Environment government manuscript, British Columbia.

### **Refereed Publications as an Environmental Consultant**

Technical reports published as an environmental consultant with Jacobs Engineering (**Reavie et al.**) are numerous. A list or sample copies are available on request.

### **Contributed papers with published abstracts (first author was presenter):**

1. Reavie, E.D., S. Juggins, "Sample size and diatom-based indicator performance," seminar at the 21<sup>st</sup> North American Diatom Symposium, Flathead Lake, Montana, September 2011.
2. Chraïbi, V., A.R. Kireta, E.D. Reavie, "Diatom-based paleolimnological study of lake superior," seminar at the 21<sup>st</sup> North American Diatom Symposium, Flathead Lake, Montana, September 2011.
3. Reavie, E.D., A.A. Cangelosi, L.E. Allinger, "Protists in ballast water: assessment methods and a performance of a candidate ship-board treatment system," seminar at the 54<sup>th</sup> International Conference on Great Lakes Research, Duluth, Minnesota, May-June 2011.
4. Kireta, A.R., E.D. Reavie, L.E. Allinger, V. Chraïbi, "Lake Superior ecological history and current trajectory as told by diatoms," seminar at the 54<sup>th</sup> International Conference on Great Lakes Research, Duluth, Minnesota, May-June 2011.
5. Johnson, L.B., E.D. Reavie, V. Brady, N. Danz, G.J. Niemi, D. Breneman, "Quantifying environmental condition in Great Lakes Coastal Areas: A multi-taxa Approach," seminar at the 54<sup>th</sup> International Conference on Great Lakes Research, Duluth, Minnesota, May-June 2011.
6. Reavie, E.D., "What is the role of algae in the recent collapse of the Great Lakes food web?," seminar at the 50<sup>th</sup> Northeast Algal Symposium, Woods Hole, Massachusetts, April 2011.

7. Allinger, L.E., Reavie, E.D., A.A. Cangelosi, "Assessing ballast water treatments: viability assessment for ambient microplankton assemblages," poster presentation at The 50<sup>th</sup> Northeast Algal Symposium, Woods Hole, Massachusetts, April 2011.
8. Reavie, E.D., M.D. Balcer, A.A. Cangelosi, L.E. Allinger, N.L. Mays, D.M. Reid, H. Saillard, T. Schwerdt, M.C. TenEyck, "The Great Ships Initiative: performance assessment of a candidate ship-board treatment system," seminar at the Minnesota-Wisconsin Invasive Species Conference, St. Paul, Minnesota, November 2010.
9. Reavie, E.D., "An experimental 'state of the lakes' diatom indicator for the pelagic Great Lakes," seminar at the 21<sup>st</sup> International Diatom Symposium, St. Paul, Minnesota, August/September 2010.
10. Kireta, A.R., E.D. Reavie, G.V. Sgro, T.R. Angradi, T.M. Jicha, D.W. Bolgrien, B.H. Hill, "Diatom indicators of disturbance in US Great Rivers," seminar at the 21<sup>st</sup> International Diatom Symposium, St. Paul, Minnesota, August/September 2010.
11. Reavie, E.D., M.D. Balcer, A.A. Cangelosi, "Testing ballast water treatments at the Great Ships Initiative land-based facility: zooplankton and phytoplankton assessments," seminar at the 53<sup>rd</sup> International Conference on Great Lakes Research, Toronto, Ontario, May 2010.
12. Reavie, E.D., "Using retrospective analyses to define restoration goals and confirm rehabilitation in Lake Superior," seminar at the Ecology of Lake Superior Conference, Duluth, Minnesota, May 2010.
13. G. Niemi, J. Kelly, L. Johnson, C. Johnston, V. Brady, R. Howe, E. Reavie, R. Axler, G. Host, T. Brown, "An Integrated Approach to Multiple Stressors in Lake Superior," seminar at the Ecology of Lake Superior Conference, Duluth, Minnesota, May 2010.
14. Jude, D.J., E.D. Reavie, S. Hensler, R. Barbiero, M. Balcer, T. Johengen, "The lower food web in Lake Huron: algae, zooplankton, and *Mysis*," seminar at the 2010 Great Lakes Fishery Commission Lake Committee Meetings, Windsor, Ontario, March 2010.
15. Cangelosi, A.A., E.D. Reavie, M.D. Balcer, "Sampling Insights from GSI land- and ship-based experiments," seminar at the ICES/IOC/IMO Working Group on Ballast and other Ship Vectors, Hamburg, Germany, March 2010.
16. Reavie, E.D., M.D. Balcer, A.A. Cangelosi, "Testing ballast water treatments at the Great Ships Initiative land-based facility: zooplankton and phytoplankton viability assessments," seminar at the Coastal and Estuarine Research Foundation 20<sup>th</sup> Biennial Conference, Portland, Oregon, November 2009.
17. Reavie, E.D. "Consequences of taxonomic discord in a Great Lakes monitoring program," seminar at the North American Diatom Symposium, Iowa Lakeside Laboratory, Iowa, September 2009.
18. Sgro, G.V., E.D. Reavie, A.R. Kireta, T.R. Angradi, T.M. Jicha, D.W. Bolgrien, B.H. Hill, "Comparison of diatom-based indices of water quality for mid-continent (USA) Great Rivers," seminar at the North American Diatom Symposium, Iowa Lakeside Laboratory, Iowa, September 2009.
19. Kireta, A.R., E.D. Reavie, G.V. Sgro, T.R. Angradi, T.M. Jicha, D.W. Bolgrien, B.H. Hill "Diatom indicators of disturbance in US Great Rivers," seminar at the North American Diatom Symposium, Iowa Lakeside Laboratory, Iowa, September 2009.
20. Reavie, E.D., "Algae as indicators of stress in great rivers: phytoplankton versus periphyton" seminar at the North American Benthological Society 57th Annual Meeting, Grand Rapids, Michigan, May 2009.
21. Reavie, E.D., M.D. Balcer, A.A. Cangelosi, "Testing ballast water treatments on microorganisms at the Great Ships Initiative land-based facility," seminar at the 16th International Conference on Aquatic Invasive Species, Montreal, Quebec, April 2009.
22. Cangelosi, A.A., N. Mays, M.D. Balcer, M. TenEyck, D. Reid, T. Markee, E.D. Reavie, H. Saillard, C. Scott, "The Great Ships Initiative: making ballast treatment in the Great Lakes a reality," seminar at the 16th International Conference on Aquatic Invasive Species, Montreal, Quebec, April 2009.
23. Reavie, E.D., "New ballast water treatment technologies: killing potentially invasive algae," seminar at the Minnesota Invasive Species Conference, Duluth, Minnesota, October 2008.

24. Cangelosi, A.A., N. Mays, M.D. Balcer, M. TenEyck, D. Reid, T. Markee, E.D. Reavie, H. Saillard, C. Scott, "The Great Ships Initiative: making ballast treatment in the Great Lakes a reality," seminar at the Minnesota Invasive Species Conference, Duluth, Minnesota, October 2008.
25. Kireta, A.R., E.D. Reavie, G.V. Sgro, "Diatoms in America's Great Rivers: periphyton versus phytoplankton indicators," seminar at the 20<sup>th</sup> International Diatom Symposium, Dubrovnik, Croatia, September 2008.
26. Hill, B.H., T.R. Angradi, D.W. Bolgrien, T.M. Jicha, M.F. Moffett, M.S. Pearson, E.D. Reavie, D.L. Taylor, "Ecological conditions in the Missouri, Mississippi and Ohio Rivers: from microbes to fish," seminar at the American Fisheries Society meeting, Portland, Oregon, May 2008.
27. Niemi, G.J, V. Brady, N.P. Danz, G. Host, L. Johnson, E.D. Reavie, R.W. Howe, J.C. Brazner, C. Johnston, J.J.H. Ciborowski, J. Kelly. "Great Lakes Environmental Indicators (GLEI) Project in Lake Superior," seminar at the Making a Great Lake Superior 2007 conference, Duluth, Minnesota, October 2007.
28. Reavie, E.D. "New Ballast Water Treatment Technologies: Are We Killing Potentially Invasive Algae?" Seminar at the Minnesota Water Resources Conference, Minneapolis, Minnesota, October 2007.
29. Sgro, G.V., E.D. Reavie, "An early look at diatom indicators for the Great Rivers," seminar at the 19th North American Diatom Symposium, University of Michigan Biological Station, Michigan, September 2007.
30. Johnson, L.B., E.D. Reavie, V. Brady, N.P. Danz, G.J. Niemi, J.C. Brazner, J.J.H. Ciborowski, "Quantifying environmental condition in Great Lakes Coastal Areas: a multi-taxa Approach," seminar at the American Fisheries Society 137<sup>th</sup> Annual Meeting, San Francisco, California, September 2007.
31. Reavie, E.D. "Great Lakes diatom tools: advantages over chemical measurements in paleolimnological and monitoring programs," seminar at the 61<sup>st</sup> Meeting of the Annual Phycological Society of America, Providence, Rhode Island, August 2007.
32. Paterson, A.M., B.J. Clark, R. Quinlan, E.D. Reavie, J.P. Smol. "Assessing the trophic status of Canadian Shield lakes: comparing management benchmarks using two methods," seminar at the 30<sup>th</sup> Congress of the International Association of Theoretical and Applied Limnology (SIL 2007), Montreal, Quebec, August 2007.
33. Kang, M., J.C. Brazner, J.J.H. Ciborowski, R.W. Howe, L.B. Johnson, C.A. Johnston, G.J. Niemi, E.D. Reavie, A.S. Trebitz. "Biodiversity patterns of the Great Lakes: the native-nonindigenous species richness relationship and community evenness," seminar at the 50th Annual Conference on Great Lakes Research, University Park, Pennsylvania, May 2007.
34. Niemi, G.J, V. Brady, N.P. Danz, G. Host, L. Johnson, E.D. Reavie, R.W. Howe, J.C. Brazner, C. Johnston, J.J.H. Ciborowski, J. Kelly. "Linkages of pressure and state indicators in the US Great Lakes coastal zone," seminar at the 50th Annual Conference on Great Lakes Research, University Park, Pennsylvania, May 2007.
35. Reavie, E.D., N.G. Baratono. "Zippel Bay: paleolimnology case study," poster presentation at the 4th International Lake of the Woods Water Quality Forum, International Falls, Minnesota, March 2007.
36. Paterson, A.M., K.M. Ruhland, S. Pla, J.P. Smol, M.B. Edlund, S.A. Heiskary, J.M. Ramstack, E.D. Reavie. "A diatom-based inference model for total phosphorus in the Lake of the Woods (LOW): Combining Minnesota lakes with LOW sites," poster presentation at the 4th International Lake of the Woods Water Quality Forum, International Falls, Minnesota, March 2007.
37. Reavie, E.D. "An early look at algal indicators for the Great Rivers," seminar at the Indicators for the Assessment of Great River Ecosystems Symposium, Duluth, Minnesota, October 2006.
38. Reavie, E.D. "Great lakes diatom tools: advantages over chemical measurements in paleolimnological and monitoring programs," seminar at the 10<sup>th</sup> International Paleolimnology Symposium, Duluth, Minnesota, June 2006.
39. Kireta, A.R., E.D. Reavie, R.P. Axler, J.C. Kingston, G.V. Sgro. "Diatom-based nutrient models for the Great Lakes: spatial and geomorphic considerations," seminar at the North American Benthological Symposium, 54th Annual Meeting, Anchorage, Alaska, June 2006.
40. Reavie, E.D., R.P. Axler, G.V. Sgro, A.R. Kireta, J.C. Kingston. "Diatom-based tools to assess environmental disturbance in Great Lakes coastal ecosystems," seminar at the 49th Annual Conference on Great Lakes Research, Windsor, Ontario, May 2006.

41. Kireta, A.R., Reavie, E.D., R.P. Axler, G.V. Sgro, J.C. Kingston. "A new diatom-based phosphorus model with considerations of lake and geomorphic characteristics," seminar at the 49th Annual Conference on Great Lakes Research, Windsor, Ontario, May 2006.
42. Brazner, J.C., N.P. Danz, G.J. Niemi, R.R. Regal, T. Hollenhorst, G. Host, T. Brown, A.S. Trebitz, R.W. Howe, J.M. Hanowski, L.B. Johnson, J.J.H. Ciborowski, C.A. Johnston, E.D. Reavie, G.V. Sgro. "Responsiveness of Great Lakes Wetland Indicators to Human Disturbances at Multiple Spatial Scales: a Multi-Assemblage Assessment," seminar at the 49th Annual Conference on Great Lakes Research, Windsor, Ontario, May 2006.
43. Reavie, E.D. "Paleoecological implications on the Southeast Lake of the Woods TMDL," seminar at the 3rd International Lake of the Woods Water Quality Forum, International Falls, Minnesota, March 2006.
44. Reavie, E.D., A.R. Kireta, J.C. Kingston, R.P. Axler, G.V. Sgro. "A new diatom-based tool for Great Lakes coastal ecosystems," seminar at the Research Progress and Problems in Shallow Lakes workshop, St. Croix, Minnesota, November 2005.
45. Reavie, E.D., M.D. Edlund, N. Baratonno, M. Hirst. "Application of the Minnesota diatom model in the shallow Zippel Bay, Lake of the Woods," seminar at the Research Progress and Problems in Shallow Lakes workshop, St. Croix, Minnesota, November 2005.
46. Clark, B.J., A.M. Paterson, E.D. Reavie, J.P. Smol. "Assessing background phosphorus concentrations in lakes: Comparing results from two methods," seminar at the 25<sup>th</sup> symposium of the North American Lake Management Society, Madison, Wisconsin, November 2005.
47. Niemi, G.J., R. Axler, V. Brady, J. Brazner, J. Ciborowski, N. Danz, J.M. Hanowski, T. Hollenhorst, G. Host, R. Howe, L.B. Johnson, C.A. Johnston, J. Kelly, E.D. Reavie, R.R. Regal, D. Swackhamer, A.S. Trebitz. "Development of environmental indicators for the U.S. Great Lakes coastal region - a summary of applications in Lake Michigan wetlands," seminar at the Joint Conference Lake Michigan: State of the Lake Great Lakes Beach Association, Green Bay, Wisconsin, November 2005.
48. Kireta, A.R., E.D. Reavie, R.P. Axler, J.C. Kingston, G.V. Sgro. "Importance of geomorphic characteristics and lake in developing diatom models in the near-shore Great Lakes," seminar at the 18th North American Diatom Symposium, Mobile, Alabama, November 2005.
49. Reavie, E.D., M.D. Edlund, N. Baratonno, M. Hirst. "The role of paleolimnology in the southeast Lake of the Woods TMDL," seminar at the Minnesota Water 2005 and Annual Water Resources Joint Conference, Minneapolis, Minnesota, October 2005.
50. Brazner, J.C., N.P. Danz, G.J. Niemi, R.R. Regal, J.M. Hanowski, C.A. Johnston, E.D. Reavie, A.S. Trebitz, L.B. Johnson, R.W. Howe. "Assessing the condition of Great Lakes coastal wetlands using multiple taxonomic groups: geographic and geomorphic influences," seminar at the 18th Biennial Conference of the Estuarine Research Federation, Norfolk, Virginia, October 2005.
51. Reavie, E.D., A.R. Kireta, J.C. Kingston, R.P. Axler, G.V. Sgro, E.F. Stoermer. "New diatom-based tools to assess environmental disturbance in Great Lakes coastal ecosystems," seminar at the 48th Annual Conference on Great Lakes Research, Ann Arbor, Michigan, May 2005.
52. Kireta, A.R., E.D. Reavie, G.V. Sgro, J.C. Kingston, R.P. Axler, E.F. Stoermer. "Importance of geomorphic characteristics in developing diatom models in the near-shore Great Lakes," seminar at the 48th Annual Conference on Great Lakes Research, Ann Arbor, Michigan, May 2005.
53. Sgro, G.V., E. D. Reavie, A.R. Kireta, J.C. Kingston, R.P. Axler, M.J. Ferguson, E.F. Stoermer. "Comparison of benthic diatom indices of habitat quality in the Laurentian Great Lakes," poster presentation at the 48th Annual Conference on Great Lakes Research, Ann Arbor, Michigan, May 2005.
54. Johnson, L.B., G.J. Niemi, R.P. Axler, V. Brady, J.M. Hanowski, G.E. Host, R.W. Howe, C.A. Johnston, E.D. Reavie, R.R. Regal, C. Richards, J. Schuldt, D.L. Swackhamer. "Development of environmental indicators and identifying reference conditions in the coastal regions of the U.S. Great Lakes basin," seminar at the 4th Annual Surface Water Monitoring and Standards (SWiMS) Meeting, Chicago, Illinois, February 2005.
55. Reavie, E.D., A.R. Kireta, J.C. Kingston, R.P. Axler, G.V. Sgro, E.F. Stoermer. "Diatom indicators of environmental condition in Great Lakes coastal ecosystems," seminar at the Estuarine and Great Lakes Coastal Indicators Program (EaGLE) Annual Meeting, Duluth, Minnesota, September 2004.

56. Reavie, E.D., A.R. Kireta, J.C. Kingston, R.P. Axler, G.V. Sgro, E.F. Stoermer. "Indicators of environmental condition and integrity in Great Lakes coastal ecosystems: development of diatom-based tools," poster presentation at the Estuarine and Great Lakes Coastal Indicators Program (EaGLE) Annual Meeting, Duluth, Minnesota, September 2004.
57. Clement, P., D. Ward, E.D. Reavie & M. Morris. "Optimization of monitoring well networks using spatial winnowing and temporal thinning applied to a contaminant plume at the Massachusetts Military Reservation," seminar at the 95th Annual Air and Waste Management Association Conference and Exhibition, Baltimore, Maryland, U.S.A., June 2002.
58. Reavie, E.D., M. Morris, P. Clement & D. Ward. "Groundwater treatment system impacts on freshwater ecosystems: A Massachusetts Military Reservation case study," seminar at the 95th Annual Air and Waste Management Association Conference and Exhibition, Baltimore, Maryland, U.S.A., June 2002.
59. Reavie, E.D., M.S.V. Douglas & N.E. Williams. "Siliceous microfossils and groundwater outflow paleoecology," seminar at the 8<sup>th</sup> International Symposium on Paleolimnology, Queen's University Kingston, Ontario, Canada, August, 2000.
60. Reavie, E.D., J.P. Smol, J. Little & P. Dillon. "Tracking patterns of past eutrophication and hypolimnetic oxygen deficits in Southeastern Ontario lakes using paleolimnological and theoretical mass-balance models," seminar at the North American Lake Management Society Symposium, Reno, Nevada, U.S.A., December, 1999.
61. Neill, K.E., E.D. Reavie & J.P. Smol. "Paleolimnological reconstructions using subfossil Chironomidae (Diptera) as indicators of hypolimnetic oxygen depletion in two south-eastern Ontario lakes," poster presentation at the North American Lake Management Society Symposium, Reno, Nevada, U.S.A., December, 1999.
62. Reavie, E.D., M.S.V. Douglas & N.E. Williams. "An investigation of the paleoecology of a groundwater outflow using siliceous microfossils," poster presentation at the 15<sup>th</sup> North American Diatom Symposium, Pingree Park, Colorado, U.S.A., September, 1999.
63. Reavie, E.D. & J.P. Smol. "Reconstructing cultural eutrophication in southeastern Ontario using a theoretical mass-balance model and a diatom-based paleolimnological model," seminar at the 15<sup>th</sup> North American Diatom Symposium, Pingree Park, Colorado, U.S.A., September, 1999.
64. Reavie, E.D. "An investigation of cultural eutrophication in southeastern Ontario using a theoretical mass-balance model and a diatom-based paleolimnological model," seminar at the 2<sup>nd</sup> International Congress of Limnogeology, Brest, France, May, 1999.
65. Reavie, E.D. and members of the Paleoecological Environmental Assessment and Research Laboratory. "Environmental assessment using paleolimnological methods," poster presentation at 'Evolution and Revolution: the Future of Biosciences', Queen's University, Kingston, Ontario, November, 1997.
66. Reavie, E.D. "Habitat specificity of the diatoms as a biomonitoring tool in the St. Lawrence River," seminar at the 4<sup>th</sup> Annual International Symposium on the St. Lawrence Ecosystem, Potsdam, New York, April, 1997.
67. Reavie, E.D. & J.P. Smol. "Diatom-inferred paleohabitat reconstruction for the St. Lawrence River," seminar at the 14th International Diatom Symposium, Tokyo, Japan, September, 1996.
68. Reavie, E.D. & J.P. Smol. "The environmental history of the St. Lawrence River as indicated by fossil algae," seminar at the 3rd International Conference on the St. Lawrence Ecosystem, Cornwall, Ontario, May, 1996.
69. Reavie, E.D. & J.P. Smol. "River sediments and long-term environmental change: tracking ecosystem degradation and recovery in the St. Lawrence River Ecosystem," poster presentation at the 2nd International Conference on the St. Lawrence Ecosystem, Cornwall, Ontario, May, 1995.
70. Reavie, E.D. & J.P. Smol. "Diatom microfossils and eutrophication in the St. Lawrence River: are we seeing a recovery?," seminar at the 34th Northeast Algal Symposium, Woods Hole, Massachusetts, April, 1995.
71. Reavie, E.D. "Diatom microfossils indicate that the St. Lawrence River may be recovering from eutrophication," seminar at the 5th Annual Great Lakes Research Consortium, Syracuse, New York, January, 1995.
72. Walker, I.R., E.D. Reavie, S. Palmer & R.N. Nordin. "Use of paleoecological techniques to assess human impact on Wood Lake in the Okanagan Valley, British Columbia," seminar at the British Columbia Studies Conference, Cornwall, British Columbia, October, 1994.

73. Reavie, E.D. & J.P. Smol. "Paleolimnology of Lake St. Francis, St. Lawrence River, Canada," poster presentation at the 13th International Diatom Symposium, Acquafredda di Maratea, Italy, September, 1994.
74. Reavie, E.D. & J.P. Smol. "Paleolimnology of a fluvial lake section of the St. Lawrence River, Canada," seminar at the St. Lawrence EcoRecovery Conference, Cornwall, Ontario, June, 1994.
75. Reavie, E.D. & J.P. Smol. "Paleolimnology of the St. Lawrence River," poster presentation at the 4th Annual Great Lakes Research Consortium, Syracuse, New York, January, 1994.
76. Reavie, E.D. & J.P. Smol. "Paleolimnology of four British Columbia lakes: tracking recent eutrophication," poster presentation at the Sixth International Paleolimnology Symposium, Canberra, NSW, Australia, April, 1993.
77. Reavie, E.D. & J.P. Smol. "Seasonality of siliceous microfossils in two morphologically distinct lakes," poster presentation at the 12th International Diatom Symposium, Renesse, The Netherlands, August, 1992.
78. Reavie, E.D. & J.P. Smol. "Diatom and chrysophyte succession in two lakes with different mixing regimes," poster presentation at the Northeast Algal Symposium, Woods Hole, Massachusetts, April, 1992.

#### **Additional Conferences and Workshops Attended:**

1. 2011 State of the Lakes Ecosystem Conference (SOLEC), Erie, Pennsylvania, October 2011.
2. 8<sup>th</sup> International Lake of the Woods Water Quality Forum, International Falls, Minnesota, March 2011.
3. International Council for the Exploration of the Sea (ICES) workshop on harmful phytoplankton that could potentially be transported or introduced by ballast water (WKHABAL), October 2010.
4. Kawishiwi Watershed Clean Water Protection and White Iron Chain of Lakes (WICOLA) committee meetings, Ely and Fall Lake, Minnesota, 2009 through 2010.
5. 7<sup>th</sup> International Lake of the Woods Water Quality Forum, International Falls, Minnesota, March 2010.
6. Ecosystems Technical Work Group "Experts Workshop," Windsor, Ontario, February 2009.
7. Minnesota Department of Natural Resources Roundtable, Minneapolis, Minnesota, January 2009.
8. 2008 State of the Lakes Ecosystem Conference, Niagara Falls, Ontario, October 2008.
9. 2<sup>nd</sup> International Lake of the Woods Water Quality Forum, International Falls, Minnesota, March 2005.
10. 19<sup>th</sup> Annual International Conference on Soils, Sediments and Water, Amherst, Massachusetts, October 2003.
11. Toward a Watershed Monitoring Framework for the Toronto Region. The International Joint Commission and the Toronto and Region Remedial Action Plan, Downsview, Ontario, May 1999.
12. Development of a Watershed Monitoring Network, stakeholder workshop. The Metropolitan Toronto and Region Conservation Authority, Downsview, Ontario, April 1999.
13. Geological Society of America annual meeting. University of Toronto, Toronto, Ontario, October, 1998.
14. Society of Canadian Limnologists (annual symposium). Queen's University, Kingston, Ontario, January, 1998.
15. Third International Chrysophyte Symposium. Queen's University, Kingston, Ontario, August, 1991.

#### **Invited Presentations:**

1. "Changing primary producers in the Great Lakes," seminar at the EPA Region 5, Great Lakes National Program Office (Chicago, Illinois), February 2011.
2. "Retrospection from algal storytellers: revealing the ecological history of four Itasca Lakes," seminar at the University of Minnesota Extension and Itasca Community College Resource Professionals Forum (Grand Rapids, Minnesota), November 2010.
3. "Freshwater management: microscopic storytellers provide environmental retrospection and future predictions," seminar at the Piragis Tuesday Group (Ely, Minnesota), November 2010.

4. "Ballast Water Pathway," seminar at the Lake Superior Binational Forum's Aquatic Invasive Species Prevention Workshop (Thunder Bay, Ontario), June 2010.
5. "The Great Ships Initiative: current efforts in the harbor to evaluate ballast water treatment systems," seminar at the Midcontinent Ecology Division Technical Seminar Series, USEPA National Health and Environmental Effects Research Laboratory (Duluth, Minnesota), March 2010.
6. "The Great Ships Initiative: killing for Great Lakes protection," seminar at the Twin Ports Freshwater Folk seminar series, Minnesota Pollution Control Agency (Duluth, Minnesota), January 2010.
7. "Tracking changes in the Great Lakes -- using phytoplankton for retrospective analyses and remedial solutions," seminar at the EPA Region 5, Great Lakes National Program Office (Chicago, Illinois), May 2009.
8. "Tracking changes in the Great Lakes -- quality phytoplankton data are needed for retrospective analyses and remedial solutions," seminar at the EPA National Health and Environmental Effects Research Laboratory (Duluth, Minnesota), May 2009.
9. "Algal tools for Great Lakes coastlines: recommendations for monitoring and paleoecology," departmental seminar in the Dept. Biology, University of Minnesota Duluth (Duluth, Minnesota), February 2006.
10. "Basic and applied aquatic research: public versus private sectors," guest lecture at Vermilion Community College (Ely, Minnesota), May 2005, 2006, 2007.
11. "Bioindicators, mud, and environmental change: a window on the past," departmental seminar at the Natural Resources Research Institute (Duluth, Minnesota), November 2003.
12. "Stuff in the mud. What does it tell us about environmental history?," departmental seminar at the Dept. of Biological Sciences, DePaul University (Chicago, Illinois), April 2000.
13. "Biological indicators and human history in North America," departmental seminar at the Dept. of Plant Sciences, University of Western Ontario (London, Ontario), April 2000.
14. "Bioindicators, lake sediments, and environmental change: a window on the past," departmental seminar at the Dept. of Biological Sciences, University of Maine (Orono, Maine), March 2000.
15. "Getting to know the eutrophication history of southern Ontario," departmental seminar at the Dept. of Zoology, University of Toronto (Toronto, Ontario), October 1999.
16. "Environmental degradation and recovery in the St. Lawrence River: a paleolimnological perspective," departmental seminar at the Dept. of Biology, Queen's University (Kingston, Ontario), February 1997.
17. "A bird atlas approach to reconstructing habitat in the St. Lawrence River," guest lecture at the Limnology Seminar Series, Dept. of Biology, Queen's University (Kingston, Ontario), November 1996.
18. "Logistic regression and an applied model using diatom indicators," guest lecture at the Behaviour, Ecology and Evolution Research Seminar series, Dept. of Biology, Queen's University (Kingston, Ontario), November 1996.
19. "The task of reconstructing the recent environmental history of the St. Lawrence Ecosystem," seminar to the Principal Investigator Committee of the Ecorecovery Project (funded by the Tri Council), University of Ottawa (Ottawa, Ontario), May 1996.
20. "Ecotoxicology and the Great Lakes/St. Lawrence ecosystem," special lecture to the students of BIOL 335 (General Limnology), Dept. of Biology, Queen's University (Kingston, Ontario), 1993-1996.
21. "PCBs and the Great Lakes," seminar at the Limnology Seminar Series, Dept. of Biology, Queen's University (Kingston, Ontario), February 1993.

#### **Outreach and Public Sector Interactions:**

1. Co-instruction of "What's Living in My Water?," evening session dedicated to educating the local community on microorganisms and their environmental importance, NRRI-Ely Field Station, November 2011.
2. Instruction of "What's in a lake?," two-week Queen's University Enrichment Mini-Course Program ( $E=MC^2$ ) for gifted and highly motivated secondary school students (grades 10-12), Queen's University Biology Station, Ontario, May 1996.
3. "Human impacts on aquatic ecosystems," 1 day of field work, lectures and subsequent group projects with high

school OAC and elementary school students at Gananoque Secondary School and Gananoque Elementary School (Gananoque, Ontario), April 1993, 1994 and 1995.

4. Science fair judge for high school students at Kingston Collegiate and Vocational Institute (Kingston, Ontario), November 1993, November 1994, November 1995.

## **Research Endeavours**

My research interests focus on limnological investigations, with an emphasis on establishing the effects of human development on aquatic ecosystems. I have been involved in a number of projects that apply physical, chemical and biological indicators to infer past and present environmental conditions in aquatic ecosystems. The following are examples of my project involvement over the last five years.

### **1. Environmental indicators**

In April 2004 I joined the Center for Water and the Environment (CWE) at the Natural Resources Research Institute (NRRI). My major commitment over the last two years has been to the ongoing GLEI project, whose goal is to develop an integrated set of environmental indicators that can be used to assess the condition of the coastal margins of the Great Lakes. Several researchers at the NRRI collected data on habitat, amphibians, fish, invertebrates, vegetation, algae, and water quality in coastal wetlands and coastal margins of the Great Lakes. My primary task in this project was to quantify the extent to which pressure indicators influence diatom community structure in nearshore wetlands, estuaries, and reaches of the Lakes. This involved the development of predictive models through multivariate analyses of communities and ecosystems. These predictive models will be used, for example, to infer limnological status at local and regional scales, to describe pre-disturbance baselines, trends, and magnitudes of change in impacted environments, and to evaluate and modify existing diatom metrics so that a number of state indicators for nutrient loading, siltation, and salinity in nearshore waters of the Great Lakes will be available to federal and state agencies. The research will develop and evaluate indicators by local habitat, by lake, by ecoregion, and by stressor activity/intensity, and will provide linkages from ecosystem function to water quality and to pressure indicators. A suite of powerful diatom indicators has been developed for key pressure indicators for use throughout the Great Lakes basin, and a number of related manuscripts have been published or are in preparation.

This work is now extending into algal indicator development for two large projects in (1) the Great Rivers of North America, and (2) the pelagic Great Lakes.

### **2. Paleolimnology**

I have also been working on a number of smaller projects characterising the recent, post-European history of several freshwater systems in Minnesota. In general, residents and state managers of these systems are concerned about water quality degradation due to excess nutrient loading, water clarity, sediment load and anoxia. The primary focus of paleolimnological analyses has been diatom investigations, supplemented by organic and inorganic geochemistry. Recent sites of study have included Zippel Bay (Lake of the Woods) and five lakes in Itasca County. In Zippel Bay, for example, significant eutrophication impacts were inferred during the 20<sup>th</sup> century as a result of agricultural and urban development in its watershed. These results have provided strong support to the total maximum daily load (TMDL) assessment for the system, as delegated by the local Soil and Water Conservation District.

A critical precursor to this work has been the development of an ever-evolving surface sediment diatom model. This model relates recent diatom assemblages to environmental conditions in a suite of ~150 Minnesota lakes. These lakes range from “pristine” (no watershed development) to “degraded” (much development, purportedly poor water quality). Relating diatom assemblages from these lakes to their contemporary water quality allows us to define the autecological properties of the diatom indicators, and so allows us to reconstruct past conditions from downcore diatom assemblages. Our NRRI group has been collaborating with other researchers from the Minnesota Pollution Control Agency, the University of Minnesota and the Science Museum of Minnesota to continuously maintain and refine this model, as it is frequently called upon for paleolimnological investigations.

New paleolimnological work is now planned on the Great Lakes and additional Minnesota lakes.

### **3. Ballast water treatment technologies**

In 2006 I commenced a new cooperative project with the Northeast-Midwest Institute in the development of practical and effective ballast treatment technologies for ships. The project team includes a steering committee that consists of representatives from the shipping industry, environmental organizations, state and federal governments, port authorities, and the research community. The project aims to develop biological and engineering performance evaluation protocols for ballast water treatment technologies, and provide feedback on the strengths and weaknesses of various

treatment systems to ship owners and policy makers. Technologies are being tested at three scales: pilot (in the laboratory), bench-scale (a full-size, onshore facility) and ship (full on-board application). Treatments include filtration, ultraviolet radiation, chemical additions, and others. As co-PI, our group is focused on the elimination of potentially invasive planktonic organisms, and the systems' efficiency at achieving its design purpose. Critical biological questions include how effective the equipment is at removing or destroying zooplankton, phytoplankton, bacteria and viruses from the intake stream and the extent to which these organisms may re-grow, die off or interact with each other during a retention period.