Scott Higgins

Research Scientist, IISD-Experimental Lakes Area

Scott is a Research Scientist at the IISD-Experimental Lakes Area (IISD-ELA), a whole-ecosystem research program based in northwestern Ontario focused on finding solutions to water-quality problems. He has worked as a Research Scientist at the ELA since 2010, first with Fisheries and Oceans Canada and then with the IISD-ELA. Scott's primary research interests focus on algal ecology, aquatic invasive species, and climate change impacts, and has participated in large collaborative projects on lake eutrophication, fish productivity, water diversion, and contaminants such as nanosilver and diluted bitumen. Scott has authored or co-authored over 30 peer-reviewed publications and book chapters and is an adjunct professor at several Canadian universities.

Employment and Education

International Institute for Sustainable Development - Experimental Lakes Area, Winnipeg, MB, Canada

Research Scientist: 2014 – present
Research Program: Algal ecology, primary production, climate change and invasive species effects on freshwater ecosystems and responsible for the Long-term Ecological Research (LTER) program.

Adjunct Professorships:
Laurier University, Waterloo, ON, 2018-present;
University of Manitoba, Winnipeg MB, Canada, 2017 – present;
University of Saskatchewan, Saskatoon, SK, Canada, 2016 – present:
University of Waterloo, Waterloo, ON, Canada, 2015 – present;
University of Winnipeg, Winnipeg MB, Canada, 2014 – present.

Fisheries and Oceans Canada-Experimental Lakes Area
Freshwater Institute, Winnipeg, MB, Canada

Research Scientist, Aquatic Invasive Species Coordinator: 2010-2014
Research Program: Algal ecology, primary production, climate change and invasive species effects on freshwater ecosystems.

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University of Wisconsin, Center for Limnology, Madison, USA.
Research Associate, 2007-2010.
Project: Ecological effects of invasive species on aquatic ecosystems.

University of Waterloo, Waterloo, ON, Canada.
Research Associate (Jointly with Ontario Ministry of the Environment), 2005-2007. Project: Assessing and modeling coastal water quality in the Laurentian Great Lakes.
Supervisor: R.E. Hecky, E.T. Howell.

Ph.D., Biology, 2001-2005
Thesis: Modeling the growth dynamics of *Cladophora* in eastern Lake Erie.
Supervisors: R.E. Hecky, S.J. Guildford.

M.Sc., Biology, 1997-1999
Thesis: Epilithic nitrogen fixation in the rocky littoral zones of Lake Malawi, Africa
Supervisors: Robert E. Hecky, W.D Taylor.

University of Manitoba, Winnipeg, MB, Canada.
B.Sc., Environmental Sciences Program, 1996.

Publications

31. Tiegs, S., D.M. Costello, M.W. Isken, G. Woodward, P.B. McIntyre, S. N. Higgins et al. Accepted. Ecosystem functioning gauged via global crowdsourcing. **Science Advances**.
30. Hall, B.D., R.H. Hesslein, C.A. Emmerton, S.N. Higgins, P. Ramlal, and M.J. Paterson. Accepted. Multi-decadal carbon sequestration in a headwater boreal lake. **Limnology and Oceanography**.
29. Emmerton, C.A., K.G. Beaty, N.J. Casson, J.A. Graydon, R.H. Hesslein, S.N. Higgins, H. Osman, M.J. Paterson, A. Park, J. Tardiff. 2018. Long-term responses of boreal watershed nutrient budgets to concurrent climate-related stressors. **Ecosystems**. DOI: 10.1007/s10021-018-0276-7.
28. Hewitt, B.A., L.S. Lopez, K.M. Gaibisels, A. Murdoch, S.N. Higgins, J.J. Magnuson, A.M. Paterson, J.A. Rusak, H. Yao, and S. Sharma. 2018. Historical

trends, drivers, and future projections of ice phenology in small north temperate lakes. **Water**. DOI: 10.3390/w10010070.

27. Higgins, S.N., M.J. Paterson, R.E. Hecky, D.W. Schindler, J.J. Venkiteswaran, and D.L. Findlay. 2017. Biological nitrogen fixation prevents the response of a eutrophic lake to reduced loading of nitrogen: Evidence from a 46 year whole lake experiment. **Ecosystems**. DOI: 10.1007/s10021-017-0204-2

26. Hampton, S.E., A.W.E. Galoway, S.M.Powers, T. Ozersky, S. Higgins et.al. 2017. Ecology under lake ice. **Ecology Letters** 20: 98-111.

25. Diodato, N., S.N. Higgins, G. Bellocchi, F. Fiorillo, N. Romano, and F.M. Guadagno. 2016. Hydro-climatic forcing of dissolved organic carbon in boreal lakes of Canada. **Science of the Total Environment** 571: 50-58.

24. Geisler, M.E., M.D. Rennie, D.M. Gillis, and S.N. Higgins. 2016. A predictive model for water clarity following dreissenid invasion. **Biological Invasions** 18: 1989-2006.

23. O'Reilly, C., Sharma, S., Gray, D., Hampton, J., Higgins, S., et al. 2015. Rapid and highly variable warming of lake surface temperatures around the globe. **Geophysical Research Letters** 42, DOI: 10.1002/2015GL066235.

22. Sharma, S., D. K. Gray, J. S. Read, C.M. O'Reilly, P. Schneider, A. Qudrat, C. Gries, S. N. Higgins et al. 2015. A global database of lake surface temperatures (1985-2009) collected by in situ and satellite methods. **Nature - Scientific Data** 2:150008. DOI: 10.1038/sdata.2015.8.

21. Watson, S.B., B.A. Whitton, S. Higgins, H.W. Paerl, B.W. Brooks, and J.D. Wehr. 2015 Harmful Algal Blooms (Chapter 20) *In*: **Freshwater Algae of North America 2nd ed**., J.D. Wehr & R.G. Sheath [eds]. Elsevier.

20. Higgins, S.N., B. Althouse, S. Devlin, Y. Vadeboncoeur, and M.J. Vander Zanden. 2014. Potential for large-bodied zooplankton and dreissenids to alter the productivity and autotrophic structure of lakes. **Ecology** 95: 2257-2267.

19 Althouse, B., S.N. Higgins, and M.J. Vander Zanden. 2014. Benthic and planktonic primary production along a nutrient gradient in Green Bay, Lake Michigan. **Freshwater Science** 33:487-498.

18. Higgins, S.N. 2014. A meta-analysis of dreissenid effects on freshwater ecosystems. *In* **Quagga and Zebra Mussels: Biology, Impacts, and Control, Second Edition**. *Edited by* T. Nalepa and D. Schloesser. CRC Press, Boca Raton, FL. p 487-494.

17. Higgins, S.N., C.M. Pennuto, E.T. Howell, T. Lewis, and J.C. Makarewicz. 2012. Urban influences on *Cladophora* blooms in Lake Ontario. **Journal of Great Lakes Research** 38: 116-123. **This manuscript received a "Highly Cited Paper Award' for 2012 by Elsevier.*

16. Leon, L.F., R.E. Smith, S.Y. Malkin, D. Depew, M. Hipsey, J. P. Antenucci, S. N. Higgins, R.E. Hecky, and R.Y. Rao. 2012. Nested 3D modelling of the spatial dynamics of nutrients and phytoplankton in a Lake Ontario nearshore zone. **Journal of Great Lakes Research** 37: 595-596.

15. Vander Zanden, M.J., Hansen, G.J.A., Higgins, S.N., and Kornis, M.S. 2011. Invasive species early detection and eradication: A response to Horns (2011). **Journal of Great Lakes Research** 37: 595-596.

14. Leon, L.F., R.E.Smith, M.R.Hipsey, M.R.Bocaniov, S.N.Higgins, R.E.Hecky, J.P.Antennuchi, and S.J.Guildford. 2011. Application of a 3D hydrodynamic-biological model for seasonal and spatial dynamics of water quality and phytoplankton in Lake Erie. **Journal of Great Lakes Research** 37:41-53.

13. Higgins, S.N., M.J. Vander Zanden, L. Joppa, and Y.Vadeboncoeur. 2011. The impact of dreissenid mussel invasions on chlorophyll and the chlorophyll:total phosphorus ratio in north-temperate lakes. **Canadian Journal of Fisheries and Aquatic Sciences** 68: 319-329.

12. Auer, M.T., L.M. Tomlinson, S.N. Higgins, S.Y. Malkin, E.T. Howell, and H.A. Bootsma. 2010. Great Lakes *Cladophora* in the 21st Century: Same alga, different ecosystem. **Journal of Great Lakes Research** 36: 248-255.

11. Higgins, S.N., and M.J. Vander Zanden. 2010. What a difference a species makes: A meta-analysis of dreissenid mussel impacts on freshwater ecosystems. **Ecological Monographs** 80: 179-196.

10. Vander Zanden, M.J., J.G. Hansen, S.N. Higgins, and M. Kornis. 2010. A pound of prevention, plus a pound cure: Early detection and eradication of invasive species in the Laurentian Great Lakes. **Journal of Great Lakes Research** 36: 199-205.

9. Squires, M.M., L.F.W. Lesak, R.E. Hecky, S.J. Guildford, P.A. Ramlal, and S.N. Higgins. 2009. Primary production and carbon dioxide metabolic balance of a lake-rich arctic river floodplain: Partitioning of phytoplankton, epipelon, macrophytes, and epiphyton production among lakes of the Mackenzie Delta. **Ecosystems** 12: 853-872.

8. Higgins, S.N., R.E. Hecky, and S.J. Guildford. 2008. The collapse of benthic macroalgal blooms in response to self-shading. **Freshwater Biology** 53: 2557-2572.

7. Higgins, S.N., S.Y. Malkin, E.T. Howell, S.J. Guildford, L. Campbell, V. Hiriart-Baer, R.E. Hecky. 2008. An ecological review of *Cladophora glomerata*

(Chlorophyta) in the Laurentian Great Lakes. **Journal of Phycology** 44: 839-854.

6. Higgins, S.N., R.E. Hecky, and S.J. Guildford. 2006. Environmental controls on *Cladophora* growth dynamics in eastern Lake Erie: Application of the *Cladophora* growth model (CGM). **Journal of Great Lakes Research** 32: 629-644.
5. Higgins, S.N., R.E. Hecky, and S.J. Guildford. 2005. Modeling the growth, biomass, and tissue phosphorus concentration of *Cladophora glomerata* in eastern Lake Erie: Model description and field testing. **Journal of Great Lakes Research** 31: 439-455.
4. Higgins, S.N., E.T. Howell, R.E. Hecky, S.J. Guildford, and R.E. Smith. 2005. The wall of green: The current status of *Cladophora glomerata* in eastern Lake Erie 1995-2002. **Journal of Great Lakes Research** 31: 547-563.
3. Smith, R.E., V.P. Hiriart-Baer, S.N. Higgins, S.J. Guildford, and M.N. Charlton. 2005. Planktonic primary production across the trophic gradient of dreissenid infested Lake Erie in 1997. **Journal of Great Lakes Research 31**(suppl.2): 50-62.
2. Higgins, S.N., H.J. Kling, R.E. Hecky, W.D. Taylor, and H.A. Bootsma. 2003. The community composition, distribution, and nutrient status of epilithic periphyton at 5 rocky littoral zone sites in Lake Malawi, Africa. **Journal of Great Lakes Research** 29 (suppl. 2): 181-189.
1. Higgins, S.N., R.E. Hecky, and W.D. Taylor. 2001. Epilithic nitrogen fixation in the rocky littoral zone of Lake Malawi, Africa. **Limnology and Oceanography** 46: 976-982.

Reports

13. Higgins, S.N., C. Charles, and G. Gunn. 2015. IISD-ELA and Climate Change. A five-part series on regional climate change and implications to boreal lakes. [http://www.iisd.org/ela/latest].
12. Auer, M.T., A. Kucynski, R.K. Gawde, S. Chapra, and S.N. Higgins 2015. Appendix B-9: Great Lakes Cladophora Model. Annex III, Canada-United States Great Lakes Water Quality Agreement. International Joint Commission.
11. Havens, S., Rennie, M., Blanchfield, P., Paterson, M., and Higgins S. 2014. Evaluation of eutrophication and water level drawdown on lake Whitefish (*Coregonus clupeaformis*) productivity; Fish habitat assessment. Can. Tech. Rep. Aquat. Sci. 3110: vi + 40 p.

10. DFO. 2014. Lake Winnipeg Zebra Mussel treatment. DFO Can. Sci. Advis. Sec. Sci. Resp 2014/031.

9. Abdel-Fattah, S., G. Christie, S. Doka, A. Dupuis, H. Ghamry, S. Higgins, M. Koops, P. Ramlal. *In review*. Risk based Assessment of Climate Change Impacts and Risks on the Biological Systems and Infrastructure within Fisheries and Oceans Canada's mandate: Freshwater Large Aquatic Basin. Canadian Science Advisory Secretariat Research Document. 2012/044.

8. Therriault, T.W., A.M. Weisse, A., S.N. Higgins, Y. Guo, and J. Duhaime. 2012. Risk Assessment for Three Dreissenid Mussels (*Dreissena polymorpha*, *Dreissena rostriformis bugensis*, and *Mytilopsis leucophaeta*) in Canadian Freshwater Ecosystems. Canadian Science Advisory Secretariat Research Document 2012/174 v + 88 p.

7. DFO, 2012. Risk-based assessment of climate impacts and risk on the biological systems and infrastructure within Fisheries and Oceans Canada mandate – Freshwater Large Aquatic Basin. DFO Can. Sci. Advis. Sec. Sci. Resp. 2012/45.

6. Hiriart-Baer, V.P., L.M. Campbell, S.N. Higgins, M.N. Charlton, L.F. Moore, S.J. Guildford, and R.E. Hecky. 2007. *Cladophora* resurgent and revisited: A brief literature review. Environment Canada, Water Science and Technology Directorate, WSTD Contribution No. 07-252. Burlington, Ontario.

5. Higgins, S.N., and R.E. Hecky. 2007. Modeling and managing *Cladophora* growth in the Laurentian Great Lakes: A technical report. Ontario Ministry of the Environment. Environmental monitoring and Reporting Branch. Etobicoke, Ontario.

4. Hecky, R.E., D. Barton, D. Depew, S. Higgins, V. Hiriart-Baer, A. Houben, L. Leon, S. Malkin, T. Ozersky, and S. Ross. 2007. Research into the cause and possible control methods of increased growth of periphyton in the western basin of Lake Ontario. Summary report for Ontario Clean Water Agency and Ontario Water Works Research Consortium. Waterloo, Ontario.

3. Tomlinson, L.M., S.N. Higgins, S.Y. Malkin, H.A. Bootsma, and M.T. Auer. 2006. Report of the Cladophora modeling group. Great Lakes Water Quality Agreement, Annex III (P-abatement) technical subgroup.

2. Higgins, S.N., and E.T. Howell. 2006. *Cladophora* update on Lake Erie. Lake Erie Lake Management Plan (LAMP), Section 11.8.

1. Higgins, S.N. 2004. The contribution of *Dreissena* to the resurgence of *Cladophora* in eastern Lake Erie. In: *Cladophora* research and management in the Great Lakes, Workshop proceedings, Great Lakes Water Institute, Milwaukee-Wisconsin; UW-Milwaukee Great Lakes Water Institute special report No. 2005-1.

Graduate Student Involvement

Student name	*Degree*	*University*	*Graduation date*	*Role*
Jennifer Mead	Ph.D.	University of Waterloo	2021	Committee member
McKenzie Perry	M.Sc.	University of Manitoba	2021	Co-Supervisor
Emily Barber	M.Sc.	University of Waterloo	2020	Committee member
Jordyn Atkins	M.Sc.	Laurier University	2020	Committee member
Brendan Malley	M.Sc.	University of Manitoba	2020	Committee member
Bryanna Sherbo	M.Sc.	University of Manitoba	2019	Co-Supervisor
Lisa Boyer	M.Sc.	University of Saskatchewan	2019	Committee member
Adrienne Ducharme	M.Sc.	University of Winnipeg	2018	Committee member
Jennifer Mead	M.Sc.	University of Waterloo	2018	Committee member
Marianne Geisler	M.Sc.	University of Manitoba	2015	Committee member

Professional Service

- **SCL-Peters Award Committee**, Society of Canadian Limnologists, 2017.
- **Invasive Species Council of Manitoba**, 2017-present.
- **Technical committee** to 'State of Knowledge of *Cladophora* in the Great Lakes Workshop' in support of Annex IV, Great Lakes Water Quality Agreement. April 2016.
- **Science Advisory Council**, Lake Winnipeg Foundation, 2014 – present.

- **Zebra Mussel Science Advisory Committee**, Province of Manitoba, 2013 – present.
- **Board of Directors**, Chair of Membership Committee, International Association for Great Lakes Research. 2011-2014.
- **Participant/Expert**, International Joint Commission technical workshop on controlling eutrophication in the Laurentian Great Lakes, February, 2009. Windsor, ON.
- **Technical advisor** to Annex III (Phosphorus strategies) sub-committee for the bi-national Great Lakes Water Quality Agreement. August-September 2006.

Fellowships and Awards

- **International Association for Great Lakes Research (IAGLR) Appreciation Award**. 2014. For service on the IAGLR Board of Directors 2011-2013.
- **Internal Award**. Fisheries and Oceans Canada. 2014. For efforts related to Aquatic Invasive Species activities in Central and Arctic region.
- **Assistant Deputy Minister Distinction Award**, Fisheries and Oceans Canada, 2013. For efforts associated with developing a science-based risk assessment for climate change to freshwater resources and infrastructure in Canada.
- **Internal Award**, Fisheries and Oceans Canada. 2012. For efforts related to Aquatic Invasive Species early detection in Manitoba.
- **Elsevier Young Scientist Award**. International Association for Great Lakes Research, 2010.
- **Guyer Postdoctoral Fellowship**, Zoology department, University of Wisconsin-Madison, $38,000 (declined), 2010.
- **National Sciences and Engineering Research Council of Canada Postdoctoral Fellowship**, $80,000, 2007-2009.
- **Pearson medal** for outstanding Ph.D. thesis, University of Waterloo, 2005.
- **Dean of Science Award** for outstanding M.Sc. thesis in Biology, University of Waterloo, 1999.