

Christopher E. Lawson, Ph.D.

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EDUCATION

- Ph.D., Environmental Engineering (Minor: Microbiology)** 09/2014 – 12/2019
University of Wisconsin-Madison, Madison, WI
Dissertation title: “Metabolic versatility and interactions of nitrogen cycling microbiomes.”
- M.S., Environmental Engineering** 09/2011 – 08/2014
University of British Columbia, Vancouver, BC
Thesis title: “Population dynamics and metabolic potential of a pilot-scale microbial community performing enhanced biological phosphorus removal.”
- B.S., Civil Engineering, Environmental Option, with Distinction** 09/2008 – 05/2010
University of British Columbia, Vancouver, BC
- Honours Diploma, Civil Engineering Technology, Co-op Stream** 09/2005 – 12/2007
Northern Alberta Institute of Technology, Edmonton, AB

RESEARCH INTERESTS

My broad research interests lie at the interface of environmental engineering and microbial ecology, particularly the application of systems biology approaches to study and engineer microbial communities for environmental biotechnology applications. Specific areas of interest include: anaerobic microbiomes for biofuels and bioproducts, biological nutrient removal and recovery, genome-scale metabolic modeling, and metabolic flux analysis of microbial communities.

CAREER SUMMARY

- Postdoctoral Researcher** 01/2020 - Present
Lawrence Berkeley National Lab, Berkeley, CA
Joint BioEnergy Institute, Emeryville, CA
Biological Systems and Engineering Division
Supervisors: Héctor García Martín and Michelle O’Malley
- Application of machine learning, automation, metabolic modeling, and synthetic biology to the design of anaerobic microbial consortia for biofuels and bioproducts.
- Graduate Research and Teaching Assistant** 09/2014 – 12/2019
University of Wisconsin – Madison, Madison, WI
Department of Civil and Environmental Engineering
Advisors: Katherine D. McMahon and Daniel R. Noguera
- Development of systems biology approaches to understand and predict microbial community interactions in nitrogen cycling microbiomes.
 - Professional mentor and teaching assistant for Senior Capstone Design course (CEE 578) and laboratory instructor for graduate course on Biological Treatment Processes (CEE 821).

- Visiting Scientist (SIAM Talent Fellow)** 10/2018 – 12/2018
Radboud University / Delft University of Technology, The Netherlands 05/2017 – 12/2017
Departments of Microbiology and Environmental Biotechnology
- Worked in the laboratories of Professor Mike Jetten and Mark van Loosdrecht conducting research on the physiology of anaerobic ammonium oxidizing (anammox) and nitrifying bacteria.
 - Developed 13C metabolomic and metaproteomic approaches to study the metabolism of anammox and nitrifying bacteria and to perform metabolic flux analysis.
- Microbial Ecologist/ Engineer** 03/2014 - 01/2015
MetaMixis Biologics Inc., Vancouver, BC
- Led environmental impact studies involving DNA-based monitoring of microbial communities.
- Graduate Research and Teaching Assistant** 09/2011 - 08/2014
University of British Columbia, Vancouver, BC
Department of Civil Engineering
Advisors: Steven J. Hallam and Eric R. Hall
- Research on the microbial ecology of a pilot-scale microbial community performing enhanced biological phosphorus removal (EBPR).
 - Led lab demonstrations and tutorial lectures for 3rd year Fluid Mechanics course (CIVL 315).
- Water & Wastewater Process Engineer** 05/2010 – 08/2011;
MPE Engineering Ltd., Edmonton, AB 05/2009 – 08/2009
- Process design of water and wastewater treatment facilities. Duties included preliminary and detailed design, facilities commissioning, resident engineering, and project management.
- Junior Civil Designer (Intern)** 07/2008 – 09/2008
AMEC, Vancouver, BC
- Designed pumping stations, drainage systems, and underground utilities to support large-scale mining operations throughout Western Canada.
- Municipal Infrastructure Inspector/Surveyor (Co-op)** 05/2006 – 10/2007
MPE Engineering Ltd., Edmonton, AB
- Resident engineering for water and wastewater infrastructure projects. Duties included field report writing, topographic and construction surveying, and construction inspection.

AWARDS AND HONOURS

W. Wesley Eckenfelder Graduate Research Award (\$1,500)	2019
Water Environment Federation Canham Graduate Studies Scholarship (\$25,000)	2018
17 th International Symposium on Microbial Ecology Travel Award (\$1,000)	2018
Soehngen Institute of Anaerobic Microbiology (SIAM) Talent Grant Fellowship (\$8,000)	2017, 2018
Wisconsin Distinguished Graduate Fellowship, UW-Madison (\$37,232)	2017-2018
Top Poster Award, 16 th International Symposium on Microbial Ecology	2016
NSERC Post-Graduate Scholarship - Doctoral (\$63,000 over 36 months)	2014-2017
1 st Place, Water Environment Federation (WEF) Student Design Competition (\$2,500)	2013
1 st Place, BC Water & Waste Association (BCWWA) Student Design Competition (\$5,000)	2013
Faculty of Applied Science Graduate Merit Award, UBC (\$5,000)	2012

BCWWA Academic Achievement Award (\$1,500)	2012
Jason Lang Scholarship, NAIT (\$1000)	2006

SPECIAL TRAINING

Mass Spectrometry Summer School <i>University of Wisconsin-Madison, Madison, WI</i>	08/2018
Lean Launch Pad - Genomics Entrepreneurship <i>University of British Columbia, Vancouver, British Columbia</i>	05/2013 – 07/2013
Pathway Tools Workshop on Metabolic Modeling using Flux Balance Analysis <i>Stanford Research Institute (SRI) International, Menlo Park, California</i>	10/2013

PROFESSIONAL AFFILIATIONS AND ACTIVITIES

- Organizing Committee, Meta-omics in Environmental Engineering Research: Theory, Statistics, and Data Interpretation, AEESP Conference Workshop, Tucson, AZ (05/2019)
- Organizing Committee, Madison Microbiome Meeting & Microbiome Engineering Workshop. Madison, WI (04/2018).
- Volunteer, Wisconsin Science Olympiad, Invitational Tournament (02/2018)
- Scientific Committee, 1st Symposium on Microbiological Methods for Waste & Water Resource Recovery, Delft, the Netherlands (05/2017)
- Co-Chair, Bridging Microbiome Science and Environmental Biotechnology Workshop, Microbial Ecology and Water Engineering 2016 Conference, Copenhagen, Denmark (09/2016)
- Professional Mentor, UW-Madison Civil & Environmental Engineering Capstone Course (09/2014 - present)
- President and Founder, UBC BCWWA Student Chapter, (01/2012 – 04/2014)
- Co-Director, Water & Environment Student Talks (June 8 -10, 2014)
- Committee Member, BCWWA Young Professionals Committee (09/2011 – 08/2014)
- Graduate Advisor, 2013 UBC International Genetically Engineered Machine (IGEM) Team
- Convener, 2013 IWA/WEF Nutrient Removal and Recovery Conference, Vancouver, BC (July 28 – 31, 2013)
- Volunteer, BC Drinking Water Week (2012 - 2014)
- Volunteer, Science Rendezvous (05/2013)
- Member, Association of Environmental Engineering and Science Professors (AEESP)
- Member, International Water Association (IWA)
- Member, International Society for Microbial Ecology (ISME)
- Member, Central States Water Environment Association (CSWEA)
- Member (#17475740), Water Environment Federation (WEF)
- Engineer-in-Training (#119453), Association of Professional Engineers and Geoscientists of Alberta (APEGA)

PUBLICATIONS

1. **Lawson, C.E.**, Nuijten, G., de Graaf, R., Jacobson, T.B., Pabst, M., Stevenson, D.M., Jetten, M.S.M., Noguera, D.R., McMahon, K.D., Amador-Noguez, D., Lückner, S. Autotrophic and mixotrophic metabolic network fluxes suggest versatile lifestyle for the anammox bacterium *Candidatus 'Kuenenia stuttgartiensis'*. *bioRxiv*, 835298 (in review).
2. **Lawson, C.E.**, Harcombe, W.R., Hatzenpichler, R., Lindmann, S.R., Löffler, F., O'Malley, M.A., García-Martin, H., Pfleger, B.F., Raskin, L., Venturelli, O.S., Weissbrodt, D.G., Noguera, D.R., McMahon, K.D. (2019) Common principles and best practice for engineering microbiomes. *Nature Reviews Microbiology* **17**: 725–741.
3. Mundinger, A., **Lawson, C.E.**, Koch, H., Jetten, M.S.M., Lückner, S. (2019) Cultivation and Transcriptional Analysis of a Canonical *Nitrospira* Under Stable Growth Conditions. *Frontiers in Microbiology* **10**: 1325.
4. Scarborough, M.J., **Lawson, C.E.**, Hamilton, J.J., Donohue, T.J., Noguera, D.R. Metatranscriptomic and thermodynamic insights into medium-chain fatty acid production using an anaerobic microbiome. *mSystems* **3**(6): e00221-18.
5. **Lawson, C.E.**, Lückner S. (2018). Complete ammonia oxidation: an important control on nitrification in engineered ecosystems? *Current Opinion in Biotechnology* **50**: 158-165.
6. **Lawson, C.E.**, Wu, S., Bhattacharjee, A.S., Hamilton, J.J., McMahon, K.D., Goel, R., Noguera, D.R. (2017) Metabolic network analysis reveals microbial community interactions in anammox granules. *Nature Communications* **8**:15416.
7. Bhattacharjee, A.S., Wu, S., **Lawson, C.E.**, Jetten, M.S., Kapoor, V., Domingo, J.W.S., McMahon, K.D., Noguera, D.R. Goel, R. (2017). Whole community metagenomics in two different anammox configurations: process performance and community structure. *Environmental Science & Technology* **51** (8): 4317–4327.
8. Oyserman, B.O., Moya, F., **Lawson, C.E.**, Garcia, A.L., Voigt, M., Heffernan, M., Noguera, D.R., McMahon, K.D. (2016) Ancestral genome reconstruction identifies the evolutionary basis for trait acquisition in polyphosphate accumulating bacteria. *The ISME Journal* **10**: 2931-2945.
9. **Lawson, C.E.**, Strachan, C.R., Williams, D.D., Koziel, S., Hallam, S.J., and Budwill, K. (2015) Patterns of endemism and habitat selection in coalbed microbial communities. *Appl. Environ. Microbiol.* **81**: 7924–7937.
10. **Lawson, C.E.**, Strachan, B.J., Hanson, N.W., Hahn, A.S., Hall, E.R., Rabinowitz, B., Mavinic, D.S., Ramey, W.D., Hallam, S.J. (2015) Rare taxa have potential to make metabolic contributions in enhanced biological phosphorus removal ecosystems. *Environ. Microbiol.* **17**: 4979–4993.

PUBLICATIONS IN PREPARATION

1. **Lawson, C.E.**, Mundinger, A., Jacobson, T.B., Noguera, D.R., Jetten, M.S.M., Amador-Noguez, D., McMahon, K.D., Lückner, S. Investigating the chemolithoautotrophic and formate metabolism of *Nitrospira moscoviensis* by constraint-based reconstruction and analysis. *In preparation*.

2. **Lawson, C.E.**, Laurenzi, M., Jofra, A.S., Jacobson, T.B., Amador-Noguez, D., McMahon, K.D., Jetten, M.S.M., Noguera, D.R., van Loosdrecht M.C.M., Kleerebezem R., Lückner, S. Impact of acetate and formate on anaerobic ammonium-oxidizing bacteria: substrate competition and metabolic network flux. *In preparation*.
3. **Lawson, C.E.**, van Kessel, M.A.H.J., Pabst, M., Jetten, M.S.M., Amador-Noguez, D., Noguera, D.R., McMahon, K.D., Lückner, S. Oxygen uptake flux predicted to be key selection parameter controlling the interaction between comammox and anammox bacteria. *In preparation*.
4. **Lawson, C.E.**, de Graaf, R. van Galen, P.M., Nuijten, G., Noguera, D.R., McMahon, K.D., Jetten, M.S.M., Amador-Noguez, D., Lückner, S. Isotopic tracing and target lipidomic analysis provide insights on the biosynthesis and *in vivo* turnover rates of diverse ladderane lipids in anammox bacteria. *In preparation*.

CONFERENCE PRESENTATIONS AND INVITED TALKS

1. **Lawson, C.E.** (2019). Carbon metabolism of versatile anaerobic ammonium-oxidizing bacteria resolved by systems-level ¹³C metabolic flux analysis. 6th International Conference on Nitrification and Related Processes. (*Plenary talk*).
2. **Lawson, C.E.** (2018). Unraveling the metabolic network and microbial interactions of anaerobic ammonium-oxidizing bacteria. University of British Columbia Microbiome Research Network Symposium. Vancouver, BC, November 10th, 2018 (*Invited*).
3. **Lawson, C.E.** (2018). Systems-level metabolic flux analysis identifies the central carbon metabolism of anaerobic ammonium oxidizing bacteria. 17th International Symposium on Microbial Ecology. Leipzig, GE, August 14th, 2018 (*Selected talk*).
4. **Lawson, C.E.** (2018). Anaerobic ammonium oxidization: from discovery to applications. Wisconsin Wastewater Operators' Association. Saukville, WI, February 18th, 2018. (*Invited*).
5. **Lawson, C.E.** (2017). Unraveling the metabolic network of anaerobic ammonium oxidizing bacteria. Environmental Biotechnology Seminar Series, Delft University of Technology. Delft, NL, November 28th, 2017. (*Invited*).
6. **Lawson, C.E.** (2017). Unraveling the metabolic network of anaerobic ammonium oxidizing bacteria. Microbiology Seminar Series, Radboud University. Nijmegen, NL, November 21th, 2017. (*Invited*).
7. **Lawson, C.E.** (2017). Engineering the Microbiome. *Emerging Frontiers in Research and Innovation Topic Presentation, National Science Foundation*, Arlington, VA, February 13th, 2017. (*Invited*).
8. **Lawson, C.E.** (2016). How can "omics" information become predictive and enable microbiome engineering? *Microbial Ecology and Water Engineering 2016 Specialist Conference*. Copenhagen, DK, September 4th, 2016. (*Oral presentation*).
9. **Lawson, C.E.**, Wu, S., Bhattacharjee, A.S., Hamilton, J.J., McMahon, K.D., Goel, R., Noguera, D.R. (2016) Distributed metabolic networks reveal microbial community interactions in anammox

granules. *16th International Symposium on Microbial Ecology*, Montreal, Canada, August 21-26, 2016. (Poster presentation). ***Top Poster Award**

10. **Lawson, C.E.**, Wu, S., Bhattacharjee, A.S., McMahon, K.D., Goel, R., D.R. Noguera (2015) Ecogenomics reveals distributed metabolic networks in suspended and attached growth anammox bioreactors. *Proceedings of the 88th Annual Water Environment Federation Technical Exhibition and Conference*, Chicago, Illinois, September 26-30, 2015. (Oral presentation).
11. **Lawson, C.E.**, Wu, S., Bhattacharjee, A.S., McMahon, K.D., Goel, R., D.R. Noguera (2015) Distributed metabolism in suspended and attached growth anammox bioreactors revealed through metagenomic sequencing. *4th International Conference on Nitrification*, Edmonton, Alberta, June 28-July 1, 2015. (Poster presentation).
12. **Lawson, C.E.**, Wu, S., Bhattacharjee, A.S., McMahon, K.D., Goel, R., D.R. Noguera (2015) Distributed metabolism in suspended and attached growth anammox bioreactors revealed through metagenomic sequencing. *Water Microbiology Conference 2015*, Chapel Hill, North Carolina, May 18-21, 2015. (Oral presentation).
13. **Lawson, C.E.**, E.R. Hall, D.S. Mavinic, W.D. Ramey, S.J. Hallam. Metagenomic analysis of a pilot-scale microbial community performing enhanced biological phosphorus removal (2014). *15th International Symposium on Microbial Ecology*, Seoul, Korea, August 24-29, 2014. (Oral presentation).
14. **Lawson, C.E.**, E.R. Hall, D.S. Mavinic, W.D. Ramey, S.J. Hallam. Opening the black-box of enhanced biological phosphorus removal with environmental genomics (2014). *Water & Environment Student Talks*, Vancouver, British Columbia, June 8 -10, 2014. (Oral presentation).
15. **Lawson, C.E.** (2014). Environmental biotechnology for sustainable water resource development and protection. *42nd British Columbia Water & Waste Association Annual Conference*, Fresh Ideas Session, Whistler, British Columbia, May 3 - 6, 2014. (Oral presentation & featured BCWWA Watermark magazine article).
16. **Lawson, C.E.**, B. Rabinowitz, D.S. Mavinic, W.D. Ramey, S.J. Hallam (2013). Structure of the active microbial community in a pilot-scale enhanced biological phosphorus removal process revealed through 454-pyrotag sequencing. *Proceedings of the 86th Annual Water Environment Federation Technical Exhibition and Conference*, Chicago, Illinois, October 5-9, 2013. (Oral presentation).
17. **Lawson, C.E.**, P.R. Bérubé (2012). Integrated membrane systems: membrane bioreactors. *Workshop on Membrane Filtration Technology: Fundamentals, Design, & Applications*, Canadian Water Network, Vancouver, British Columbia, June 13 - 15, 2012. (Oral presentation).