

JEFFRA K. SCHAEFER

Department of Environmental Sciences
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EDUCATION

Ph.D. Microbiology and Molecular Genetics, Rutgers University, New Brunswick, NJ. January 2005.
Dissertation: The role of mercury resistance genes in the environment and the factors controlling their expression.

B.A. Biochemistry and Molecular Biology, University of California at Berkeley. May 1997.

RESEARCH EXPERIENCE

Assistant Research Professor, Rutgers University

Department of Environmental Science, 2013 – Present.

Associate Research Scholar, Princeton University

Department of Geosciences, 2008 – 2013.

Research on the mechanism of mercury uptake and methylation in anaerobic bacteria

Post-Doctoral Research Associate, Princeton University

Department of Geosciences, 2005 – 2008. Dr. François Morel, Advisor.

Research on the mechanism of mercury methylation in bacteria; determining the source of methylmercury in the open ocean.

Graduate Research Assistant, Rutgers University

Department of Biochemistry and Microbiology, 2000 – 2005. Dr. Tamar Barkay, Advisor.

Biologist, US Geological Survey

Water Resources Division, Menlo Park, CA, 1994 – 1999

Isolation of novel aerobic and anaerobic bacteria; characterization of methylhalide degradation in water and soils; characterization of anaerobic respiratory processes, including dissimilatory reduction of arsenate, selenate, iron, and sulfate.

TEACHING EXPERIENCE

Current Courses, Rutgers University.

Introduction to Environmental Science, 375:101; Fall (1 section, 75 students) and Spring (2 sections online, 76 students total).

Soil Ecology, 375:453 and 375:573. Fall. (1 section, 50 – 80 undergraduates, 5 – 12 graduate students). Overall Course Student Evaluations = 4.26 (2015).

Analytical Environmental Chemistry, 375:310. Spring. (2 – 3 sections; 30 – 42 students); Required lab course for Environmental Science majors. Completely revised curriculum in 2015. Overall Course Student Evaluations = 4.25 (2016). Secured \$1000 in Classroom Enrichment Funds (2016) for rental of the R/V Rutgers boat to take students down the Raritan River and collect water/sediment samples and field measurements.

Guest Lecturer. Pollution Microbiology. Rutgers University, Spring 2014 – 2017. L. Young, Professor. One guest lecture during the semester on the topic of “Metals and Microbes”.

Instructor. Freshman Seminar Course on the Everglades. Dept of Geosciences, Princeton University. Spring 2009. A. Kraepiel, lead instructor. Responsible for 25% of the class during the second half of the semester. Topic: “Mercury in the Everglades”.

Instructor. General Microbiology. Rutgers University, Summer 2008. Responsible for one third of the lecture course of 34 students.

Lecturer. ENV202b: Fundamentals of Environmental Studies: Climate, Air Pollution, Toxics, and Water Lab Course, Princeton University, Spring 2007 and 2008. Responsible for 1 – 2 sections of 13-16 students each. Developed part of the lab course on acid rain and mercury deposition from scratch by incorporating published field data with bench-top lab simulations.

Part-Time Lecturer. Microbial Ecology and Biodiversity Lab Course. Rutgers University, Fall 2003. Responsible for 1 section of 15 students.

Teacher’s Assistant. Microbial Ecology and Biodiversity Lab Course. Rutgers University, Spring 2003. T. Barkay, Professor. Responsible for 1 section of 10 students. Aided professor in the development and writing of the lab manual; prepared and delivered lectures and assignments for each lab topic, in addition to the preparation of lab materials and grading of assignments.

Teacher’s Assistant. General Microbiology Laboratory. Rutgers University, 2003. D. Davis, Professor. Responsible for 1 section of ~30 students. Introduced the lab topic and graded all laboratory assignments.

CURRENTLY FUNDED PROJECTS:

Collaborative Research: Effects of trophic status alterations on pathways of mercury methylation in northern wetlands. NSF Arctic Natural Sciences. M. Hines (Lead PI, U Mass Lowell), T. Barkay (Co-PI), **J. K. Schaefer (Collaborator)**. 7/1/2013 -6/31/2018.

PREVIOUSLY FUNDED GRANT PROPOSALS:

Mechanisms of Hg(II) uptake and methylation in methylating bacteria. Subsurface Biogeochemical Research, U. S. Department of Energy. 11/30/2011 – 11/30/2015. F. M. M. Morel (Lead PI, Princeton) and **J. K. Schaefer (Co-PI)**.

Diversity and expression of the mercury methylating gene, *hgcA*. University Research Council, Rutgers University. 7/1/2014 – 5/1/2015. **J. K. Schaefer (Lead PI)**

Identification of hot spots for methylmercury production after forest clear-cut – a multidisciplinary approach providing a scientific basis for practical guidelines. The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning. 1/2010-6/2013. U. Skyllberg (Lead PI, SLU, Sweden), E. Björn (Co-PI, Umeå U., Sweden), **J. K. Schaefer (Co-PI, Princeton U)**, R. Kretzchmar (Co-PI, ETH, Zürich), B. Bourdon (Co-PI, ETH, Zürich), J. Wiederhold (Co-PI, ETH, Zürich), C.-M. Mörth (Co-PI, Stockholm U.), R. Giesler (Umeå U., Sweden) O. Kårén (Co-PI, Holmen Skog AB, Sweden).

PUBLICATIONS

1. A. G. Bravo, S. Peura, M. Buck, O. Ahmed, A. Mateos-Rivera, S. Herrero, , **J. K. Schaefer**, E. Björn, and S. Bertilsson. Methanogens and iron-reducing bacteria are major contributors to mercury methylation in boreal lake sediments. Submitted to *ISME J*.
2. A. G. Bravo, J. Zopfi, M. Buck, J. Xu, S. Bertilsson, **J. K. Schaefer**, J. Poté, and C. Cosio. *Pelobacteraceae* and *Geobacteraceae* are important members of mercury methylating communities of ferruginous sediments. Submitted to *ISME J*.
3. S. Jonsson, A. Andersson, M. B. Nilsson, U. Skyllberg, E. Lundberg, **J. K. Schaefer**, S. Åkerblom, and E. Björn. 2017. Terrestrial discharges mediate trophic shifts and enhance methylmercury accumulation in estuarine biota. *Sci. Adv.* 3:e1601239.
4. Y. Wang, J. K. Schaefer, B. Mishra, and N. Yee. 2016. Intracellular Hg(0) oxidation in *Desulfovibrio desulfuricans* ND132. *Environ. Sci. Technol.* 50:11049-11056.
5. S. E. Janssen, **J. K. Schaefer**, J. D. Blum, T. Barkay, and J. R. Reinfelder. 2016. Fractionation of mercury stable isotopes during microbial methylmercury production in iron- and sulfate-reducing bacteria. *Environ. Sci. Technol.* 50:8077-8083.
6. **J. K. Schaefer**. 2016. Better living through mercury. News & Views. *Nat. Geosciences.* 9: 94-95.
7. A. Szczuka, F. M. M. Morel, and **J. K. Schaefer**. 2015. The effect of thiols, zinc, and redox conditions on Hg uptake in *Shewanella oneidensis*. *Environ. Sci. Technol.* 49: 7432-7438.
8. **J. K. Schaefer**, A. Szczuka, and F. M. M. Morel. 2014. Effect of divalent metals on Hg(II) uptake and methylation by bacteria. *Environ. Sci. Technol.* 48: 3007-3013.
9. **J. K. Schaefer**, R.-M. Kronberg, F. M. M. Morel, U. Skyllberg. 2014. Detection of a key Hg methylation gene, *hgcA*, in wetland soil. *Environ. Microbiol. Rep.* 6: 441-447.
10. **J. K. Schaefer**, S. S. Rocks, W. Zheng, L. Liang, B. Gu, and F. M. M. Morel. 2011. Active transport, substrate specificity, and methylation of Hg(II) in anaerobic bacteria. *Proc. Nat. Acad. Sci.* 108: 8714-8719.
11. E. G. Malcolm, **J. K. Schaefer**, E. B. Ekstrom, C. B. Tuit, A. Jayakumar, H. Park, B. B. Ward, and F. M. M. Morel. 2010. Mercury methylation in oxygen deficient zones of the oceans: no evidence for the predominance of anaerobes. *Mar. Chem.* 122: 11-19.
12. **J. K. Schaefer**, and F. M. M. Morel. 2009. High methylation rates of mercury bound to cysteine by *Geobacter sulfurreducens*. *Nature Geosci.* 2: 123-126.
13. T. Cardona-Marek, **J. K. Schaefer**, K. Ellickson, T. Barkay, J. R. Reinfelder. 2007. Mercury speciation, reactivity, and bioavailability in a highly contaminated estuary, Berry's Creek, New Jersey Meadowlands. *Environ. Sci. Technol.* 41: 8268-8274.
14. S. M. Ní Chadhain*, **J. K. Schaefer***, S. Hicks, G. J. Zylstra, and T. Barkay. 2006. Analysis of mercuric reductase (*merA*) gene diversity in an anaerobic mercury-contaminated sediment enrichment. *Environ. Microbiol.* 8: 1746-1752. *Authors contributed equally to this manuscript.

15. **J. K. Schaefer**, J. Yagi, J. Reinfelder, T. Cardona, K. M. Ellickson, S. Tel-Or, T. Barkay. 2004. The role of the bacterial organomercury lyase (MerB) in controlling methylmercury accumulation in mercury contaminated natural waters. *Environ. Sci. Technol.* 38: 4304-4311.
16. **J. K. Schaefer**, J. Letowski, and T. Barkay. 2002. *mer*-mediated resistance and volatilization of Hg(II) under anaerobic conditions. *Geomicrobiol. J.* 19: 87-102.
17. **J. K. Schaefer**, K. D. Goodwin, I. R. McDonald, J. C. Murrell, R. S. Oremland. 2002. *Leisingera methylohalidivorans*, gen. nov., sp. nov., a marine methylotroph that grows on methyl bromide. *Int. J. Syst. Evol. Microbiol.* 52: 851-859.
18. T. Barkay and **J. Schaefer**. 2001. Metal and radionucleotide bioremediation: issues, considerations and potentials. *Curr. Opin. Microbiol.* 4: 318 – 323.
19. R. S. Oremland, P. R. Dowdle, S. Hoelt, J. P. Sharp, **J. K. Schaefer**, L. G. Miller, J. S. Blum, R. L. Smith, N. S. Bloom, D. Wallschlaeger. 2000. Bacterial Dissimilatory Reduction of Arsenate and Sulfate in Meromictic Mono Lake, California. *Geochimica et Cosmochimica Acta* 64: 3073-3084.
20. **J. K. Schaefer** and R. S. Oremland. 1999. Oxidation of Methyl Halides by the Facultative Methylotroph Strain IMB-1. *Appl. Environ. Microbiol.* 65: 5035-5041.
21. K. D. Goodwin, **J. K. Schaefer**, and R. S. Oremland. 1998. Bacterial Oxidation of Dibromomethane and Methyl Bromide in Natural Waters and Enrichment Cultures. *Appl. Environ. Microbiol.* 64: 4629-4636.
22. M. Laverman, J. S. Blum, **J. K. Schaefer**, E. J. Philips, D. R. Lovley, and R. S. Oremland. 1995. Growth of Strain SES-3 with Arsenate and Other Diverse Electron Acceptors. *Appl. Environ. Microbiol.* 61: 3556-3561.

PROFESSIONAL PRESENTATIONS

1. Sofi Jonsson, A. L. Soerensen, **J. K. Schaefer**, A. Poulain. Workshop: Biogeochemical Cycling of Mercury in Marine Systems – Where do we go from here. ICMGP. July 2017. *Invited Speaker*.
2. S. Janssen and **J. K. Schaefer**. Mercury Uptake and Bioavailability in a Gram-Positive Firmicute, *Desulfitobacterium metallireducens*. ICMGP, Providence July 2017
3. Y. Wang, **J. K. Schaefer**, B. Mishra, and N. Yee. Adsorption of Methylmercury onto *Geobacter bemidjensis* Bem. ICMGP, Providence, July 2017.
4. D. Krabbenhoft, J. DeWild, J. Ogorek, G. Aiken, B. Poulin, M. Hines, T. Barkay, and **J. K. Schaefer**. Biogeochemical Controls on Mercury Methylation in Alaskan Peatlands Spanning a Large Range of Trophic Status. ICMGP, Providence, July 2017
5. M. E. Hines, L. Zhang, X. Liu, T. Barkay, **J. K. Schaefer**, D. P. Krabbenhoft, B. A. Poulain, and G. R. Aiken. Changing Pathways of Mercury Methylation along Trophic Gradients in Northern Wetlands. ICMGP, Providence, July 2017
6. A. Bravo, S. Bouchet, J. Tolu, A. Mateos-Rivera, S. Peura, M. Buck, **J. K. Schaefer**, Erik Bjorn, and S. Bertilsson. Molecular Composition of Organic Matter Controls the Activity of Mercury Methylating Microbial Communities. ICMGP, Providence, July 2017

7. S. Jonsson, A. Andersson, M. Nielsson, U. Skyllberg, E. Lundberg, V. Nguyen, **J. K. Schaefer**, S. Akerblom, and E. Bjorn. Methylation and Bioaccumulation of Mercury from “New” and “Old” Sources in Estuarine Systems. ICMGP, Providence, July 2017.
8. **J. K. Schaefer**. Mercury bioavailability and uptake in iron-reducing bacteria. Microbiology at Rutgers Symposium. February 2017. *Invited Speaker*.
9. **J. K. Schaefer**. Bioavailability and uptake of mercury in anaerobic microorganisms. Rutgers University. April 2016. *Invited Speaker*.
10. **J. K. Schaefer**, S. Janssen, E. Gwyszcz, M. de Freitas, A. Szczuka, and F. M. M. Morel. Comparison of Hg(II) uptake and methylation across diverse anaerobic microorganisms. Geological Society of America Annual Meeting. Baltimore, MD. November 2015.
11. **J. K. Schaefer**. The role of low molecular weight thiols in Hg(II) uptake by methylating and non-methylating microorganisms. Swedish University of Agricultural Sciences, Umeå, Sweden. August 2015. *Invited Speaker*.
12. **J. K. Schaefer**. Molecular approaches for studying Hg methylation. Swedish University of Agricultural Sciences, Umeå, Sweden. August 2015. *Invited Speaker*.
13. **J. K. Schaefer**. Unraveling the mechanism of Hg(II) transport and methylation in bacteria. Department of Civil and Environmental Engineering, University of Delaware. May 2015. *Invited Speaker*.
14. **J. K. Schaefer**. A molecular approach for identifying the microbial guilds responsible for methylmercury cycling in wetlands. Uppsala University, Uppsala, Sweden. May 2014. *Invited Speaker*.
15. **J. K. Schaefer**. Identifying the bacteria responsible for methylmercury formation: detection of *hgcA* gene and transcripts in soils. Symposium on Mercury Cycling Related to Forestry Activities. Umeå, Sweden. February 2014. *Invited Speaker*.
16. **J. K. Schaefer**, A. Szczuka, and F. M. M. Morel. Active uptake of Hg(II) by mercury methylating bacteria: where and how? International Conference on Mercury as a Global Pollutant. Edinburgh. July 2013.
17. **J. K. Schaefer**, A. Szczuka, and F. M. M. Morel. Active uptake of Hg(II) by mercury methylating and non-methylating bacteria. Department of Marine Sciences and Chemistry Seminar. University of Connecticut, Groton, CT. April 2013. *Invited Speaker*.
18. **J. K. Schaefer**, A. Szczuka, and F. M. M. Morel. Unraveling the mechanism of Hg(II) transport and methylation in anaerobic bacteria. Department of Environmental Sciences Seminar, Rutgers University. April 2013. *Invited Speaker*.
19. **J. K. Schaefer**, O. Baars, R. Anwar, L. Liang, B. Gu, and F. M. M. Morel. Role of zinc transporters in the uptake of Hg(II) by *Geobacter sulfurreducens*. Subsurface Biogeochemical Research Annual Meeting. Washington DC. April 2012.

20. **J. K. Schaefer**, S. S. Rocks, W. Zheng, L. Liang, B. Gu, and F. M. M. Morel. 2011. Active transport and methylation of Hg(II) in anaerobic bacteria. Subsurface Biogeochemical Research Annual Meeting. Washington DC. April 2011.
21. **J. K. Schaefer**. Mechanisms of Hg(II) uptake and methylation in anaerobic bacteria. Theobald Smith Society, Rutgers University, New Brunswick, NJ. Dec. 2011. *Invited Speaker*.
22. **J. K. Schaefer**, S. S. Rocks, W. Zheng, L. Liang, B. Gu, and F. M. M. Morel. Active transport and methylation of Hg(II) in anaerobic bacteria. Subsurface Biogeochemical Research PI Meeting. Washington DC. April 2011.
23. **J. K. Schaefer**, S. Rocks, and F. M. M. Morel. Differences in the availability of Hg-thiol complexes to anaerobic bacteria. Goldschmidt. Knoxville, TN. June 2010.
24. **J. K. Schaefer** and F. M. M. Morel. Mercury bioavailability: the role of thiols in promoting bacterial mercury methylation. Department of Biochemistry and Microbiology, Rutgers University, New Brunswick, NJ. April 2008. *Invited speaker*.
25. **J. K. Schaefer**, M. J. Walsh, B. Ahner, and F. M. M. Morel. Complexation of inorganic mercury by cysteine promotes bacterial mercury methylation. American Geophysical Union Fall Meeting. San Francisco, CA. Dec. 2007.
26. **J. K. Schaefer** and F. M. M. Morel. Relationship between mercury emissions and methylation, Water and Ecosystem Area Council Meeting. Electric Power and Research Institute (EPRI), Cleveland, OH. Sep. 2007. *Invited speaker*.
27. **J. K. Schaefer**, T. Barkay, and F. M. M. Morel. Inorganic mercury bioavailability studies in iron-reducing bacteria. ASLO Aquatic Sciences Meeting. Sante Fe, NM. February 2007.
28. **J. K. Schaefer** and T. Barkay. Diversity of mercuric reductase (*merA*) genes and transcripts in natural waters. 105th Annu. Meet. Am. Soc. Microbiol. Atlanta, GA. June 2005.
29. **J. K. Schaefer**, J. Yagi, T. Cardona-Marek, K. Ellickson, S. Tel-Or, J. Reinfelder, and T. Barkay. The role of the bacterial enzyme, organomercurial lyase, in controlling methylmercury accumulation in mercury contaminated natural waters. 7th International Conference on Mercury as a Global Pollutant. Ljubljana, Slovenia. June 2004.
30. **J. K. Schaefer**, T. Cardona-Marek, K. Ellickson, J. Yagi, T. Barkay, and J. Reinfelder. Mercury contamination in Berry's Creek and downstream ecosystems. Meadowlands Symposium. Lyndhurst, NJ. October 2003.
31. **J. K. Schaefer**, J. Yagi, J. Reinfelder, S. Tel-Or, and T. Barkay. The potential role of *mer*-mediated resistance in controlling methylmercury accumulation in freshwater ecosystems in New Jersey. 102nd Annu. Meet. Am. Soc. Microbiol. Salt Lake City, UT, May 2002.
32. **J. K. Schaefer**, K. D. Goodwin, I. McDonald, J. C. Murrell, and R. S. Oremland. Methylhalide oxidation by a novel marine methylotroph, *Ruegeria* sp. strain MB2. American Geophysical Union Fall Meeting. San Francisco, CA. December 2000.

MENTORING EXPERIENCE

Associate Member of Graduate Faculty in the following Graduate Programs at Rutgers:

Environmental Sciences, Microbial Biology, and Microbiology and Molecular Genetics.

Ph.D. Graduate Students (Co-Advisor):

Spencer Roth, Environmental Sciences, Rutgers (2016 - current); Yuwei Wang (2015-current, Environmental Sciences); Rose-Marie Kronberg, Swedish University of Agricultural Sciences, Umeå. PhD Thesis 2014.

PhD Qualifying Exam Committee Member:

Rachel Dean (2017, Microbial Biology)

PhD Thesis Defense Committee Member:

K. Munson (2013, MIT/WHOI Joint Program)

Masters Student Committee Member:

Swetha Kasetty (Thesis 2017, Environmental Sciences); Azar Galer (Exam 2016, Environmental Sciences)

Undergraduate George H. Cook Scholars (Advisor):

Christopher Tkach (2018); Lauren Foy (2017).

Aresty Undergraduate Research Assistants (Advisor):

Harold Ofori (2017-2018); Lauren Foy (2014-2015)

Visiting Reseach Scholar Mentor:

Yundang Wu, Guangdong Institute of Eco-environmental Science and Technology. 2017; Dr. Haiyan Hu, Chinese Academy of Sciences. 2015.

Undergraduate Mentor: Lauren Foy (2014-2017), Michelle de Freitas (2015-2016), Sumit Bhattacharjee (2015), Ewelina Gwiszcz (2014-2015), Aleksandra Szczuka (2012 – 2014); Raheel Anwar (2011 – 2012), Sarah Blucher (2011 – 2012), and Marjorie Wilner (2009).

Technicians (Primary Supervisor): Dawn Wang, 2012 – 2013; Cristina Cobb-Adams, 2007 – 2012

PROFESSIONAL SERVICE

Peer Review Experience (Grants): NOAA's National Sea Grant College Program; NSF Geobiology and Low-Temperature Geochemistry; Agence Nationale de la Recherche MICMAC, France

Peer Review Experience (Journals, past 3 years):

Environmental Microbiology; Environmental Engineering Science; Environmental Science and Pollution Research; Environmental Science and Technology; Environmental Science and Technology Letters; FEMS Microbiology Letters; Geomicrobiology Journal; Int. J. Environmental Research and Public Health; Marine Chemistry; Microorganisms; Nature Geosciences; Photosynthesis Research; Science of the Total Environment

Professional Memberships: American Chemical Society; American Society for Microbiology

STEM OUTREACH

Microbiology Expert for a fourth grade science project examining the impact of turmeric on the growth of *Escherichia coli* K12, Thomas Edison EnergySmart Charter School, Franklin Township, NJ. Spring 2015.

Presented “Bioluminescent Bacteria” at the Science Fair, Hillcrest Elementary School, Franklin Township, NJ. June 4, 2015.

Science Expert for the Big Ideas Learning and Leadership Development Program (BILLD) for K-12 science teachers, Rider University’s Science Education and Literacy Center. Nov - Dec. 2013.

Led professional development workshop in science education for K-12 teachers across 2 school districts (Pine Hill, NJ and Willingboro, NJ) funded by a grant awarded to Rowan University from NJ Department of Education entitled “Articulation of Content, Expectations, and Standards in Math and Science (ACES)” in 2010-2011, year-long workshop for 20 teachers.

Science Expert for the Hamilton Township School district group in the CONNECT-Ed (Consortium for New Explorations in Coherent Teacher Education) program for the designing of a Big Idea Module (BIM) for grades 2-12 on the topic of natural selection. Presented our project at the CON-QUEST workshop at Rider University in July 2008.

Presented Oceans Unit in QUEST, week long professional development workshop for middle school science teachers, Princeton Environmental Institute, Princeton University, July 2006.

Science and Engineering Expo for Middle School students. Princeton Environmental Institute, Princeton University, 2006. “Life without Oxygen – Photosynthetic Bacteria and the Sulfur Cycle”