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Education

B.A., Amherst College (*Magna cum laude*), 1974

Ph.D., Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program in Biological Oceanography, 1979

Professional Experience

1993-Present David R. Atkinson Professor of Ecology & Environmental Biology, Cornell University.

2009 Visiting Professor, Institute of Pierre and Marie Curie, University of Paris

2000-Present Adjunct Senior Scientist, Marine Biological Laboratory, Woods Hole.

1983-Present Founding Editor, *Biogeochemistry* (Editor-in-Chief, 1983-2004).

2010-Present Director, Agriculture, Energy, & Environment Program, Cornell University

2005-2009 Director, Agricultural Ecosystems Program, Cornell University.

2000-2001 Oceans Program Director and Senior Scientist, Environmental Defense.

1995-2000 Director, Program in Biogeochemistry & Environmental Change, Cornell.

1992-1995 Senior Fellow, and coordinator for the Initiative in Earth, Atmospheric, & Aquatic Sciences, Center for the Environment, Cornell University.

1990-1993 Professor, Section of Ecology & Systematics, Cornell University.

1985-1990 Associate Professor, Section of Ecology & Systematics, Cornell University.

1980-1985 Assistant and Associate Scientist, Marine Biological Lab, Woods Hole.

1979 Noyes Postdoctoral Fellow, Marine Biological Laboratory, Woods Hole.

National and International Committees and Activities

2007-2012 Chair, International SCOPE Biofuels Project: Environmental Consequences of Biofuels (International Council of Science).

2007-2009 President, Coastal & Estuarine Research Federation.

2008-2010 Member, Board of Directors, Council of Scientific Society Presidents

2007-2011 Co-chair, Committee on Energy & Environment, Council of Scientific Society Presidents.

2005-2016 Representative from the State of New York to the Scientific and Technical Advisory Committee of the Chesapeake Bay Program.

2006-2008 Member, Gulf of Mexico Hypoxia Advisory Panel, US EPA.

2005-2007 Member, Steering Committee, N2007 International N Symposium, Brazil.

2004-2007 Member, Biogeochemical Cycling Rapid Response Team, Ecological Society of America.

2003-Present Editor, book series on Environmental Management, Springer.

2003-2008 Member, Coast and Oceans Working Group, the Heinz Center.

2003-2006 Director, North American Regional Center, International Nitrogen Initiative.

2003-Present Member, Advisory Committee, International Nitrogen Initiative

2002-2005 Coordinating Lead Author, chapter on responses to nutrient pollution, the Millenium Ecosystem Assessment.

2002-2004 Member, Advisory Committee, N2004 International N Symposium, China.

2002-2003	Coordinator and lead author, Working Group to Develop a Federal Interagency Research Plan for Coastal Nutrient Pollution.
2001-2002	Consultant on coastal nutrient pollution, the Pew Oceans Commission.
2000-2003	Member, US Committee for SCOPE, National Academy of Sciences.
2000-2003	Member, Scientific Advisory Board, National Center for Ecological Analysis & Synthesis, University of California at Santa Barbara.
2001-2002	Member, Committee to Evaluate the Water Programs of the US Army Corps of Engineers, National Academy of Sciences.
1992-2002	Co-Chair, International SCOPE Nitrogen Project on Nitrogen: A Regional and Global Analysis (International Council of Science).
2000-2001	Member, Advisory Committee, N2001 Symposium, Potomac, MD.
1998-2001	Member, National Climate Change Assessment (Coastal Marine Sector).
1998-2000	Chair, Committee on Causes and Management of Coastal Eutrophication, National Academy of Sciences.
2000	Chair, Panel on Coastal Nitrogen Pollution, Ecological Society of America.
1996-1998	Member, Board of Scientific Counselors, U.S. EPA
1997	Member, Panel on Non-Point Source Pollution, Ecological Soc. of America.
1996	Member, Panel on Human Alteration of the N Cycle, Ecol. Soc. of America.
1994-1995	Member, Panel on Nitrogen Cycling in China, Committee on Scholarly Communication with China, National Academy of Sciences.
1995	Chair, Working group on Scientific Studies in Pristine Areas, National Academy of Sciences.
1994-1997	Member, Steering Committee, Sustainable Biosphere Initiative, ESA.
1994	Member, Committee on High-Priority Science to Meet National Coastal Needs, National Academy of Sciences.
1992-1998	Member, Committee on Ethics, Am. Soc. of Limnol. & Oceanography.
1990-1993	Member, Committee on Opportunities to Improve Wastewater Management for Urban Coastal Areas, National Academy of Sciences.
1991-1995	Member, Advisory Committee for the National Water-Quality Assessment Program, U.S. Geological Survey.
1989-1992	Member, Committee on the Coastal Ocean, National Academy of Sciences.
1991-1993	Member, Governing Board, Estuarine Research Federation.
1988-1990	Member, U. S. National Committee for SCOPE, National Academy of Sciences.
1985-1991	Member, Scientific Advisory Committee, the International SCOPE Sulphur Project (Moscow, USSR).
1989-1990	Member, Panel on Fluxes of Trace Gases and Nutrients to and from Terrestrial Ecosystems, Committee on Global Change, National Academy of Sciences.
1986-1988	Member, Public Affairs Committee, Am. Soc. of Limnol. & Oceanography.
1981-1984	Member, Panel on Ecological Effects, Committee on Fate and Effects of Oil in the Sea, National Academy of Sciences.

Research Interests

Application of science to sustaining the biosphere; biogeochemistry and aquatic ecosystem science; global and regional nitrogen and phosphorus cycles; environmental consequences of biofuels; role of trace gases in global warming and climate disruption; life-cycle analysis for greenhouse-gas footprint of energy technologies; influence of land-use, management practices, and climate change on nutrient fluxes from the landscape; atmospheric deposition of nitrogen onto the landscape; controls and consequences of eutrophication in estuaries; biotic, physical, and geochemical controls on nitrogen fixation; environmental management and the effects of pollutants on aquatic ecosystems.

Recent Awards and Honors (since 2000)

Awarded the Zayed International Prize for the Environment (2007), jointly with the other lead authors of the Millennium Ecosystem Assessment.

Presented invited briefing on coastal water quality at the White House to the President's Science Advisor and staff of the Office of Science and Technology Policy (2006).

Selected by ISI Web of Science (Scientific Citation Index) as one of 250 most cited scientists globally in ecology and environmental science disciplines (2006, 2007, 2008, 2009, and 2010).

Appointed to "Biology Faculty of 1,000" (2005, 2006, 2007, 2008, 2009, 2010, and 2011).

Received the Lindeman Award in Ecology, University of Minnesota (2003).

Selected as an Aldo Leopold Leadership Fellow, Ecological Society of America (2000).

Recognized as "Eminent Ecologist," Kellogg Biological Station, Michigan State Univ. (2000).

Publications:

- 2011 Howarth, R. W., R. Santoro, and A. Ingraffea. 2011. Methane and the greenhouse gas footprint of natural gas from shale formations. *Climatic Change Letters*, doi: 10.1007/s10584-011-0061-5
- Howarth, R. W., G. Billen, F. Chan, D. Conley, S. C. Doney, J. Garnier, and R. Marino. 2011. Coupled biogeochemical cycles: Eutrophication and hypoxia in coastal marine ecosystems. *Frontiers in Ecology & Environment* 9: 18-26; doi: 10.1890/100008
- Howarth, R. W., D. Swaney, G. Billen, J. Garnier, B. Hong, C. Humborg, P. Johnes, C. Morth, and R. Marino. 2011. Nitrogen fluxes from large watershed to coastal ecosystems controlled by net anthropogenic nitrogen inputs and climate. *Frontiers in Ecology & Environment*, in press; doi:10.1890/100178
- Billen, G., M. Silvestre, B. Grizzetti, A. Leip, J. Garnier, M. Voss, R. Howarth, F. Bouraoui, H. Behrendt, A. Lepisto, P. Kortelainen, P. Johnes, C. Curtis, C. Humborg, E. Smedberg, O. Kaste, R. Ganeshram, A. Beusen, & C. Lancelot. 2011. Nitrogen flows from European regional watersheds to coastal marine waters. Chapter 13, European Nitrogen Assessment. Cambridge University Press, in press.
- Grizzetti, B., F. Bouraoui, G. Billen, H. van Grinsven, A. Cardoso, V. Thieu, J. Garnier, C. Curtis, R. Howarth, and P. Johnes. 2011. Nitrogen as a threat to European water quality. Chapter 17, European Nitrogen Assessment. Cambridge University Press, in press.
- Hong, B., D. Swaney, and R. W. Howarth. 2011. A toolbox for calculating net anthropogenic nitrogen inputs (NANI). *Environmental Modeling and Software* 26: 623–33.
- McLenaghan, N. A., A. C. Tyler, U. H. Mahl, R. W. Howarth, and R. M. Marino. 2011. Benthic macroinvertebrate functional diversity regulates nutrient and algal dynamics in a shallow estuary. *Mar. Ecol. Progr. Ser.* 426: 171-184.
- Baojing Gu, Yimei Zhu, Jie Chang, Chanhui Peng, Dong Liu, Yong Min, Weidong Luo, R. W. Howarth, and Y. Ge. 2011. The role of technology and policy in mitigating regional nitrogen pollution. *Env. Res. Letters* 6: 014011. doi:10.1088/1748-9326/6/1/014011

- 2010 Townsend, A. & R. W. Howarth. 2010. Human acceleration of the global nitrogen cycle. *Scientific American* 302 (1): 32-39
- Howarth, R. W. 2010. Solutions to environmental challenges: Nitrogen cycle. *Scientific American* 302 (#4, April 2010): 38.
- Johnson, P. T. J., A. R. Townsend, C. C. Cleveland, P. M. Glibert, R. W. Howarth, V. J. McKenzie, E. Rejmankova, and M. H. Ward. 2010. Linking environmental nutrient enrichment and disease emergence in humans and wildlife. *Ecological Applications* 20: 16-29.
- Howarth, R. W. 2010. Celebrating 100 volumes. *Biogeochemistry* 100: 1-2.
- Najjar, R., C. R. Pyke, M. B. Adams, D. Breitburg, C. Hershner, M. Kemp, R. Howarth, M. R. Mulholland, M. Paolisso, D. Secor, K. Sellner, D. Wardrop and R. Wood. 2010. Potential climate-change impacts on the Chesapeake Bay. *Estuarine and Coastal Shelf Science* 86: 1-20.
- Dale, V. H., C. L. Kling, J. L. Meyer, J. Sanders, H. Stallworth, T. Armitage, D. Wangsness, T. Bianchi, A. Blumber, W. Boynton, D. J. Conley, W. Crumpton, M. David, D. Gilbert, R. W. Howarth, R. Lowrance, K. Mankin, J. Opaluch, H. Paerl, K. Reckhow, A. N. Sharpley, T. W. Simpson, C. S. Snyder, and D. Wright. 2010. Hypoxia in the Northern Gulf of Mexico. 284 pages. Springer.
- Davidson, E. A., K. E. Savage, N. D. Bettez, R. Marino, and R. W. Howarth. 2010. Nitrogen in runoff from residential roads in a coastal area. *Water Air Soil. Pollut.* 210: 3-13.
- 2009 Conley, D. J, H. W. Paerl, R. W. Howarth, D. F. Boesch, S. P. Seitzinger, K. E. Havens, C. Lancelot, & G. E. Likens. 2009. Controlling eutrophication: Nitrogen and phosphorus. *Science* 323: 1014-1015.
- Conley, D. J, H. W. Paerl, R. W. Howarth, D. F. Boesch, S. P. Seitzinger, K. E. Havens, C. Lancelot, & G. E. Likens. 2009. Reply to comments on “controlling eutrophication: nitrogen and phosphorus.” *Science* 324: 724-725.
- Boesch, D., W. Boynton, L. Crowder, R. Diaz, R. Howarth, L. Mee, S. Nixon, N. Rabalais, R. Rosenberg, J. Sanders, D. Scavia, and R. Turner. 2009. Nutrient enrichment drives Gulf of Mexico hypoxia. *Eos* 90: 117-128.
- Bringezu, S., H. Schutz, M. O’Brien, L. Kauppi, R. Howarth, and J. McNeely. 2009. Towards Sustainable Production and Use of Resources: Assessing Biofuels. International Panel for Sustainable Resource Management, United Nations Environment Program, Paris, France (<http://www.unep.fr/scp/rpanel/biofuels.htm>).
- Howarth, R. W., and S. Bringezu (eds). 2009. Biofuels: Environmental Consequences and Interactions with Changing Land Use. Proceedings of the International SCOPE Biofuels Project Rapid Assessment, 22-25 September 2008, Gummersbach Germany. Cornell University, Ithaca NY, USA. (<http://cip.cornell.edu/biofuels/>)
- Howarth, R.W., S. Bringezu, M. Bekunda, C. de Fraiture, L. Maene, L. Martinelli, O. Sala. 2009. Rapid assessment on biofuels and environment: Overview and key findings. Pages 1-13 in R.W. Howarth and S. Bringezu (eds), Biofuels: Environmental Consequences and Interactions with Changing Land Use. Proceedings

- of the International SCOPE Biofuels Project Rapid Assessment, 22-25 September 2008, Gummersbach Germany. Cornell University, Ithaca NY, USA.
(<http://cip.cornell.edu/biofuels/>)
- Howarth, R.W., S. Bringezu, L.A. Martinelli, R. Santoro, D. Messem, O.E. Sala. 2009. Introduction: biofuels and the environment in the 21st century. Pages 15- 36, in R.W. Howarth and S. Bringezu (eds) Biofuels: Environmental Consequences and Interactions with Changing Land Use. Proceedings of the International SCOPE Biofuels Project Rapid Assessment, 22-25 September 2008, Gummersbach Germany. Cornell University, Ithaca NY, USA. (<http://cip.cornell.edu/biofuels/>)
- Simpson, T.W., L.A. Martinelli, A.N. Sharpley, R.W. Howarth. 2009. Impact of ethanol production on nutrient cycles and water quality: the United States and Brazil as case studies. Pages 153-167 in R.W. Howarth and S. Bringezu (eds) Biofuels: Environmental Consequences and Interactions with Changing Land Use. Proceedings of the International SCOPE Biofuels Project Rapid Assessment, 22-25 September 2008, Gummersbach Germany. Cornell University, Ithaca NY, USA.
(<http://cip.cornell.edu/biofuels/>)
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- Marino, R. & R. W. Howarth. 2009. Nitrogen fixation. Pages 65-72 in G. E. Likens (ed.), Encyclopedia of Inland Waters. Elsevier, Oxford.
- Townsend, A. R., L. A. Martinelli, & R. W. Howarth. 2009. The global nitrogen cycle, biodiversity, and human health. Pages 159-178 in O. E. Sala, L. A. Meyerson, & C. Parmeson. Biodiveristy Change and Human Health. SCOPE #69. Island Press, Washington, DC.
- Davidson, E. A., K. E. Savage, N. D. Bettez, R. Marino, & R. W. Howarth. 2009. Nitrogen in runoff from residential roads in a coastal area. *Water Air Soil Pollution* DOI 10.1007/s11270-009-0218-2
- Entringer, R., and R. Howarth. 2009. Workshop on Atmospheric Deposition of Nitrogen - Chesapeake Bay Program Science and Technical Advisory Committee. January 8, 2009. STAC Publication 09-001.
(<http://www.chesapeake.org/stac/Pubs/atmosphericnitrogen.report.pdf>)
- 2008 Howarth, R. W. & H. Paerl. 2008. Coastal marine eutrophication: Control of both nitrogen and phosphorus is necessary. *Proceedings of National Academy of Sciences* 105: E104
- Howarth, R. W. 2008. Coastal nitrogen pollution: A review of sources and trends globally and regionally. *Harmful Algae* 8: 14-20.
- Boyer, E. W., and R. W. Howarth. 2008. Nitrogen fluxes from rivers to the coastal oceans. Pages 1565-1587 in D. Capone, D. A. Bronk, M. R. Mulholland & E. J. Carpenter (eds.), Nitrogen in the Marine Environment, 2nd Edition, Elsevier, Oxford.
- Swaney, D. P., D. Scavia, R. W. Howarth, & R. M. Marino. 2008. Estuarine classification and response to nitrogen loading: Insights from simple ecological models. *Estuarine, Coastal & Shelf Science* 77: 253-263.

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- Howarth, R. W. 2008. How important is atmospheric deposition as a source of nitrogen to coastal marine ecosystems in the northeastern United States? Pages 47-65 in A. Desbonnet and B. A Cost-Pierce (eds.), *Science of Ecosystem-Based Management*. Springer, NY.
- 2007 Davidson, E. & R. W. Howarth. 2007. Nutrients in synergy. *Nature* 449: 1000-1001.
- Gettel, G. M., A. E. Giblin, & R. W. Howarth. 2007. The effect of grazing by the snail, *Lymnae elodes*, on benthic N₂ fixation and primary production in oligotrophic, Arctic lakes. *Limnology & Oceanography* 52: 2398-2409.
- Hambright, D., N. G. Hairston, Jr., W. R. Schaffner, & R. W. Howarth. 2007. Grazer control of nitrogen fixation: Synergisms in the feeding ecology of two freshwater crustaceans. *Fundamental and Applied Limnology/Archiv fur Hydrobiologie* 170: 89-101.
- Hambright, D., N. G. Hairston, Jr., W. R. Schaffner, & R. W. Howarth. 2007. Grazer control of nitrogen fixation: Phytoplankton taxonomic composition and ecosystem functioning. *Fundamental and Applied Limnology/Archiv fur Hydrobiologie* 170: 103-124.
- Turner, R. E., N. N. Rabalais, R. B. Alexander, G. McIsaac, & R. W. Howarth. 2007. Characterization of nutrient and organic matter loads from the Mississippi River into the northern Gulf of Mexico. *Estuaries and Coasts* 30: 773-790.
- 2006 Howarth, R. W. & R. Marino. 2006. Nitrogen as the limiting nutrient for eutrophication in coastal marine ecosystems: Evolving views over 3 decades. *Limnol. Oceanogr.* 51: 364-376.

- Martinelli, L. & R. W. Howarth (eds.). 2006. Nitrogen Cycling in the Americas: Natural and Anthropogenic Influences and Controls. Springer, Dordrecht. 427 pages.
- Howarth, R. W., E. W. Boyer, R. Marino, D. Swaney, N. Jaworski, & C. Goodale. 2006. The influence of climate on average nitrogen export from large watersheds in the northeastern United States. *Biogeochemistry* 79: 163-186.
- Chapin, F. S. III, G.M Woodwell, J. Randerson, G. Lovett, D. Baldocchi, D. A. Clark, M.E. Harmon, E. Rastetter, D. Schimel, R. Valentini, C. Wirth, J. Cole, M. Goulden, J. Harden, M. Heimann, R. Howarth, P. Matson, A.D. McGuire, J. Melillo, H. Mooney, J. Neff, R. Houghton, M. Pace, M.G. Ryan, S. Running, O. Sala, W. Schlesinger & D. Schulze. 2006. Reconciling carbon cycle concepts, terminology, and methods. *Ecosystems* 9: 1041-1050.
- Martinelli, L. A, R. W. Howarth, E. Cuevas, S. Filoso, A. T. Austin, L. Donos, V. Huzsar, D. Keeney, L. L. Lara, C. LLerena, G. McIssac, E. Medina. J. Ortiz-Zaya, D. Scavia, D. W. Schindler, D. Soto & A. Townsend. 2006. Sources of reactive nitrogen affecting ecosystems in Latin America and the Caribbean: Current trends and future perspectives. *Biogeochemistry* 79: 3-234.
- Filoso, S., L. Martinelli, R. W. Howarth, E. W. Boyer & F. Dentener. 2006. Human activities changing the N cycle in Brazil. *Biogeochemistry* 79: 61-89.
- Marino, R., F. Chan, R. W. Howarth, M. L. Pace & G. E. Likens. 2006. Experimental tests of ecological constraints on planktonic nitrogen fixation in saline estuaries: 1. Nutrient and trophic controls. *Marine Ecology Progress Series* 309: 25-39.
- Chan, F., R. Marino, R., R. W. Howarth & M. L. Pace. 2006. Experimental tests of ecological constraints on planktonic nitrogen fixation in saline estuaries: 1. Mechanisms of trophic control. *Marine Ecology Progress Series* 309: 41-53.
- Joye, S. B., V. H. Smith, R. W. Howarth, R. W. Bachmann, J. E. Cloern, R. E. Hecky, & D. W. Schindler (editors). 2006. Eutrophication of Freshwater and Marine Ecosystems. *Limnol. Oceanogr.* (special issue), Vol. 51, number 1, part 2.
- Roberts, B. J. & R. W. Howarth. 2006. Nutrient and light availability regulate the relative contribution of autotrophs and heterotrophs to respiration in freshwater pelagic ecosystems. *Limnol. Oceanogr.* 51: 288-295.
- Howarth, R. W., R. Marino, D. P. Swaney & E. W. Boyer. 2006. Wastewater and watershed influences on primary productivity and oxygen dynamics in the lower Hudson River estuary. Pages 121-139 in J. S. Levinton & J. R. Waldman (eds.), *The Hudson River Estuary*, Cambridge Univ. Press.
- Howarth, R. W. 2006. Atmospheric deposition and nitrogen pollution in coastal marine ecosystems. Pages 97-116 in G. R. Visgilio & D. M. Whitelaw (eds.), *Acid in the Environment: Lessons Learned and Future Prospects*. Springer, NY.
- Boyer, E. W., R. W. Howarth., J. Galloway, F. J. Dentener, P. A. Green & C. A. Vorosmarty. 2006. Riverine nitrogen export from the continents to the coasts. *Global Biogeochemical Cycles* 20, No. 1, GB1S91, 10.1029/2005GB002537
- 2005 Howarth, R. W., K. Ramakrishna, E. Choi, R. Elmgren, L. Martinelli, A. Mendoza, W. Moomaw, C. Palm, R. Boy, M. Scholes & Zhu Zhao-Liang. 2005. Chapter 9:

- Nutrient Management, Responses Assessment. Pages 295-311 in *Ecosystems and Human Well-being, Volume 3, Policy Responses, the Millennium Ecosystem Assessment*. Island Press, Washington, DC.
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- Howarth, R. W. 2003. Human acceleration of the nitrogen cycle: Drivers, consequences, and steps towards solutions. *Water Science and Technology* 49: 7-13.
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- Howarth, R. W. 2002. Nutrient over-enrichment of coastal waters in the United States: Steps toward a solution. Pew Oceans Commission, Washington, DC.
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