

ROBERT W. HOWARTH

Department of Ecology & Evolutionary Biology
Cornell University, Ithaca, NY 14853 USA

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.
2005-Present Director, Agricultural Ecosystems Program, Cornell University.
2000-Present Adjunct Senior Scientist, Marine Biological Laboratory, Woods Hole.
1983-Present Founding Editor, *Biogeochemistry* (Editor-in-Chief, 1983-2004).
2000-2001 Senior Scientist and Oceans Program Director, 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

2007-2009 President, Coastal & Estuarine Research Federation.
2007-2009 Chair, Committee on Energy & Environment, Council of Scientific Society
Presidents.
2007-2012 Chair, International SCOPE Biofuels Project: Environmental Consequences
of Biofuels (International Council of Science).
2005-2010 Representative from the State of New York to the Scientific and Technical
Advisory Committee of the Chesapeake Bay Program.
2006-2007 Member, Gulf of Mexico Hypoxia Advisory Panel, US EPA.
2006-present Member, Oversight Board, North American Nitrogen Center.
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.
2002-2006 Member, Executive Committee and Scientific Advisory Committee,
International Nitrogen Initiative (International Council on Science).

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

Biogeochemistry and aquatic ecosystem science; global and regional nitrogen and phosphorus cycles; biotic, physical, and geochemical controls on nitrogen fixation; 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; environmental management and the effects of pollutants on aquatic ecosystems; environmental consequences of biofuels; application of science to sustaining the biosphere.

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

- 2008 Howarth, R. W. & H. Paerl. Coastal marine eutrophication: Control of both nitrogen and phosphorus is necessary. *Proceedings of the National Academy of Sciences*, in press.
- Townsend, A. & R. W. Howarth. Human acceleration of the global nitrogen cycle. *Scientific American*, in press.
- Howarth, R. W. & S. Bringezu (eds.). Biofuels: Environmental Consequences and Interactions with Changing Land Use. Report of the International SCOPE Biofuels Project. Cornell University Press, in press. (<http://cip.cornell.edu/biofuels/>)
- Howarth, R. W., S. Bringezu, L. Martinell, D. Messem & Sala. Biofuels and the environment in the 21st Century. In R. W. Howarth & S. Bringezu (eds.). Biofuels: Environmental Consequences and Interactions with Changing Land Use. Report of the International SCOPE Biofuels Project. Cornell University Press, in press. (<http://cip.cornell.edu/biofuels/>)
- Simpson, T. W., L. Martinelli, A. N. Sharpley & R. W. Howarth. Impacts of biofuel production on nutrient cycles and water quality. In R. W. Howarth & S. Bringezu (eds.). Biofuels: Environmental Consequences and Interactions with Changing Land Use Report of the International SCOPE Biofuels Project. Cornell University Press, in press. (<http://cip.cornell.edu/biofuels/>)
- Howarth, R. W. The nitrogen cycle. In G. E. Likens (ed.), *Encyclopedia of Inland Waters*. Elsevier, Oxford, in press.

- Marino, R. & R. W. Howarth. Nitrogen fixation. In G. E. Likens (ed.), *Encyclopedia of Inland Waters*. Elsevier, Oxford, in press.
- Howarth, R. W. Coastal nitrogen pollution: A review of sources and trends globally and regionally. *Harmful Algae* 8: 14-20.
- Townsend, A.R., L.A. Martinelli & R.W. Howarth. The global nitrogen cycle, biodiversity and human health. In O. Sala & C. Parmesan (eds.), *Biodiversity and Human Health*, Island Press, in press.
- Boyer, E. W., and R. W. Howarth. 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. Estuarine classification and response to nitrogen loading: Insights from simple ecological models. *Estuarine, Coastal & Shelf Science* 77: 253-263.
- Simpson, T. W., A. N. Sharpley, R. W. Howarth, H. W. Paerl & K. R. Mankin. The new gold rush: Fueling ethanol production while protecting water quality. *Journal of Environmental Quality* 37: 318-324.
- Glibert, P.A., R. Azanza, M. Burford, K. Furuya, E. Abal, A. Al-Azri, F. Al-Yamani, P. Andersen, D. Anderson, J. Beardall, G. M. Berg, L. Brand, D. Bronk, J. Brookes, J. M. Burkholder, A. Cembella, W. P. Cochlan, J. L. Collier, Y. Collos, R. Diaz, R. Doblin, T. Drennen, S. Dyhrman, Y. Fukuyo, M. Furnas, J. Galloway, E. Granéli, Dao Viet Ha, G. Hallegraeff, J. Harrison, P. J. Harrison, C. A. Heil, K. Heimann, R. Howarth, C. Jauzein, A. Kana, T. M. Kana, H. Kim, R. Kudela, C. Legrand, M. Mallin, M. Mulholland, S. Murray, J. O'Neil, G. Pitcher, Yuzao Qi, N. Rabalais, R. Raine, S. Seitzinger, P. S. Salomon, C. Solomon, D. K. Stoecker, G. Usup, J. Wilson, Kedong Yin, Mingjiang Zhou & Mingyuan Zhu. Ocean urea fertilization for carbon credits poses high ecological risks. *Marine Pollution Bulletin* 56: 1049-1056.
- Pyke, C. R., R. G. Najjar, M. B. Adams, D. Breitburg, M. Kemp, C. Hershner, R. Howarth, M. Mulholland, M. Paolisso, D. Secor, K. Sellner, D. Wardrop, and R. Wood. Climate change and the Chesapeake Bay: State-of-the-science review and recommendations. A report of the Chesapeake Bay Program Science and Technical Advisory Committee (STAC), Annapolis, MD.
- 2007 Davidson, E. & R. W. Howarth. Nutrients in synergy. *Nature* 449: 1000-1001.
- Gettel, G. M., A. E. Giblin, & R. W. Howarth. 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. 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. 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. Characterization of nutrient and organic matter loads from the Mississippi River into the northern Gulf of Mexico. *Estuaries and Coasts* 30: 773-790.
- Howarth, R. W. 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.
- 2006 Howarth, R. W. & R. Marino. 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.). *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. 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. 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. 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. 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. 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). *Eutrophication of Freshwater and Marine Ecosystems*. *Limnol. Oceanogr.* (special issue), Vol. 51, number 1, part 2.
- Roberts, B. J. & R. W. Howarth. 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. 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. 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. 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.
- Howarth, R. W. The development of policy approaches for reducing nitrogen pollution to coastal waters of the USA. *Science in China, Ser. C Life Sciences* 48: 791-806
- 2004 Boyer, E. W., R. W. Howarth, J. N. Galloway, F. J. Dentener, C. Cleveland, G. P. Asner, P. Greene, and C. Vorosmarty. Current nitrogen inputs to world regions. Pages 221-230 in A. R. Mosier, J. K. Syers & J. R. Freney (eds.), *Agriculture and the Nitrogen Cycle*. SCOPE #65. Island Press, Washington, DC.
- Galloway, J. N., F. J. Dentener, D. G. Capone, E. W. Boyer, R. W. Howarth, S. P. Seitzinger, G. P. Asner, C. Cleveland, P. A. Green, E. Holland, D. M. Karl, A. Michaels, J. H. Porter, A. Townsend & C. Vorosmarty. Nitrogen cycles: past, present, and future. *Biogeochemistry* 70: 153-226.
- Chan, F. M. Pace, R.W. Howarth & R. Marino. Bloom formation in heterocystic nitrogen-fixing cyanobacteria: The dependence of colony size and zooplankton grazing. *Limnol. Oceanogr.* 49: 2171-2178.
- David, M. B., McIsaac, G. F., Howarth, R. W., Goodale, C. L. & LE Drinkwater, L. E. Fertilizer: Complex Issue Calls for Informed Debate. *Nature* 427: 99.
- 2003 Howarth, R. W., R. Marino & D. Scavia. Priority Topics for Nutrient Pollution in Coastal Waters: An Integrated National Research Program for the United States. National Ocean Service, NOAA, Silver Spring, MD.
- Townsend, A. R., R. Howarth, F. A. Bazzaz, M. S. Booth, C. C. Cleveland, S. K. Collinge, A. P. Dobson, P. R. Epstein, E. A Holland, D. R. Keeney, M. A. Mallin, C. A. Rogers, P. Wayne & A. H. Wolfe. Human health effects of a changing global nitrogen cycle. *Frontiers in Ecology & Environment* 1: 240-246.
- Galloway, J. N., J. D. Aber, J. W. Erisman, S. P. Seitzinger, R. H. Howarth, E. B. Cowling & B. J. Cosby. The nitrogen cascade. *BioScience* 53: 341-356.
- Marino, R., R. W. Howarth, F. Chan, J. J. Cole & G. E. Likens. Sulfate inhibition of molybdenum-dependent nitrogen fixation by planktonic cyanobacteria under seawater conditions: a non-reversible effect. *Hydrobiologia* 500: 277-293.

- Howarth, R. W. Human acceleration of the nitrogen cycle: Drivers, consequences, and steps towards solutions. *Water Science and Technology* 49: 7-13.
- Austin, A., R. W. Howarth, J. S. Baron, F. S. Chapin, T. R. Christensen, E. A. Holland, M. V. Ivanov, A. Y. Lein, L. Z. Martinelli, J. M. Melillo, and Chao Shang. Human disruption of element interactions: Drivers, consequences, and trends for the 21st Century. Pages 15-45 in Melillo, J. M., C. B. Field & B. Moldan (eds.), *Interactions of the major Biogeochemical Cycles: Global Change and Human Impacts*. SCOPE #61. Island Press, Washington, DC.
- Howarth, R. W. Coastal ecosystems. Pages 65-74 in J. C. White & J. Teninko (eds.), *Acid Rain: Are the Problems Solved? American Fisheries Society Trends in Fisheries Science and Management 2*, Bethesda, MD.
- Howarth, R. W. & D. M. Rielinger. Nitrogen from the atmosphere: Understanding and reducing a major cause of degradation of our coastal waters. *Science and policy bulletin #8*, Waquoit Bay National Estuarine Research Reserve, NOAA.
- 2002 Howarth, R. W., E. W. Boyer, W. J. Pabich & J. N. Galloway. Nitrogen use in the United States from 1961-200 and potential future trends. *Ambio* 31: 88-96.
- Howarth, R. W., D. Walker & A. Sharpley. Sources of nitrogen pollution to coastal waters of the United States. *Estuaries* 25: 656-676.
- Howarth, R. W. Nutrient over-enrichment of coastal waters in the United States: Steps toward a solution. Pew Oceans Commission, Washington, DC.
- Howarth, R. W. The nitrogen cycle. Pages 429-435 in H. A. Mooney and J. G. Canadell (eds.), *Encyclopedia of Global Environmental Change. Vol. 2, the Earth System: Biological and Ecological Dimensions of Global Environmental Change*. Wiley, Chichester.
- Marino, R., F. Chan, R. Howarth, M. Pace & G. Likens. Ecological and biogeochemical interactions constrain planktonic nitrogen fixation in estuaries. *Ecosystems* 5: 719-725.
- Scavia, D., J. C. Field, Boesch, R. Buddemeier, V. Burkett, D. Cayan, M. Fogarty, M. Harwell, R. W. Howarth, C. Mason, D. J. Reed, T. C. Royer, A. H. Sallenger & J. G. Titus. Climate change impacts on US coastal and marine ecosystems. *Estuaries* 25: 149-164.
- Boyer, E. W. & R. W. Howarth (eds.). *Global and Regional Synthesis of the Nitrogen Cycle*. Kluwer, Dordrecht. 519 pages.
- Vitousek, P. M., K. Cassman, C. Cleveland, T. Crews, C. B. Field, N. B. Grimm, R. W. Howarth, R. Marino, L. Martinelli, E. B. Rastetter & J. I. Sprent. Towards an ecological understanding of biological nitrogen fixation. *Biogeochemistry* 57&58: 1-45.
- Van Breemen, N., E. W. Boyer, C. L. Goodale, N. A. Jaworski, K. Paustian, S. Seitzinger, K. Lajtha, B. Mayer, D. van Dam, R. W. Howarth, K. J. Nadelhoffer, M. Eve & G. Billen. Where did all the nitrogen go? Fate of nitrogen inputs to large watersheds in the northeastern USA. *Biogeochemistry* 57&58: 267-293.

- Seitzinger, S. P., R. V. Styles, E. W. Boyer, R. Alexander, G. Billen, R. Howarth, B. Mayer & N. van Breemen. Nitrogen retention in rivers: model development and application to watersheds in the northeastern US. *Biogeochemistry* 57&58: 199-237.
- Boyer, E. W., C. L. Goodale, N. A. Jaworski & R. W. Howarth. Anthropogenic nitrogen sources and relationships to riverine nitrogen export in the northeastern USA. *Biogeochemistry* 57&58: 137-169.
- Mayer, B., E. Boyer, C. Goodale, N. Jaworski, N. van Breemen, R. Howarth, S. Seitzinger, G. Billen, K. Lajtha, K. Nadelhoffer, D. van Dam., L. J. Hetling, M. Nosal & K. Paustian. Sources of nitrate in rivers draining sixtenn watersheds in the northeastern US: Isotopic constraints. *Biogeochemistry* 57&58: 171-197.
- 2001 Tilman D., J. Fargione, B. Wolff, C. D'Antonio, A. Dobson, R.W. Howarth, D. Schindler, W. Schlesinger, D. Simberloff & D. Swackhamer. Forecasting agriculturally driven global environmental change. *Science* 292: 281-284.
- Howarth, R. W. Hypoxia, fertilizer, and the Gulf of Mexico. *Science* 292: 1485-1486.
- 2000 Howarth, R. W., D. Anderson, J. Cloern, C. Elfring, C. Hopkinson, B. Lapointe, T. Malone, N. Marcus, K. McGlathery, A. Sharpley & D. Walker. Nutrient pollution of coastal rivers, bays, and seas. *Issues in Ecology* 7: 1-15.
- Howarth, R. W., D. Swaney, T. J. Butler & R. Marino. Climatic control on eutrophication of the Hudson River estuary. *Ecosystems* 3: 210-215.
- Tartowski, S. & R. W. Howarth. Nitrogen, nitrogen cycling. *Encyclopedia of Biodiversity*. 4: 377-388.
- Sala, O., R. Jackson, H. Mooney, and R. W. Howarth (eds.). *Methods in Ecosystem Science*, Springer, NY. 430 pages.
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- Howarth, R. W., N. Jaworski, D. Swaney, A. Townsend & G. Billen. Some approaches for assessing human influences on fluxes of nitrogen and organic carbon to estuaries. Pages 17-41 in: J. E. Hobbie (ed.), *Estuarine Synthesis: The Next Decade*. Island Press, Washington, DC.
- Fisher, T. R., D. Correll, R. Costanza, J. T. Hollibaugh, C. S. Hopkinson, R. W. Howarth, N. N. Rabalais, J. E. Richey, C. Vorosmarty & R. Wiegert. Synthesizing drainage basin inputs to coastal systems. Pages 81-101 in: J. E. Hobbie (ed.), *Estuarine Synthesis: The Next Decade*. Island Press, Washington, DC.
- Howarth, R. W. Review of "Estuary restoration and maintenance: the National Estuary Program" *Limnology & Oceanography*. 45: 1889.
- 1999 Howarth, R.W., F. Chan & R. Marino. 1999. Do top-down and bottom-up controls interact to exclude nitrogen-fixing cyanobacteria from the plankton of estuaries: explorations with a simulation model. *Biogeochemistry* 46: 203-231.
- Downing, J. A., M. McClain, R. Twilley, J. M. Melack, J. Elser, N. N. Rabalais, W. M. Lewis, R. E. Turner, J. Corredor, D. Soto, A. Yanez-Arancibia & R. W. Howarth.

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- Corredor, J.E., R. W. Howarth, R. R. Twilley & J. M. Morell. Nitrogen cycling and anthropogenic impact in the tropical inter-American seas. *Biogeochemistry* 46: 163-178.
- Howarth, R. W. & R. Marino. Oil spills: Containment and clean-up. Pages 456-458 in D. E. Alexander & R. W. Fairbridge (eds.), *Encyclopedia of Environmental Science*. Kluwer, Dordrecht.
- Swaney, D. P., R. W. Howarth & T. J. Butler. A novel approach for estimating ecosystem production and respiration in estuaries: application to the oligohaline and mesohaline Hudson River estuary. *Limnol. Oceanogr.* 44: 1509-1521.
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- 1998 Howarth, R. W. & R. Marino. A mechanistic approach to understanding why so many estuaries and brackish waters are nitrogen limited. In: *Effects of Nitrogen in the Aquatic Environment* (pages 117-136), KVA Report 1998: 1, Kungl. Vetenskapsakademien (Royal Swedish Academy of Sciences), Stockholm.
- Carpenter, S. R., N. F. Caraco, D. L. Correll, R. W. Howarth, A. N. Sharpley & V. H. Smith. Nonpoint pollution of surface waters with phosphorus and nitrogen. *Ecological Applications* 8: 559-568.
- Carpenter, S. R., N. F. Caraco, D. L. Correll, R. W. Howarth, A. N. Sharpley & V. H. Smith. Nonpoint pollution of surface waters with phosphorus and nitrogen. *Issues in Ecology* 3: 1-12.
- Sherman, R. E., T. J. Fahey & R. W. Howarth. Soil-plant interactions in a neotropical mangrove forest: iron, phosphorous, and sulfur dynamics. *Oecologia* 115: 553-563.
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- Howarth, R. W. An assessment of human influences on inputs of nitrogen to the estuaries and continental shelves of the North Atlantic Ocean. *Nutrient Cycling in Agroecosystems* 52: 213-223.
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