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Education:

- Ph.D., Ecology and Evolutionary Biology, Cornell University, Ithaca, NY, 1984
- B.S. (with high honor), Zoology, Michigan State University, East Lansing, MI, 1976

Professional Positions:

- Senior Scientist, Cary Institute of Ecosystem Studies, Millbrook, NY 2004-present
- Scientist, Institute of Ecosystem Studies, Millbrook, NY, 1997-2004
- Visiting Professor, Bard College, Annandale, NY, Spring 2004, Fall 2010
- Adjunct Professor, University at Albany, State University of New York, 1997-present
- Visiting Scholar, Ohio Northern University, Ada, OH, Fall 1996
- Associate Scientist, Institute of Ecosystem Studies, Millbrook, NY, 1997
- Assistant Scientist, Institute of Ecosystem Studies, Millbrook, NY, 1991
- Associate Member of the Graduate Faculty in Ecology, Rutgers University, New Brunswick, NJ, 1988-present
- Postdoctoral Associate, Institute of Ecosystem Studies, Millbrook, NY, 1985
- Lecturer, Biological Sciences 462, Limnology, Cornell University, Ithaca, NY, Spring 1983

Selected Professional Honors:

- L. Floyd Clarke Memorial Lecturer, University of Wyoming (2009)
- Kaeser Visiting Scholar, Center for Limnology, University of Wisconsin (2007)
- Brown and Williamson Distinguished Speaker, University of Louisville (2006)
- Fellow, American Association for the Advancement of Science (2003-)
- Outstanding Environmental Researcher of the Year, Hudson River Environmental Society (2000)
- *Parvidrilus strayeri*, the first known species of a new family of oligochaete worm, named in my honor by Christer Erséus (Proc. Biol. Soc. Wash. 112: 327-337, 1999)

Research Interests and Activities:

A group of scientists now or formerly at the Cary Institute (Nina Caraco, Jon Cole, Stuart Findlay, Mike Pace, and Emma Rosi-Marshall) has been studying the Hudson River ecosystem

for ~25 years. Currently we are focusing on two projects. We have been conducting a long-term study of the Hudson's zebra mussel population and its effects on the ecosystem. Zebra mussels, invasive bivalves from Europe, first appeared in the Hudson in 1991. Their population has been cycling since 1992, probably as a result of strong interactions between the adult mussels and their larvae (Strayer and Malcom 2006), but usually has been high enough to filter a volume of water equal to all of the water in the river every 1-4 days during the summer. Consequently, plankton populations dropped by 70-90%, and many populations of invertebrates and fish that depended on plankton fell steeply (e.g., Strayer et al. 2004, Caraco et al. 2006, Strayer 2009). We are now seeing evidence that the zebra mussel population and its effects are changing over the long term. Survival rates of zebra mussels are now only ~1% of what they were early in the invasion, perhaps because of high predation rates from crabs and fish (Carlsson and Strayer 2009, Carlsson et al. 2011, Strayer et al. 2011). Amazingly, the zebra mussel population is able to tolerate these vastly increased rates of mortality, and has scarcely declined. Nevertheless, the body size of zebra mussels now in the river has fallen, and several parts of the ecosystem are now recovering to pre-invasion levels (e.g., Strayer and Malcom 2007a, Pace et al. 2010, Strayer et al. 2011). We will continue to track the long-term dynamics of this invasion, looking in particular for evidence that the effects of zebra mussels may be moderating or changing over time.

Second, we have been working on the ecological functions of different habitats in the Hudson and other heterogeneous aquatic ecosystems. We have been working with Cornell University, the Hudson River National Estuarine Research Reserve, and New York Sea Grant to describe the distribution and ecological functions of beds of submersed aquatic vegetation (SAV) in the Hudson. These SAV beds are ecological hotspots, supporting a rich fauna of animals and high biogeochemical activity (Findlay et al. 2006, Strayer and Malcom 2007b). The importance of these roles probably has increased since the collapse of the planktonic food web with the zebra mussel invasion. Working again with the Hudson River National Estuarine Research Reserve, Stuart Findlay and I are now turning our attention to the functions performed by different kinds of shorelines (Strayer and Findlay 2010), many of which have been heavily modified by humans. The goal of our group is to encourage shoreline management practices that preserve or enhance ecological functions, while maintaining and protecting human uses and infrastructure in the shore zone.

The zebra mussel is only one of thousands of non-native species in our region and around the world. These non-native species are now recognized as one of the major influences on species and ecosystems around the world (Strayer 2010). Jonathan Jeschke and I have been trying to understand the factors that lead to the success of animal invasions. We compiled a large data set on the vertebrates of Europe and North America, and tried to correlate invasion success with biological traits, association with humans, and propagule pressure. We found that the degree of association with humans is a better predictor of invasion success than biological traits of the species (Jeschke and Strayer 2006), which is leading us to try to understand human preferences for wild species. Interestingly, the traits that favor invaders are not simply the opposite of traits that lead to imperilment of rare species (Jeschke and Strayer 2008). Our analyses also showed that establishment and spread rates of alien vertebrates have been much higher than the 10% often quoted in textbooks and the popular media (Jeschke and Strayer 2005). Jonathan and I are

now working with other invasion ecologists around the world to test some of the major hypotheses in invasion biology.

Finally, I am interested in the ecology of pearly mussels (Unionoida). Pearly mussels are abundant in rivers, streams, and lakes around the world. They probably play important ecological roles in freshwater ecosystems, support regionally and historically important fisheries, and are severely imperiled by human activities. In addition to following the long-term dynamics of pearly mussels in response to the zebra mussel invasion of the Hudson River, I have just published a critical review of the importance of multiple factors (dispersal, habitat, fish hosts, food, and predation) in controlling the distribution and abundance of these animals (*Freshwater mussel ecology: a multifactor approach to distribution and abundance*, University of California Press: <http://www.ucpress.edu/books/pages/11082.php>). We are also in the middle of a project to investigate the extent and causes of recruitment failures in mussel populations by measuring the size and age structures and reproductive status of mussel populations at sites throughout southeastern New York. We are measuring concentrations of nitrogen, dissolved oxygen, and fine sediments, along with populations of invasive crayfish to test whether these factors might be causing mussel populations to fail.

Selected Publications:

Strayer, D.L. 2011. The Hudson River: a primer to the ecology of an iconic river. University of California Press. In press.

Carlsson, N.O.L., H. Bustamante, D.L. Strayer, and M.L. Pace. 2011. Biotic resistance on the move: native predators structure invasive zebra mussel populations. *Freshwater Biology*. In press.

Strayer, D.L., N. Cid, and H.M. Malcom. 2011. Long-term changes in a population of an invasive bivalve and its effects. *Oecologia* 165: 1063-1072.

Pace, M.L., D.L. Strayer, D.T. Fischer, and H.M. Malcom. 2010. Increased mortality of zebra mussels associated with recovery of zooplankton in the Hudson River. *Ecosphere* 1(1):art3. doi:10.1890/ES10-00002.1.
(<http://www.esajournals.org/doi/full/10.1890/ES10-00002.1>)

Strayer, D.L. 2010. Alien species in fresh waters: ecological effects, interactions with other stressors, and prospects for the future. *Freshwater Biology* 55 (Supplement 1): 152-174.
(<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2427.2009.02380.x/pdf>)

Strayer, D.L., and D. Dudgeon. 2010. Freshwater biodiversity conservation: recent progress and future challenges. *Journal of the North American Benthological Society* 29: 344-358. (<http://www.bioone.org/doi/full/10.1899/08-171.1>)

Strayer, D.L., and S.E.G. Findlay. 2010. The ecology of freshwater shore zones. *Aquatic Sciences* 72: 127-163.
(<http://www.springerlink.com/content/147526m7134jnt48/fulltext.pdf>)

- Carlsson, N.O.L., and D.L. Strayer. 2009. Intraspecific variation in the consumption of exotic prey – a mechanism that increases biotic resistance against invasive species? *Freshwater Biology* 54: 2315-2319.
- Carlsson, N.O.L., O. Sarnelle, and D.L. Strayer. 2009. Native predators and exotic prey – an acquired taste? *Frontiers in Ecology and the Environment* 7: 525-532.
- Strayer, D.L. 2009. Twenty years of zebra mussels: lessons from the mollusk that made headlines. *Frontiers in Ecology and the Environment* 7: 135-141.
- Strayer, D.L. 2009. Benthic invertebrate fauna, lakes and reservoirs. Pages 191-204 *In: G.E. Likens (editor). Encyclopedia of Inland Waters, Volume 2. Elsevier.*
- Strayer, D.L. 2008. Freshwater mussel ecology: a multifactor approach to distribution and abundance. University of California Press. 204 pp.
- Kelly, V.R., G.M. Lovett, K.C. Weathers, S. Findlay, D.L. Strayer, D.J. Burns, and G.E. Likens. 2008. Long-term sodium chloride retention in a rural watershed – legacy effects of road salt on streamwater concentration. *Environmental Science and Technology* 42: 410-415.
- Strayer, D.L., M.L. Pace, N.F. Caraco, J.J. Cole, and S.E.G. Findlay. 2008. Hydrology and grazing jointly control a large-river food web. *Ecology* 89: 12-18.
- Newton, T.J., D.A. Woolnough, and D.L. Strayer. 2008. Using landscape ecology to understand freshwater mussel populations. *Journal of the North American Benthological Society* 27: 424-439.
- Strayer, D.L. 2008. A new widespread morphological deformity in freshwater mussels from New York. *Northeastern Naturalist* 15: 149-151.
- Jeschke, J.M., and D.L. Strayer. 2008. Are threat status and invasion success two sides of the same coin? *Ecography* 31: 124-130.
- Jeschke, J.M., and D.L. Strayer. 2008. Usefulness of bioclimatic models for studying climate change and invasive species. *Annals of the New York Academy of Sciences (The Year in Ecology and Conservation Biology)* 1134: 1-24.
- Strayer, D.L., and H.M. Malcom. 2007. Submersed vegetation as habitat for invertebrates in the Hudson River estuary. *Estuaries and Coasts* 30: 253-264.
- Strayer, D.L., and H.M. Malcom. 2007. Shell decay rates of native and alien freshwater bivalves and implications for habitat engineering. *Freshwater Biology* 52: 1611-1617.

- Meyer, J.L., D.L. Strayer, J.B. Wallace, S.L. Eggert, G.S. Helfman, and N.E. Leonard. 2007. The contribution of headwater streams to biodiversity in river networks. *Journal of the American Water Resources Association* 43: 86-103.
- Strayer, D.L., and H.M. Malcom. 2007. Effects of zebra mussels (*Dreissena polymorpha*) on native bivalves: the beginning of the end or the end of the beginning? *Journal of the North American Benthological Society* 26: 111-122.
- Waldman, J.R., K.E. Limburg, and D.L. Strayer (editors). 2006. Hudson River fishes and their environment. *American Fisheries Society Symposium* 51. 365 pp.
- Corey, C.A., R. Dowling, and D.L. Strayer. 2006. Display behavior of *Ligumia* (Bivalvia: Unionidae). *Northeastern Naturalist* 13: 319-332.
- Jeschke, J.M., and D.L. Strayer. 2006. Association with humans predicts invasion success of vertebrates. *Global Change Biology* 12: 1608-1619.
- Strayer, D.L. 2006. Challenges for freshwater invertebrate conservation. *Journal of the North American Benthological Society* 25: 271-287. (Rosemary Mackay Fund article)
- Strayer, D.L., V.T. Eviner, J.M. Jeschke, and M.L. Pace. 2006. Understanding the long-term effects of species invasions. *Trends in Ecology and Evolution* 21: 645-651.
- Strayer, D.L., H.M. Malcom, R.E. Bell, S. Carbotte, and F. Nitsche. 2006. Combining geophysical and biological information to define benthic habitats in the Hudson River. *Freshwater Biology* 51: 25-38.
- Strayer, D.L., and H.M. Malcom. 2006. Long-term demography of a zebra mussel (*Dreissena polymorpha*) population. *Freshwater Biology* 51: 117-130.
- Strayer, D.L. 2006. Alien species in the Hudson River. Pages 296-310 *In*: J.S. Levinton and J.R. Waldman (eds.). *The Hudson River estuary*. Cambridge University Press.
- Strayer, D.L. 2006. The benthic animal communities of the tidal-freshwater Hudson River estuary. Pages 266-278 *In*: J.S. Levinton and J.R. Waldman (eds.). *The Hudson River estuary*. Cambridge University Press.
- Strayer, D.L., E.A. Blair, N.F. Caraco, J.J. Cole, S. Findlay, W.C. Nieder, and M.L. Pace. 2005. Interactions between alien species and restoration of large-river ecosystems. *Archiv für Hydrobiologie Supplementband* 155: 133-145.
- Doyle, M.W., E.H. Stanley, D.L. Strayer, R.B. Jacobson, and J.C. Schmidt. 2005. Dominant discharge analysis of ecological processes in streams. *Water Resources Research* 41: article number W11411 (16 pages).

- Strayer, D.L. 2005. Challenges in understanding the functions of ecological heterogeneity. Pages 411-425 *In*: G.M. Lovett, C.G. Jones, M.G. Turner, and K.C. Weathers (eds). Ecosystem function in heterogeneous landscapes. Springer-Verlag.
- Jeschke, J., and D.L. Strayer. 2005. Invasion success of vertebrates in Europe and North America. *Proceedings of the National Academy of Sciences* 102: 7198-7202.
- Strayer, D.L., J.A. Downing, W.R. Haag, T.L. King, J.B. Layzer, T.J. Newton, and S.J. Nichols. 2004. Changing perspectives on pearly mussels, North America's most imperiled animals. *BioScience* 54: 429-439.
- Strayer, D.L., K. Hattala, and A. Kahnle. 2004. Effects of an invasive bivalve (*Dreissena polymorpha*) on fish populations in the Hudson River estuary. *Canadian Journal of Fisheries and Aquatic Sciences* 61: 924-941.
- Strayer, D.L., C. Lutz, H.M. Malcom, K. Munger, and W.H. Shaw. 2003. Invertebrate communities associated with a native (*Vallisneria americana*) and an alien (*Trapa natans*) macrophyte in a large river. *Freshwater Biology* 48: 1938-1949.
- Strayer, D.L., H. Ewing, and S. Bigelow. 2003. What kinds of spatial and temporal detail are required in models of heterogeneous systems? *Oikos* 102: 654-662.
- Strayer, D.L., M.E. Power, W.F. Fagan, S.T.A. Pickett, and J. Belnap. 2003. A classification of ecological boundaries. *BioScience* 53: 723-729.
- Meyer, J.L., L.A. Kaplan, D. Newbold, D.L. Strayer, C.J. Woltemade, J.B. Zedler, R. Beilfuss, Q. Carpenter, R. Semlitsch, M.C. Watzin, and P.H. Zedler. 2003. Where rivers are born: the scientific imperative for defending small streams and wetlands. *American Rivers and the Sierra Club*, Washington, DC. 23 pp.
- Strayer, D.L., R.E. Beighley, L.C. Thompson, S. Brooks, C. Nilsson, G. Pinay, and R.J. Naiman. 2003. Effects of land-cover change on stream ecosystems: roles of empirical models and scaling issues. *Ecosystems* 6: 407-423.
- Strayer, D.L., and D.R. Smith. 2003. A guide to sampling freshwater mussel populations. *American Fisheries Society Monograph* 8: 1-103.
- Strayer, D.L., and L.C. Smith. 2001. The zoobenthos of the freshwater tidal Hudson River and its response to the zebra mussel (*Dreissena polymorpha*) invasion. *Archiv für Hydrobiologie Supplementband* 139: 1-52.
- Strayer, D.L. 2001. Endangered freshwater invertebrates. Pages 425-439 *In*: S.A. Levin (editor). *Encyclopedia of biodiversity*, Volume 2. Academic Press.
- Strayer, D.L., and J.W. Reid. 1999. Distribution of hyporheic cyclopoids (Crustacea: Copepoda) in the eastern United States. *Archiv für Hydrobiologie* 145: 79-92.

- Strayer, D.L. 1999. Use of flow refuges by unionid mussels in rivers. *Journal of the North American Benthological Society* 18: 468-476.
- Strayer, D.L. 1999. The statistical power of presence-absence data to detect population declines. *Conservation Biology* 13: 1034-1038.
- Strayer, D.L., and A.R. Fetterman. 1999. Changes in the distribution of freshwater mussels (Unionidae) in the upper Susquehanna River basin, 1955-1997. *American Midland Naturalist* 142: 328-339.
- Strayer, D.L., N.F. Caraco, J.J. Cole, S. Findlay, and M.L. Pace. 1999. Transformation of freshwater ecosystems by bivalves: a case study of zebra mussels in the Hudson River. *BioScience* 49: 19-27.
- Strayer, D.L. 1999. Effects of alien species on freshwater mollusks in North America. *Journal of the North American Benthological Society* 18: 74-98.
- Strayer, D.L., S.E. May, P. Nielsen, W. Wollheim, and S. Hausam. 1997. Oxygen, organic matter, and sediment granulometry as controls on hyporheic animal communities. *Archiv für Hydrobiologie* 140: 131-144.
- Caraco, N.F., J.J. Cole, P.A. Raymond, D.L. Strayer, M.L. Pace, S.E.G. Findlay, and D.T. Fischer. 1997. Zebra mussel invasion in a large, turbid river: phytoplankton response to increased grazing. *Ecology* 78: 588-602.
- Strayer, D.L., and K.J. Jirka. 1997. The pearly mussels of New York state. *Memoirs of the New York State Museum* 26: 1-113 + 27 plates.
- Strayer, D.L., and L.C. Smith. 1996. Relationships between zebra mussels (*Dreissena polymorpha*) and unionid clams during the early stages of the zebra mussel invasion of the Hudson River. *Freshwater Biology* 36: 771-779.
- Strayer, D.L., S. Claypool, and S. Sprague. 1997. Assessing unionid populations with quadrats and timed searches. pp. 163-169 In: K.S. Cummings, A.C. Buchanan, C.A. Mayer, and T.J. Naimo (eds). *Conservation and management of freshwater mussels II. Initiatives for the future*. Upper Mississippi River Conservation Committee.
- Mills, E.L., D.L. Strayer, M.D. Scheuerell, and J.T. Carlton. 1996. Exotic species in the Hudson River basin - a history of invasions and introductions. *Estuaries* 19: 814-823.
- Strayer, D.L., J. Powell, P. Ambrose, L.C. Smith, M.L. Pace, and D.T. Fischer. 1996. Arrival, spread, and early dynamics of a zebra mussel (*Dreissena polymorpha*) population in the Hudson River estuary. *Canadian Journal of Fisheries and Aquatic Sciences* 53: 1143-1149.

- Strayer, D.L., S. Sprague, and S. Claypool. 1996. A range-wide assessment of populations of *Alasmidonta heterodon*, an endangered freshwater mussel (Bivalvia: Unionidae). *Journal of the North American Benthological Society* 15: 308-317.
- Strayer, D.L., May, S.E., Nielsen, P., Wollheim, W., and S. Hausam. 1995. An endemic groundwater fauna in unglaciated eastern North America. *Canadian Journal of Zoology* 73: 502-508.
- Strayer, D.L. Hunter, D.C., Smith, L.C., and C. Borg. 1994. Distribution, abundance, and role of freshwater clams (Bivalvia: Unionidae) in the freshwater tidal Hudson River. *Freshwater Biology* 31: 239-248.
- Strayer, D.L. 1994. Limits to biological distributions in groundwater. pp. 287-310 In: J. Gibert, D. Danielopol, and J. Stanford (eds.). *Groundwater ecology*. Academic Press, San Diego.
- Strayer, D.L., and L.C. Smith. 1993. The distribution of the zebra mussel *Dreissena polymorpha* in estuaries and brackish waters. pp. 715-727 In: T.F. Nalepa and D.W. Schloesser (eds.). *Zebra mussels: biology, impact, and control*. Lewis Publishers, Ann Arbor.
- Strayer, D.L., and J. Ralley. 1993. Microhabitat use by an assemblage of stream-dwelling unionaceans (Bivalvia), including two rare species of *Alasmidonta*. *Journal of the North American Benthological Society* 12: 247-258.
- Strayer, D.L. 1993. Macrohabitats of freshwater mussels (Bivalvia: Unionacea) in streams of the northern Atlantic Slope. *Journal of the North American Benthological Society* 12: 236-246.
- Strayer, D. 1991. Projected distribution of the zebra mussel, *Dreissena polymorpha*, in North America. *Canadian Journal of Fisheries and Aquatic Sciences* 48: 1389-1395.
- Strayer, D. 1991. Perspectives on the size structure of the lacustrine zoobenthos, its causes, and its consequences. *Journal of the North American Benthological Society* 10: 210-221.
- Strayer, D. 1991. Notes on Lindeman's progressive efficiency. *Ecology* 72: 348-350.
- Strayer, D. 1988. On the limits to secondary production. *Limnology and Oceanography* 33:1217-1220.
- Strayer, D., and G.E. Likens. 1986. An energy budget for the zoobenthos of Mirror Lake, New Hampshire. *Ecology* 67:303-313.
- Strayer, D. 1986. The size structure of a lacustrine zoobenthic community. *Oecologia* 69:513-516.

Strayer, D. 1985. The benthic micrometazoans of Mirror Lake, New Hampshire. *Archiv für Hydrobiologie Supplementband* 72:287-426.

Strayer, D. 1983. The effects of surface geology and stream size on freshwater mussel distribution in southeastern Michigan, USA. *Freshwater Biology* 13:253-264.