

Lauren A. Patterson

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Summary

I am motivated by the bringing together data and information to develop analytical approaches to understand and address current public policy challenges. I value communicating these solutions through written, visual, and interactive tools as a means to facilitate new perspectives and conversations.

Education

Ph.D. | 2012 | Geography | University of North Carolina – Chapel Hill

Geographic Information Systems Certificate | 2009 | UNC Chapel Hill

M.A. | 2007 | Geography | University of North Carolina – Chapel Hill

B.S. | 2004 | Earth Science (summa cum laude) | Purdue University

Experience

SENIOR WATER POLICY ASSOCIATE | NICHOLAS INSTITUTE FOR ENVIRONMENTAL POLICY SOLUTIONS, DUKE UNIVERSITY | 2017-PRESENT

- Manage projects and develop analyses and communication platforms. Two projects illustrate the range of activities. First, I cofounded the [Internet of Water](#) project with Martin Doyle from proposal writing, to strategic planning, to communications planning and web development, to recruiting and hiring an Executive Director and Advisory Board, and to creating content and tools. Second, a long-term project with the Army Corp of Engineers involved data collection, synthesis, analysis, and the development of [interactive visualization tools](#). I am also responsible for managing teams of students working on these projects, as well as advising students in their master's work.

WATER POLICY ASSOCIATE | NICHOLAS INSTITUTE FOR ENVIRONMENTAL POLICY SOLUTIONS, DUKE UNIVERSITY | 2013-2017

- Collaborate on a wide spectrum of projects to develop innovative solutions related to infrastructure, financing, ecosystem services, energy, and climate change. Several projects involved working with a group formed under the Science for Nature and People Partnership through the National Center for Ecological Analysis and Synthesis on the impact of hydraulic fracturing on water resources and policy recommendations. Activities largely focused on analyzing data, producing reports, and developing interactive data visualization tools to inform decision-making.

ENVIRONMENTAL SCIENTIST | GREENE RESOURCES CONTRACTED AT RESEARCH TRIANGLE INTERNATIONAL, RTI | 2012-2013

- Developed an analytic approach to determining ecological flows from fish and benthic data, and created reports and presentations for the Ecological Flows Scientific Advisory Board in North Carolina.

HYDROLOGIC ANALYST | RESEARCH ASSISTANT, UNC – DEPARTMENT OF GEOGRAPHY | 2011-2012

- Led statistical analysis of climate and streamflow trends in the South Atlantic for Corps of Engineers. Explored contribution of human and climate components to changes in streamflow. Designed methods to model water system interconnection capacities to distribute water under historic drought events.

GIS & FINANCIAL ANALYST | ENVIRONMENTAL FINANCE CENTER, UNC – SCHOOL OF GOVERNMENT | 2008-2011, SUMMER 2012

- Developed interactive dashboards exploring rates for water, wastewater, and stormwater utilities. I also collected and developed tools to assist local governments in generating sustainable watershed protection revenue for the Nature Conservancy. My GIS skills were used to model the potential for interconnections between community water systems for the North Carolina Department of Natural Resources.

GIS ANALYST | ORISE INTERNSHIP | OAK RIDGE NATIONAL LABORATORY COMPUTATIONAL SCIENCES AND ENGINEERING DIVISION | 2004-2005, SUMMER 2006

- Participated in the data collection and quality control for high resolution geospatial demographic models (LandScan). Research how LandScan could be applied to hazard preparation, as well as population dispersal following natural and manmade disasters.

RESEARCH ASSISTANT | PURDUE UNIVERSITY | 2000-2002, 2004

- Development of website resource for faculty teaching assessments and evaluations in cooperation with the Discovery Learning Center. Participated in fieldwork and data analysis examining potential sources of *E. coli* in Lake Shafer, IN. Developed and distributed middle school curriculum that met state education standards while centered on local water quality issues.

Technical Skills

DATA TOOLS: GitHub | Excel | JavaScript | Python | Rcran | SAS | SQL

GEOSPATIAL TOOLS: ArcGIS 10 | ArcInfo Workstation | ArcView | Hawth's Geospatial Modeling Environment | Visual Basic Scripting

VISUALIZATION TOOLS: Java Script | HTML5 | RMarkdown | RShiny | Tableau | Xcelcius

WATER POLICY: Army Corps reservoir operations | Ecological flows | Flood and drought extremes | Inter-basin transfers | Unconventional oil and gas | Watershed financing | Water data infrastructure | Water utilities

Peer Reviewed Publications

25. Doyle, M.W. and L.A. Patterson. 2019. Federal Decentralization and Adaptive Management: Reservoir Reallocation by the U.S. Army Corps of Engineers. *JAWRA*. 20 pp. doi: 10.1111/1752-1688.12767.
24. Patterson, L.A. and M.W. Doyle. 2019. Managing Rivers under Changing Environmental and Societal Boundary Conditions, Part 1: National Trends and U.S. Army Corps of Engineers Reservoirs. *River Research and Applications*. 14 pp. doi: <https://doi.org/10.1002/rra.3418>
23. Patterson, L.A., M. Tchamkina, and M.W. Doyle. 2019. Managing Rivers under Changing Environmental and Societal Boundary Conditions, Part 2: Expected versus Experienced Conditions at U.S. Army Corps of Engineers Reservoirs. *River Research and Applications*. 12pp. doi: <https://doi.org/10.1002/rra.3419>.
22. Patterson, L.A. and M.W. Doyle. 2018. A Nationwide Analysis of U.S. Army Corps of Engineers Reservoir Performance in Meeting Operational Targets. *Journal of the American Water Resources Association (JAWRA)* 1-22, doi: 10.1111/1752-1688.12622.
21. Entrekin, S. A. Trainor, J. Saiers, L. Patterson, K. Maloney, J. Fargione, J. Kiesecker, S. Baruch-Mordo, J.P. Nicot, K. Konschnik, H. Wiseman and J. Ryan. 2018. Water stress from high volume hydraulic fracturing threatens aquatic biodiversity and ecosystem services in Arkansas, U.S.A. *ES&T*, doi: 10.1021/acs.est.7b03304
20. Jordaan, S.M., Patterson, L.A., and L. Diaz Anadon. 2018. A spatially-resolved inventory of the water consumed by the coal-to-gas transition of Pennsylvania. *Journal of Cleaner Production*
19. Patterson, L., K. Konschnik, H. Wiseman, J. Fargione, K. Maloney, J. Kiesecker, J.P. Nicot, S. Baruch-Mordo, S. Entrekin, A. Trainor, J. Saiers. 2017. Unconventional oil and gas spills: Risks, mitigation priorities and state reporting requirements. *ES&T* 51 (5): 2563-2573, doi: 10.1021/acs.est.6b05749.
18. Maloney, K.O., S. Baruch-Mordo, L. Patterson, J.P. Nicot, S. Entrekin, J. Fargione, J. Kiesecker, K. Konschnik, J. Ryan, A. Trainor, J. Saiers, H. Wiseman. 2017. Unconventional oil and gas spills: materials, volumes and risks to surface waters in four states of the U.S. *Total Science* 581-582, pp 369-377, doi: <http://dx.doi.org/10.1016/j.scitotenv.2016.12.142>
17. Patterson, L., J. Phelan, C. Goudreau, and T. Cuffney. 2017. Flow-Biology Relationships Based on Fish Habitat Guild in North Carolina. *Journal of American Water Resources Association* 53 (1), 56-66; doi: 10.1111/1752-1688.12495.

16. Phelan, J., T. Cuffney, L. Patterson, M. Eddy, S. Pearsall, R. Dykes, C. Goudreau, J. Meade, and F. Tarver. 2017. Fish and Invertebrate Flow-Biology Relationships to Support the Determination of Ecological Flows for North Carolina. *Journal of American Water Resources Association* 53 (1), 42-55; doi: 10.1111/1752-1688.12497.
15. Eddy, M.C., Phelan, J., L. Patterson, J. Allen and S. Pearsall. 2017. Evaluating Flow-Metric Based Stream Classification Systems to Support the Determination of Ecological Flows in North Carolina. *Journal of American Water Resources Association* 53 (1), 30-41; doi: 10.1111/1752-1688.12498.
14. Patterson, L. and K.O. Maloney. 2016. Transport of hydraulic fracturing waste from Pennsylvania wells: A county-level analysis of road use and associated road repair costs. *Journal of Environmental Management* 181, pg 353-362, doi: 10.1016/j.jenvman.2016.06.048.
13. Doyle, M.W., L. Patterson, Y. Chen, K. Schnier, and A.J. Yates. 2014. The Optimal Scale For Water Quality Trading. *Water Resources Research*, 50, doi:10.1002/2014WR015395
12. Patterson, L., B. Lutz, and M.W. Doyle. 2013. Climate and Direct Human Contributions to Changes in Mean Annual Streamflow in the South Atlantic, U.S. *Water Resources Research* 49, 7278-7291, doi: 10.1002/2013WR014618
11. Patterson, L., B. Lutz, and M.W. Doyle. 2013. Characterization of Drought in the South Atlantic, United States. *Journal of American Water Resources Association* 1-13, doi: 10.1111/jawr.12090.
10. Patterson, L., B. Lutz, and M.W. Doyle. 2012. Streamflow changes in the South Atlantic, USA during the Mid and Late 20th Century. *Journal of American Water Resources Association* 48 (6): 1126-1138, doi: 10.1111/j.1752-1688.2012.00674.x
9. Patterson, L., G. Barnes, J. Hughes and S. Berhazer. 2012. A Question of Boundaries: Revenuesheds for Watershed Protection and Sustainable Financial Planning. *Journal of American Water Resources Association* 48 (4): 838-848.
8. Patterson, L. and M.W. Doyle. 2011. Hypsographic demography across scale. *The Professional Geographer* 63 (4): 514-530.
7. Patterson, L., M. Urban, A. Myers, B. Bhaduri, E. Bright and P. Coleman. 2009. Effects of Quality Control on Decreasing Error Propagation in the LandScan USA Population Distribution Model: A Case Study of Philadelphia County. *Transactions in GIS* 13: 215-228.
6. Patterson, L. and M.W. Doyle. 2009. Assessing effectiveness of flood policy application through spatiotemporal monitoring of socioeconomic exposure. *Journal of the American Water Resources Association* 45 (2): 237-252.
5. Xue, J., T. McCurdy, J. Burke, B. Bhaduri, C. Liu, J. Nutaro, and L. Patterson. 2009. Analysis of School Commuting Data for Exposure Modeling Purposes. *Journal of Exposure Science and Environmental Epidemiology*: 1-10.
4. Patterson, L., M. Urban, A. Myers, B. Bhaduri, E. Bright and P. Coleman. 2007. Assessing Spatial and Attribute Errors in Large National Datasets for Population Distribution Models: A Case Study of Philadelphia County Schools. *GeoJournal* 69: 93-102.
3. Myers, A., L. Patterson and M. Minner. 2005. LandScan USA: Searching High and Low, Day and Night. ESRI 2006 Map Book, Volume 1, Map #273.
2. Patterson, L. and J. Harbor. 2005. Using assessment to evaluate and improve inquiry-based geoenvironmental science activities: Case study of a middle school watershed *E. coli* investigation. *Journal of Geoscience Education* 53: 204-215.
1. Debroka, K., J. Frankenberger, J. Harbor, L. Patterson, D. Frasier, R. Turco, G. Thomas, C. Nakatsu, S. Brouder, and A. Bhunia. 2001. GIS and Streamflow Analysis to Support *E. coli* Source Identification. The Society for Engineering in Agricultural, Food, and Biological Systems Meeting Paper No. 01-2138. St. Joseph, Mich.: ASAE.

Data Visualization Tools

11. U.S. Army Corps of Engineers Reservoir Reallocations Tool | 2019 | <https://nicholasinstitute.duke.edu/reservoir-reallocation/>

10. Expected Compared with Experienced Conditions at Nine U.S. Army Corps of Engineers Reservoirs | 2019 | <https://nicholasinstitute.duke.edu/reservoir-comparison/>
9. Trends Across the Nation | 2019 | <https://nicholasinstitute.duke.edu/reservoir-national-trends/>
8. Developed Wireframes and Web Content for the Internet of Water | 2019 | <https://internetofwater.org/>
7. Visualizing U.S. Army Corps of Engineers Reservoir Data | 2018 | <https://nicholasinstitute.duke.edu/reservoir-data/>
6. Visualizing Spills Data from Unconventional Oil and Gas Activity | 2017 | <http://snappartnership.net/groups/hydraulic-fracturing/webapp/spills.html>
5. Visualizing Road Impacts from Transportation of Hydraulic Fracturing Waste from Pennsylvania Wells | 2016 | <https://nicholasinstitute.duke.edu/transportation-of-hydraulic-fracturing-waste/>
4. Visualizing Changes in Water Consumption During the Pennsylvania Coal-to-Gas Transition | 2016 | <https://nicholasinstitute.duke.edu/hydraulic-fracturing/>.
3. Interactive Map of Community Water System Interconnections in North Carolina | 2011 | <https://efc.sog.unc.edu/resource/interactive-map-community-water-system-interconnections-north-carolina>. (Since updated)
2. Dashboard for Capacity for Watershed Protection Investment | 2011 | *Environmental Finance Center at UNC*. <https://efc.sog.unc.edu/resource/capacity-watershed-protection-investment-dashboard>.
1. North Carolina Stormwater Utility Dashboard | 2010 | *Environmental Finance Center at UNC*. (Since updated).

Other Publications

14. Patterson, LA. 2019. Series of short articles around the value of water data and data stories (four).
13. Patterson, L.A., M.W. Doyle, G. Gershuny, and D. Monsma. Reaching Watershed Scale Through Cooperation and Integration: A Report from the 2018 Aspen-Nicholas Water Forum.
12. Doyle, M.W. and L.A. Patterson. 2018. Our nearby dams worked after Florence. But someday they won't. *News and Observer*. <https://www.newsobserver.com/opinion/article219009555.html>
11. Patterson, Lauren A., M.W. Doyle, and S. Kuzma. 2018. *Creating Data as a Service for U.S. Army Corps of Engineers Reservoirs*. NI R 18-01. Durham, NC: Duke University. <http://nicholas.institute.duke.edu/publications>.
10. Patterson, L.A., M.W. Doyle, and D. Monsma. The Future of Groundwater: A Report from the 2017 Aspen-Nicholas Water Forum. <https://www.aspeninstitute.org/publications/future-of-groundwater/>
9. Doyle, M. and L. Patterson. 2017. Imagine an Internet of Water. *Aspen Journal of Ideas*. August 8, 2017. <https://www.aspeninstitute.org/aspen-journal-of-ideas/imagine-internet-water/>
8. Gardner, J., M. Doyle, and L. Patterson. 2017. Estimating the Value of Public Water Data. Working Paper: NI WP 17-05, Nicholas Institute for Environmental Policy Solutions. <https://nicholasinstitute.duke.edu/water/publications/estimating-value-public-water-data>
7. Patterson, L., M. Doyle, K. King, and D. Monsma. 2017. INTERNET OF WATER: Sharing and Integrating Water Data for Sustainability. A Report from the Aspen Institute Dialogue Series on Water Data. <https://www.aspeninstitute.org/publications/internet-of-water/>
6. Patterson, L.A., M. Doyle, and N. Buckley. 2016. Conservation Finance & Impact Investing for U.S. Water: A Report from the 2016 Aspen-Nicholas Water Forum. <https://www.aspeninstitute.org/publications/2016-aspen-nicholas-water-forum-report/>
5. Patterson, L., S.M. Jordaan, and L. Diaz-Anadon. 2016. A Spatiotemporal Exploration of Water Consumption Changes Resulting from the Coal to Gas Transition in Pennsylvania. White Paper Published Jointly with the Nicholas Institute for Environmental Policy Solutions: Duke and the Belfer Center for Science and International Affairs: Harvard. <https://nicholasinstitute.duke.edu/water/publications/spatiotemporal-exploration-water-consumption-changes-resulting-coal-gas-transition>

4. Patterson, L. and M.W. Doyle. June 26, 2015. Water and big data: 21st century solution to 21st century droughts. *Contra Costa Times*, Op-Ed. http://www.contracostatimes.com/opinion/ci_28383807/guest-commentary-water-and-big-data-21st-century
3. Patterson, L and S. Eskaf. (2011) Assessment of Current and Potential Water System Interconnections in North Carolina. Environmental Finance Center at the University of North Carolina. Informal report to the North Carolina Department of Natural Resources Public Water Supply Section and the US Environmental Protection Agency: pp 165.
2. Bhaduri, B., C. Liu, J. Nutaro, and L. Patterson. Dec. 2008. Geospatial Modeling and Simulation Based Approach for Developing Commuting Patterns of School Children. CSI Communications
1. Doyle, M. and L. Patterson. Sept. 4, 2008. N.C. overflows with flood risk. News and Observer, Op-Ed <http://www.newsobserver.com/opinion/editorials/story/1205659.html>

Professional Distinctions

MORRIS K. UDALL FELLOWSHIP | 2011-2012 | Environmental Public Policy & Conflict Resolution Ph.D. Dissertation Completion Fellowship

NATIONAL PERISHIP AWARD | 2011 | Dissertation Fellowships in Hazards, Risk, and Disasters

BOGGESS AWARD | 2010 | American Water Resources Association [in honor of the author of the best paper published in the *Journal of the American Water Resources Association*]

JEANNE X. KASPERSON AWARD | 2008 | Association of American Geographers Hazards Specialty Group Student Paper Award

GRADUATE EDUCATION ADVANCEMENT BOARD IMPACT AWARD | 2008 | University of North Carolina [in recognition of research that has a direct impact on citizens of North Carolina]

NATIONAL SCIENCE FOUNDATION GRADUATE RESEARCH FELLOWSHIP | 2005 - 2008

GRADUATE SCHOOL UNIVERSITY MERIT ASSISTANTSHIP | 2005 | University of North Carolina

GRADUATE SCHOOL SCHOLARS OF TOMORROW FELLOWSHIP | 2005 | University of North Carolina

OUTSTANDING SENIOR IN SCHOOL OF SCIENCE | 2004 | Purdue University

BARRY M. GOLDWATER NATIONAL SCHOLARSHIP | 2002

ALPHA LAMBDA DELTA NATIONAL SCHOLARSHIP | 2002

Awarded Proposals

Martin Doyle and Lauren Patterson were awarded over \$2.9 million to launch the Internet of Water project. Funding to date has come from seven philanthropic foundations.

Contracted by the Aspen Institute to rapporteur and create summaries from Internet of Water roundtable events. These will become an addendum to the original Internet of Water report.

Contracted by the US Army Corps of Engineers Institute for Water Resources to work on the Project: Source Attribution of Reservoir Departures, 2017-2018.

Nicholas School (Duke) Grant in Environmental Innovation and Entrepreneurship to develop a Water Risk Assessment Tool. Summer 2016.

Contracted by the US Army Corps of Engineers Institute for Water Resources to work on the project: Corps-Climate. 2015 – 2016.

Contracted by The Nature Conservancy to work on the Science for People and Nature project: Impacts of hydraulic fracturing on water quantity and quality for nature and people: Are we prepared for the future? 2015 - 2016.

Contracted by the Environmental Finance Center at UNC Chapel Hill to work on the project: Water Fund on the Cape Fear: Financial Considerations. 2013

Graduate Students Advised

Dennis Lee and Felipe Amadori | 2019-2020 | Master of Environmental Management. Water Risk Assessment & Strategy.

Melissa Stine | 2018-2019 | Master of Environmental Management. Assessing Utility Water Risk for Industry.

Samantha Kuzma | 2016-2017 | Master of Environmental Management. Integrated Water Finance Solutions to Drought in the Yakima Basin: Recommendations for the Yakima Drought Relief Pumping Plant (YDRPP).

Mary Tchamkina | 2015-2016 | Master of Environmental Management. Evaluating Need for Adaptation for U.S. Army Corps of Engineers Wilmington District Reservoirs.

Mark Ziman | 2015-2016 | Master of Environmental Management. Data Intelligence for Improved Water Resource Management.

Courses Taught

Co-taught a Water Data Boot Camp in Spring 2018 with John Fay. The course was voluntary (taught in three 3-hour segments). It was designed for students to work through the entire data life cycle of: problem identification, data collection, data management, data analysis, and communication. Students were exposed to a variety of tools such including excel, R Studio, Python, Jupyter Notebooks, and Tableau.

An occasional lecture given on unconventional oil and gas, reservoir operations, and flood data/policy.

Committee Service

CUAHSI PROGRAM COMMITTEE | 2018-2019

- Serving on the program committee for the 2019 CUAHSI Conference on Hydroinformatics

THE WATER DATA COLLABORATIVE | 2017-2019

- The Pisces Foundation created a steering committee for the purposes of creating a framework and process from citizen scientist data collection, to data management and sharing, to the analysis and communication of those data as information that impacts decision-making.

TEXAS WATER DATA INITIATIVE | 2017-2018

- The Mitchell Foundation has convened several stakeholders in Texas to advance the development of a Texas Water Data hub. This has involved monthly meetings and participation in a Texas Connect Water Data conference in April of 2018.