

**Ryan A Hill**

Post-Doctoral Fellow

Oak Ridge Institute for Science and Education

% US EPA Western Ecology Division

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**Research Interests**

- Stream Ecology | Community & Landscape Ecology | Bioassessment
- Hydrology | Climate Change | River/Stream Temperature | Geomorphology
- Geospatial Analyses | Statistical Modeling and Machine Learning

**Education**

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| Ph.D. – | Utah State University, Logan.<br>Watershed Sciences (emphasis in Watershed Ecology). 2013.<br>Dissertation title: <i>Modeling USA stream temperatures for stream biodiversity and climate change assessments</i> |
| B.S. –  | Utah State University, Logan.<br>Major: Environmental Studies. Minor: Portuguese. 2001.  |

**Professional Research Positions, Responsibilities, Achievements**

*Post-Doctoral Fellow (Jan. 2014 – present) – Oakridge Institute of Science and Education (ORISE) postdoctoral participant at the US EPA Western Ecology Division. Current and completed projects include:*

- *The Stream-Catchment (StreamCat) Dataset* – StreamCat characterizes the upstream features and landscapes of 2.6 million rivers and stream across the conterminous US (CONUS) and the data are available to the public for download ([www.epa.gov/national-aquatic-resource-surveys/streamcat](http://www.epa.gov/national-aquatic-resource-surveys/streamcat)). I helped to develop the methods to generate StreamCat data, including improvements to the computer algorithms that reduced processing times of geospatial layers from 7 hours to 20 minutes. In addition, I developed quality assurance protocols and documentation to ensure the integrity of the dataset and this approach has since been adopted by the US EPA Office of Research and Development. StreamCat was a major EPA product for FY 2015 and I was instrumental in moving the project forward with a team of researchers at critical points so that all deadlines were achieved, including publication of a data paper describing the development and features of StreamCat in the *Journal of the American Water Resources Association* (see Hill et al. 2016 in *Publications*). StreamCat was awarded the EPA's Bronze Medal.
- *Modeling and mapping the biological condition of USA rivers and streams* – I developed a random forest model to spatially predict the probable biological condition of 1.1 million streams and rivers within the CONUS. This model leveraged the US EPA's National Rivers and Streams Assessment of macroinvertebrate condition to predict probable conditions with StreamCat data. I led the development of a manuscript that described this work (see Hill et al. 2017) and co-authored a second manuscript that focused on aspects of variable selection with random forests (Fox et al. 2017). This product was a major EPA product for FY 2016.
- *Index of watershed integrity* – I participated in a workgroup and co-authored a paper that formalized a definition of the term "watershed integrity" and provided guidance on how this definition could be operationalized (Flotemersch et al. 2016). I assisted in the application of this definition with

StreamCat data to map an index of watershed integrity (IWI) for 2.6 million catchments within the CONUS. I co-authored a paper describing the application of the IWI, the resulting map, and its potential uses in watershed management (see Thornbrugh et al. 2018). Two additional papers on the application and improvement of IWI are forthcoming (Aho et al. *in review*, Johnson et al. *in review*).

- *Nitrogen concentration in US streams and rivers* – I collaborated with Western Ecology Division (WED) researchers to model the drivers of nitrogen concentrations in streams across the conterminous US. I helped to develop and derive the suite of predictor variables for the model. In addition, I developed methods to estimate the spatial proximity and overlap of sample watersheds to test for spatial autocorrelation among nitrogen samples. I contributed in the writing of these methods in a paper that was published *Science of the Total Environment* (see Bellmore et al. 2018)
- *The Lake-Catchment (LakeCat) Dataset* – LakeCat is a database of lake-basin characteristics for ca. 380,000 lakes across the conterminous US. This dataset will support the modeling and mapping of lake conditions nationally and parallels the StreamCat Dataset in terms of the numbers and types of metrics. I developed an algorithm to hydrologically link lake catchments to accumulate watershed metrics using similar approaches as StreamCat. A manuscript describing the LakeCat dataset was published in *Freshwater Science* (see Hill et al. 2018).
- *Antibiotic resistance* – I am collaborating on a project to investigate the use of DNA markers to model and map the distributions of antibiotic-resistance genes within US waterways with logistic regression and StreamCat data (Hill et al. *in prep*). This manuscript was part of a product package considered the #1 FY18 WED Key Accomplishment.
- *Hydrologic connectivity of wetlands to streams* – As part of a WED team, I helped to develop methods and computer code to characterize the degree of hydrologic connectivity of ca. 4 million wetlands to streams across the conterminous US. I helped to push this project forward under very short deadlines and was awarded a certificate of recognition from the EPA WED for this effort. I will lead portions of a paper on this work to describe the methods we used to link wetlands and streams.
- *Salinity of US rivers and streams* – I used StreamCat data and an existing random forest model to map the predicted river salinity (electrical conductivity) of 2.6 million stream segments across the conterminous US (Cormier et al. 2018).

*Senior Research Associate (Sept. 2006 – Jan. 2014) – Utah State University, Western Center for Monitoring and Assessment of Freshwater Ecosystems:*

- Development of large-scale models of stream temperature, hydrology, and stream benthic invertebrate distributions and community composition as part of USEPA and USGS funded projects.
- Development of GIS-based watershed and stream reach-level descriptors in support of more than 10 state and national aquatic bioassessments, including lakes and rivers.

*Research Assistant (Jan. 2002 – Aug. 2006) – Utah State University, Department of Watershed Sciences:*

- US EPA STAR-funded (Science Towards Achieving Results) research to develop an automated process for rapid delineation of many watershed boundaries (<http://hydrology.usu.edu/mwdtool/>) and development of GIS-based predictors of stream invertebrate assemblages for bioassessments.

#### **Technical Advice to Agencies & Invited Workgroups**

- *Invited technical expert (2016-2017)* – Panel to provide advice to the Southern California Coastal Water Resources Project on the spatial representativeness of bioassessment samples.
- *Invited member (September 2016 - present)* – USEPA steering committee to apply a Biological Condition Gradient to the Puget Lowlands (WA) and Willamette Valley (OR) ecoregions.
- *Invited member (November 2017 - present)* – [Power Center Research Group: North American Analysis and Synthesis on the Connectivity of “Geographically Isolated Wetlands” to Downstream Waters.](#)

**Journal Articles***In Review or Advanced Stages of Preparation*

- Hill, R.A.**, M.A. Jahne, S.P. Keely, N.E. Brinkman, R.A. Haugland, S.G. Leibowitz, E.A. Wheaton, J.L. Garland, and R.W. Martin. *In prep.* Anthropogenic watershed stressors predict the occurrences of antibiotic resistance genes in conterminous US rivers and streams.
- Beck, M.W., R.D. Mazor, S. Johnson, K. Wisenbaker, J. Westfall, P.R. Ode, **R.A. Hill**, C. Loflen, M. Sutula, and E.D. Stein. *In prep.* Prioritizing management goals for stream biological integrity within the developed landscape context.
- Pennino, M.J., S.G. Leibowitz, J.E. Compton, **R.A. Hill**, and R.D. Sabo. *In prep.* Predicting drinking water nitrate contamination across the conterminous United States.
- Johnson, Z.C., S.G. Leibowitz, and **R.A. Hill**. *In review.* Revising the index of watershed integrity national maps. *Science of the Total Environment*.
- Aho, K.B., J.E. Flotemersch, S.G. Leibowitz, Z.C. Johnson, M.H. Weber, and **R.A. Hill**. *In review.* Applying the Index of Watershed Integrity to the Western Balkans Region. *Water Science and Technology*.
- Chen, K., J.R. Olson, J.J. Vander Laan, **R.A. Hill**, B. Wang, C.P. Hawkins. *In review.* Improving the performance of ecological indices by balancing reference site quality and representativeness. *Hydrobiologia*.

*Published in Refereed Journals*

- Bellmore, R.A., J.E. Compton, J.R. Brooks, E.W. Fox, **R.A. Hill**, D.J. Sobota, D.J. Thornbrugh, M.H. Weber. 2018. Relative importance of anthropogenic sources and internal sinks for nitrogen concentrations in U.S. streams and rivers. *Science of the Total Environment* 639: 1349-1359.
- Hill, R.A.**, M.H. Weber, R.M. Debbout, S.G. Leibowitz, and A.R. Olsen. 2018. The LakeCat-Catchment (LakeCat) Dataset: Characterizing landscape features for lake basins within the conterminous US. Submitted to *Freshwater Science* 37: <https://doi.org/10.1086/697966>.
- Thornbrugh, D.J., S.G. Leibowitz, **R.A. Hill**, M.H. Weber, A.R. Olsen, J.E. Flotemersch, J.L. Stoddard, D.V. Peck. 2018. Mapping watershed integrity for the conterminous United States. *Ecological Indicators* 85: 113-1148. DOI: 10.1016/j.ecolind.2017.10.070
- Cormier, S. M., L. Zeng, **R. A. Hill**, R. Novak, C. M. Flaherty. 2018. A flow-chart for developing water quality criteria from two field-based methods. *Science of the Total Environment* 633: 1647-1656.
- Hill, R.A.**, E.W. Fox, S.G. Leibowitz, A.R. Olsen, D.J. Thornbrugh, M.H. Weber. 2017. Predictive mapping of the biotic condition of conterminous-USA rivers and streams. *Ecological Applications* 27: 2397-2415.
- E.W. Fox, **R.A. Hill**, S.G. Leibowitz, A.R. Olsen, D.J. Thornbrugh, M.H. Weber. 2017. Assessing the accuracy and stability of variable selection methods for random forest modeling in ecology. Submitted to *Environmental Monitoring and Assessment* 182: 316.
- Hill, R.A.**, M.H. Weber, S.G. Leibowitz, A.R. Olsen, D.J. Thornbrugh. 2016. The Stream-Catchment (StreamCat) Dataset: a database of watershed metrics for the conterminous USA. *Journal of the American Water Resources Association (JAWRA)* 52: 120-128. DOI: 10.1111/1752-1688.12372
- Flotemersch, J.E., S.G. Leibowitz, **R.A. Hill**, J.L. Stoddard, M.C. Thoms, R.E. Tharme. 2016. A watershed integrity definition and assessment approach to support strategic management of watersheds. *River Research and Applications* 32: 1654-1671. DOI: 10.1002/rra.2978
- Hill, R.A.**, C.P. Hawkins. 2014. Using modeled stream temperatures to predict macro-spatial patterns of stream invertebrate biodiversity. *Freshwater Biology* 59: 2632-2644.

- Hill, R.A.**, C.P. Hawkins, and J. Jin. 2014. Predicting thermal vulnerability of stream and river ecosystems to climate change. *Climatic Change* 125: 399-412.
- Hill, R.A.**, C.P. Hawkins, and D.M Carlisle. 2013. Predicting thermal reference conditions for USA streams and rivers. *Freshwater Science* 32: 39-55.
- Vander Laan, J.J., C.P. Hawkins, J.R. Olson, and **R.A. Hill**. 2013. Linking land use, in-stream stressors, and biological condition to infer causes of regional ecological impairment in streams. *Freshwater Science* 32: 801-820.
- Chinnayakanahalli, K. J., C.P. Hawkins, D.G. Tarboton, and **R.A. Hill**. 2011. Natural flow regime, temperature and the composition and richness of invertebrate assemblages in streams of the western United States. *Freshwater Biology* 56: 1248-1265.
- Hawkins, C.P., J.R. Olson, and **R.A. Hill**. 2010. The reference condition: Predicting benchmarks for ecological and water-quality assessments. *Journal of the North American Benthological Society* 29: 312-343.

### **Manuals**

- Chinnayakanahalli, K., **Hill, R.A.**, Olson, J.R., Kroeber, C., Tarboton, D.G., and C.P. Hawkins. 2006. The multi-watershed delineation tool: GIS software in support of regional watershed analyses, user's manual. Department of Civil and Environmental Engineering and Department of Aquatic, Watershed, & Earth Resources, Utah State University.

### **Conference Presentations (First Author)**

- Hill, R.A.**, S.P. Keely, N.E. Brinkman, R.A. Haugland, E.A. Wheaton, S.G. Leibowitz, M.A. Jahne, R.W. Martin. The prevalence of antibiotic resistance genes in US waterways and their responses to water quality and land use indicators. Annual meeting of the Society for Freshwater Science, Detroit, MI, May 20-24, 2018.
- Hill, R.A.**, M.H. Weber, and S.G. Leibowitz. StreamCat, LakeCat, and Wetland Connectivity: An overview of algorithms, data, and models developed at the US EPA Western Ecology Division to facilitate and advance watershed prediction in the conterminous US. 2018 AWRA Spring Specialty Conference: GIS & Water Resources X, April 22-25, 2018.
- Hill, R.A.**, M.H. Weber, R.M. Debbout, S.G. Leibowitz, A.R. Olsen. 2017. The Lake-Catchment (LakeCat) Dataset for characterizing hydrologically-relevant landscape features for lakes across the conterminous US. Annual meeting of the Society for Freshwater Science, Raleigh, NC.
- Hill, R.A.**, M.H. Weber, R.M. Debbout, S.G. Leibowitz, A.R. Olsen. 2017. The Stream-Catchment (StreamCat) and Lake-Catchment (LakeCat) Datasets: leveraging existing geospatial frameworks and data to characterize lotic and lentic ecosystems across the conterminous US for ecological and environmental modeling. Annual meeting of the Ecological Society of America, Portland, OR.
- Hill, R.A.**, M.H. Weber, E.W. Fox, S.G. Leibowitz, D.J. Thornbrugh. 2016. Using StreamCat and the NHDPlus framework to model and map the biological condition of USA streams and rivers. AWRA Summer Specialty Conference – GIS and Water Resources IX, Sacramento, CA.
- Hill, R.A.**, E.W. Fox, S.G. Leibowitz, A.R. Olsen, D.J. Thornbrugh. M.H. Weber. 2016. Variable selection with random forest: Balancing stability, performance, and interpretation in ecological and environmental modeling. Annual meeting of the Society for Freshwater Science, Sacramento, CA.
- Hill, R.A.**, M.H. Weber, S.G. Leibowitz, A.R. Olsen, D.J. Thornbrugh. 2015. Mapping the biological condition of USA streams and rivers. Annual meeting of the Society for Freshwater Science, Milwaukee, WI.
- Hill, R.A.**, C.P. Hawkins, J. Jin, D.G. Tarboton. 2013. Response of streams to climate change (IV): stream temperature modeling. Annual Meeting of the Ecological Society of America, Minneapolis, MN.

- Hill, R.A.** and C.P. Hawkins. 2013. Modeled stream temperature matched observed temperature in predicting stream invertebrate community composition. Annual meeting of the Society for Freshwater Science, Jacksonville, FL.
- Hill, R.A.** and C.P. Hawkins. 2012. Predicting differential vulnerabilities of stream and river temperatures to climate change. Annual meeting of the American Geophysical Union, San Francisco, CA.
- Hill, R.A.** and C.P. Hawkins. 2012. Predicting the vulnerability of stream and river temperatures to climate change. Annual meeting of the Society for Freshwater Science, Louisville, KY.
- Hill, R.A.** and C.P. Hawkins. 2011. Effects of natural and altered catchment attributes on stream temperatures of the western USA. Annual Meeting of the North American Benthological Society, Providence, RI.
- Hill, R.A.** and C.P. Hawkins. 2010. Establishing Thermal Reference Condition: Development of Stream Temperature Models in Support of Biological Monitoring and Assessment in the Western USA. National Water Quality Monitoring Conference, Denver, CO.
- Hill, R.A.** and C.P. Hawkins. 2009. Establishing Thermal Reference Condition: Development of Stream Temperature Models in Support of Biological Monitoring and Assessment in the Western USA. Northwest Biological Assessment Workgroup, McCall, ID.
- Hill, R.A.**, Hawkins, C.P. and N. Burbank. 2008. Establishing thermal reference condition for streams: A critical need for assessing the effects of altered climate, riparian cover, and hydrology on stream temperatures and biota. Annual Meeting of the North American Benthological Society, Salt Lake City, UT.
- Hill, R.A.** and C.P. Hawkins. 2005. Spatially explicit mapping of potential benthic invertebrate assemblage classes with GIS. Annual Meeting of the North American Benthological Society, New Orleans, LA.
- Hill, R.A.** and C.P. Hawkins. 2004. Valley width as a predictor of streambed sediment size in the western United States. Annual Meeting of the North American Benthological Society, Vancouver, BC.
- Hill, R.A.** and C.P. Hawkins. 2003. Correlations between valley width and sediment size distribution: A GIS-based approach to characterizing physical stream structure. Annual Meeting of the North American Benthological Society, Athens, GA.

#### ***Conference Posters (First Author)***

- Hill, R.A.**, M.H. Weber, S.G. Leibowitz, A.R. Olsen, D.J. Thornbrugh. 2015. Towards national mapping of aquatic condition (II): Predicting the probably biological condition of USA streams and rivers. 9<sup>th</sup> International Association of Landscape Ecologists World Congress, Portland OR.
- Hill, R.A.**, M.H. Weber, S.G. Leibowitz, A.R. Olsen. 2014. Developing a large-scale model to predict the effects of land use and climatic variation on the biological condition of USA streams and rivers. Annual meeting of the American Geophysical Union, San Francisco, CA.
- Hill, R.A.**, M. Weber, S.G. Leibowitz, A. Olsen. 2014. Developing a large-scale model to predict the effects of land use and climatic variation on the biological condition of USA streams and rivers. Annual meeting of the American Geophysical Union, San Francisco, CA.
- Hill, R.A.**, Chinnayakanahalli, K., Olson, J.R., Hawkins, C.P. and D.G. Tarboton. 2007. Rapid watershed delineation and characterization with the Multi-Watershed Delineation tool: GIS software in support of regional watershed analyses. Annual Meeting of the North American Benthological Society, Columbia, SC.

#### ***Teaching, Workshops, & Session Organization***

- Instructor, Utah State University, Watershed Sciences Department (Fall 2013) – Developed and taught Honors Breadth Life Sciences (HONR 1350).

- Teaching Assistant, Utah State University, Department of Geography (Fall 2000) – Geographic Information Systems (GEOG 4930).
- Instructor, Fundamentals of Spatial Data Access and Analysis in R – Developed and taught workshop at the Annual Meeting of the Society for Freshwater Science, Detroit, MI, 2018. Course materials available here: <https://ryan-hill.github.io/sfs-r-gis-2018/>
- Session organizer, *Watershed Scale Spatial Prediction and Modelling*. 2018 AWRA Spring Specialty Conference: GIS & Water Resources X, Orlando, FL.

**Technical expertise**

- 18 years experience with ESRI GIS products, including ArcGIS. Five years with QGIS.
- 12 years experience with the Python Programming Language, including experience with numpy, pandas, and other modules to develop custom, open-source geospatial processes.
- 15 years experience with R Statistical Programming Language/Software.
- Experience with Git/GitHub Version Control Systems for project management and collaboration.
- Experience and course work using the Unix/Linux operating system with shell commands, Perl, C, Visual Basic, HTML, Markdown, and Interactive Data Language.

**Awards & Recognition**

- Certificate of Recognition from US EPA Western Ecology Division (2016) for supporting the development of Wetland Hydrological Maps for North America.
- Certificate of Recognition from US EPA Western Ecology Division (2015) for leadership in developing a quality assurance process and documentation for StreamCat Dataset.
- Best Oral Presentation on an Applied Research Topic (2003) – Annual Meeting of the North American Benthological Society, Athens, GA.

**Additional Experience/Interests/Skills**

- Web Editor for the [Society for Freshwater Science](#), June 2016 – present. I recently oversaw the complete overhaul of the Society's website that launched Feb. 1, 2018.
- Reviewer for the journals *Ecology*, *Climatic Change*, *Ecological Modelling*, *Nature Scientific Data* and others.
- Extensive outdoor experience and fieldwork.
- Backpacking and whitewater rafting.
- Fluent in Portuguese and functional in Spanish.