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% 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*

Ph.D. – Utah State University, Logan.  
Watershed Sciences (emphasis in Watershed Ecology). 2013.  
Dissertation title: *Modeling USA stream temperatures for stream biodiversity and climate change assessments*

B.S. – Utah State University, Logan.  
Major: Environmental Studies. Minor: Portuguese. 2001.

### *Teaching Experience*

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

Teaching Assistant (Fall 2000) *Utah State University – Department of Geography:* Geographic Information Systems (GEOG 4930).

### *Professional Positions*

*Post-Doctoral Fellow (2014 – Present) – Oakridge Institute of Science and Education (ORISE) post-doctoral 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).
- *Index of watershed integrity* – I participated in a workgroup and coauthored 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 streams within the CONUS. I coauthored a paper describing the application of the IWI, the resulting map, and its potential uses in watershed management (see Thornbrugh et al. 2018).
- *Nitrogen concentration in US streams and rivers* – I collaborated with 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 sample sites. I contributed in the writing of these methods in a paper that is under review in *Science of the Total Environment* (see Bellmore et al. *in review*).
- *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 the lake conditions nationally and will parallel 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 the same code that was developed for StreamCat. A manuscript describing the LakeCat dataset is under review at *Freshwater Science* (see Hill et al. *in review*).
- *Riverine microbiome* – I am collaborating on a project to investigate the use of riverine microbiome data (microbial DNA) as an indicator of stream biological condition, including the exploration of patterns and responses of microbial assemblages to human-related watershed alterations. In addition, we are investigating the use of DNA markers to quantify the concentration of antibiotic resistance genes (ARG) within US waterways.
- *Hydrologic connectivity of wetlands to streams in North America* – As part of a 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 US EPA Western Ecology Division for this effort. These methods are being expanded to an analysis of all wetlands in North America. I will lead portions of a paper on this work that describe the methods we used to link wetlands and streams.
- *Salinity of irrigation waters of the western US* – I used random forests to model the salinity (electrical conductivity) of rivers and streams across the western US to characterize their use as irrigation water in support of an analysis of final ecosystem goods and services.
- *Response of stream electrical conductivity and biota to drought* – I am part of a collaboration of federal and university researchers that is modeling and predicting the response of electrical conductivity in streams to drought and the effects on resident macroinvertebrates. My responsibilities include the application of models to StreamCat data to produce national maps of these predicted responses across the conterminous US.

*Senior Research Associate (2006 – 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, 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 (2002 – 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 and development of GIS-based predictors of stream invertebrate assemblages for bioassessments.

*Technical Advice to Agencies*

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

*Journal Articles*

- 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. Submitted to *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. *Accepted*. A flow-chart for developing water quality criteria from two field-based methods. *Science of the Total Environment*.
- Hill, R. A.**, M. H. Weber, R.M. Debbout, S. G. Leibowitz, and A. R. Olsen. *In review*. The LakeCat-Catchment (LakeCat) Dataset: Characterizing landscape features for lake basins within the conterminous US. Submitted to *Freshwater Science*.
- 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*. Accepted Author Manuscript. doi:10.1002/eap.1617.
- 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.
- Bellmore, R.A., J.E. Compton, J.R. Brooks, E.W. Fox, **R.A. Hill**, D.J. Sobota, D.J. Thornbrugh, M.H. Weber. *In review*. Relative importance of anthropogenic sources and internal sinks for nitrogen concentrations in U.S. streams and rivers. Submitted to *Science of the Total Environment*.
- 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.**, 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.

### *Technical expertise*

- ArcGIS and QGIS softwares.
- Python Programming Language, including experience with numpy, pandas, and other modules to develop custom, open-source geospatial processes.
- R Statistical Programming Language/Software.
- Git/GitHub Version Control Systems.
- 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 will launch Feb. 1, 2018.
- Reviewer for the journals *Ecology*, *Climatic Change*, *Ecological Modelling*, *Nature Scientific Data* and others.
- Extensive outdoor experience and fieldwork.
- Backpacking, whitewater rafting.
- Fluent in Portuguese and functional in Spanish.