

RYAN A. McMANAMAY, Ph.D.

Aquatic Ecologist, Research Scientist
Oak Ridge National Laboratory
Environmental Sciences Division, P.O. Box 2008, MS-6351
Oak Ridge, TN 37831
(865) 241-8668 (work)
mcmamayra@ornl.gov
<http://ornl.academia.edu/RyanMcManamay>

Education:

Ph.D. Fish and Wildlife Conservation, Virginia Tech, 2011
M.S. Biological Sciences, Virginia Tech, 2007
B.S. Biological Sciences, Clemson University, 2004

Fields of Interest:

Ecohydrology, fish and macroinvertebrate community ecology, classification systems, hydrologic modeling, fluvial geomorphology, environmental flow management, water policy, landscape ecology, restoration ecology, renewable energy, river and wetland ecosystems, riparian ecology, terrestrial-aquatic interface, hydrologic alterations, climate change and water stress, dam regulation

Research Experience:

2013-Current	Aquatic Ecologist, Research Scientist, Oak Ridge National Lab, Oak Ridge, TN <ul style="list-style-type: none">• Hydropower-Environmental related research• Stream habitat classifications• Fish ecology and community applications• Hydrology and fluvial geomorphology of stream systems• Landscape ecology applications to energy development
2011- 2013:	Postdoctoral Research Associate, Oak Ridge National Lab, Oak Ridge, TN <ul style="list-style-type: none">• Modeled fish life history strategies and hydrology across US• Developed hydrologic classification for continental US• Developed a geospatial framework to identify fisheries concerns related to hydropower development
2011	Environmental Flow Consultant, Contract with Southeastern Aquatic Resources Partnership (SARP), St. Marys, GA <ul style="list-style-type: none">• Created database of instream flow research to inform water policy
2007 – 2011	Research Assistant, Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA <ul style="list-style-type: none">• Researched effects of flow and substrate restoration on fish, macroinvertebrates, and riparian vegetation below a hydropower dam• Assessed fluvial geomorphology, hydrology, and fish assemblages in Upper Tennessee River Basin
2009	Sussman Fund Internship, US Fish and Wildlife Service, Asheville, NC <ul style="list-style-type: none">• Bedload transport and monitoring gravel restoration• Fish spawning surveys• Monitored endemic minnow reintroductions
2006 – 2007	Research Assistant, Biological Sciences, Virginia Tech, Blacksburg, VA <ul style="list-style-type: none">• Researched contribution of fish and invertebrates to nutrients in streams• Assisted in watershed hydrology and DOC export research

- 2004 – 2005 Hemlock Woolly Adelgid Field and Lab Tech, Entomology, Clemson University, SC
- Assessed Hemlock mortality and effectiveness of predatory beetles
- 2002 – 2004 Fish Ecology Field and Lab Tech, Biological Sciences, Clemson University, SC
- Stream surveys of cutthroat trout populations in Idaho and Wyoming
 - Collected genetic samples to identify separate populations

Teaching Experience:

- 2013 American Fisheries Society, Continuing Education Workshop, “Instream Flow – what it is and why it matters”
- Instructed on modern methods to guide instream flow determination and participation in relicensing procedures for hydroelectric projects
- 2008 – 2010 Ichthyology Lab Instructor, Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA
- Lectured students in identification/anatomy of freshwater and marine fishes
- 2009 Stream Habitat Management Guest Lecturer
- Lectured on hydrologic and morphological impacts of dam regulation
- 2008 Stream Restoration Instructor, Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA
- Lectured students on stream hydrology, geomorphology, and stream-channel design applications to fisheries
 - Facilitated field trips for students to assist in local stream restoration project
 - Facilitated creation of public education materials
- 2007 Fisheries Techniques Teaching Assistant, Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA
- Assisted students in fishery and habitat assessment methods
- 2005 - 2007 Biology Lab Instructor, Biological Sciences, Virginia Tech, Blacksburg, VA
- Lectured students on general biology and life sciences

Publications (34 Total - 20 Journal articles, 14 Other publications)

Journal Publications (20) (** in press):

- McManamay, R.A., and E.A. Frimpong. 2015. Hydrologic filtering of fish life history strategies across the US: Implications of streamflow alteration on fish assemblages. *Ecological Applications* 25: 243-263. <http://dx.doi.org/10.1890/14-0247.1>
- McManamay, R.A., N. Samu, S-C. Kao, M.S. Bevelhimer, and S.C. Hetrick. 2015. A multi-scale spatial approach to address environmental effects of small hydropower development. *Environmental Management* 55: 217-243. DOI: 10.1007/s00267-014-0371-2
- McManamay, R.A., R.M. Utz. 2014. Open-access databases as unprecedented resources and drivers of cultural change in fisheries science. *Fisheries* 39: 417-425. DOI:10.1080/03632415.2014.946128
- McManamay, R.A. 2014. Quantifying and Generalizing Hydrologic Responses to Dam Regulation using a Statistical Modeling Approach. *Journal of Hydrology* 519: 1278-1296. DOI: 10.1016/j.jhydrol.2014.08.053
- McManamay, R.A., M.S. Bevelhimer, E.A. Frimpong. 2014. Associations among hydrologic classifications and fish traits to support environmental flow standards. *Ecohydrology* DOI: 10.1002/eco.1517
- Bevelhimer, M.S., **R.A. McManamay**, B. O’Conner. 2014. Characterizing sub-daily flow regimes: implications of hydrologic resolution on ecohydrology studies. *River Research and Applications* DOI: 10.1002/rra.2781
- Jager, H.I., and **R.A. McManamay**. 2014. Comment on “Cumulative biophysical impact of small and large hydropower development in Nu River, China” by Kelly Kibler and Desiree Tullos. *Water Resources Research* 49: 1–2. doi:10.1002/2013WR014378

- McManamay, R.A., D.J. Orth, H.I. Jager. 2014. Accounting for variation in species detection in fish community monitoring. *Fisheries Management and Ecology* 21: 96–112. doi: 10.1111/fme.12056
- McManamay, R.A., M.S. Bevelhimer, S. Kao. 2014. Updating the US hydrologic classification: an approach to clustering and stratifying ecohydrologic data. *Ecohydrology* 7, 903–926
- McManamay, R.A., D.J. Orth, C.A. Dolloff. 2013. Macroinvertebrate community responses to gravel augmentation in a Southeastern regulated river. *Southeastern Naturalist* 12: 599-618.
- Peoples, B.K., **R.A. McManamay**, D.J. Orth, E.A. Frimpong. 2013. Nesting habitat use by river chubs in a hydrologically variable Appalachian tailwater. *Ecology of Freshwater Fish* DOI: 10.1111/eff.12078
- McManamay, R.A., D.J. Orth, C.A. Dolloff. 2013. Case Study: Application of the ELOHA framework to regulated rivers in the Upper Tennessee River basin. *Environmental Management* 51:1210–1235.
- McManamay, R.A., D.J. Orth, J. Kauffman, M.D. Davis. 2013. A database and meta-analysis of ecological responses to flow in the South Atlantic Region. *Southeastern Naturalist* 12 (Monograph 5): 1-36.
- McManamay, R.A., J.T. Young, D.J. Orth. 2012. Spawning of white sucker (*Catostomus Commersoni*) in a stormwater pond inlet. *American Midland Naturalist* 168: 466-476.
- McManamay, R.A., D.J. Orth, C.A. Dolloff. 2012. Revisiting the homogenization of dammed rivers in the Southeastern US. *Journal of Hydrology* 424-425: 217-237.
- McManamay, R. A., D. J. Orth, C. A. Dolloff, and E. A. Frimpong. 2012. Regional frameworks applied to hydrology: can landscape-based frameworks capture the hydrologic variability? *River Research and Applications* 28: 1325-1339.
- McManamay, R. A., D. J. Orth, C. A. Dolloff, and E. A. Frimpong. 2012. A regional classification of unregulated streamflows: spatial resolution and hierarchical frameworks. *River Research and Applications* 28: 1019–1033.
- McManamay, R.A., J.R. Webster, H.M. Valett, C.A. Dolloff. 2011. Does diet influence consumer nutrient cycling? Macroinvertebrate and fish excretion in streams. *Journal of the North American Benthological Society* 30: 84-102.
- McManamay, R.H., L.M. Resler, J.B. Campbell, and **R.A. McManamay**. 2011. Assessing the impact of balsam woolly adelgid (*Adelges piceae* Ratz.) and anthropogenic disturbance on the stand structure and mortality of Fraser fir (*Abies fraseri* (Pursh) Poir.) in the Black Mountains of North Carolina. *Castanea* 76: 1-19.
- McManamay, R. A., D. J. Orth, C. A. Dolloff, and M. A. Cantrell. 2010. Gravel addition as a habitat restoration technique for tailwaters. *North American Journal of Fisheries Management* 30:1238-1257.

Manuscripts in Review:

- McManamay, R.A., B.K. Peoples, D.J. Orth, C.A. Dolloff, D.C. Matthews. 2014. Isolating causal pathways between flow and fish in the regulated river hierarchy? *Canadian Journal of Fisheries and Aquatic Sciences*

Manuscripts in Prep:

- McManamay, R.A., M.J. Troia. 2014. From Riverscapes to Hydroscaapes: Landscape Ecology Applications to Hydropower Development. *Landscape Ecology*
- McManamay, R.A., S-C. Kao, M.S. Bevelhimer, C. Oigbokie. 2014. A classification of US hydropower dams by their modes of operation. *River Research and Applications*
- McManamay, R.A., S.K. Brewer, M.S. Bevelhimer, H.I. Jager. 2015. Organizing environmental flow frameworks to meet US Hydropower mitigation needs. *River Research and Applications*
- McManamay, R.A., R.T. Jett, M.G. Ryon, M.J. Peterson, S.M. Gregory. 2015. Fragmentation limits fish recovery following water quality remediation. *Fisheries Management and Ecology*

Reports, Proceedings, Magazine articles:

- McManamay, R.A., M.J. Troia, C.R. DeRolph, M.S. Bevelhimer, M. P. Schramm, K.B. Larson, J.D. Tagestad, G.E. Johnson, H.I. Jager. 2015. Identifying Environmental Opportunities outside the Hydropower Project Boundary: An Updated Methodology of the Basin Scale Opportunity Assessment. ORNL TM-2014-540. January 2015.
- Larson, K.B., G.E. Johnson, J.D. Tagestad, C.A. Duberstein, M.S. Bevelhimer, **R.A. McManamay**, C.R. DeRolph, and S.H. Geerlofs. 2014. The Integrated Basin-Scale Opportunity Assessment Initiative: Scoping Assessment for the Connecticut River Basin. Final Report. *Pacific Northwest National Laboratory Report PNNL-23778*. October 2014.
- Olivero Sheldon, A., **R.A. McManamay**. 2014. Literature review of freshwater classification frameworks. Prepared for the Appalachian LCC as part of the Grant, "A Stream Classification System for the Appalachian Landscape Conservation Cooperative." May 2014.
- Johnson G.E., M.S. Bevelhimer, K.B. Larson, J.D. Tagestad, J.W. Saulsbury, **R.A. McManamay**, C.A. Duberstein, C.R. DeRolph, S.L. Hetrick, B.T. Smith, S.H. Geerlof. 2014. The Basin-Scale Opportunity Assessment Initiative: Synopsis of the Preliminary Scoping Assessments for the Connecticut and Roanoke River Basins. Hydrovision International 2014 Annual Meeting Proceedings. Nashville, Tn. July 22-25, 2014. Available at: <http://s36.a2zinc.net/clients/pennwell/HVI2014/Public/SessionDetails.aspx?FromPage=Calendar.aspx&SessionID=8554>
- Kao, S.-C., **R. A. McManamay**, K. M. Stewart, N. M. Samu, B. Hadjerioua, S. T. DeNeale, D. Yeasmin, M. F. K. Pasha, A. A. Oubeidillah, and B. T. Smith. 2014. New Stream-reach Development: A Comprehensive Assessment of Hydropower Energy Potential in the United States, GPO DOE/EE-1063, Wind and Water Power Program, Department of Energy, Washington, DC.
- Jager, H.I., B.A. Elrod, N.Samu, **R.A. McManamay**, and B.T. Smith. 2013. ESA Protection for the American Eel: Implications for U.S. Hydropower. Oak Ridge National Laboratory. ORNL/TM-2013/361. November 2013.
- McManamay, R.A., P.W. Bonsall, S.C. Hetrick, J.Harn, J. Duncan, and B.T. Smith. 2013. Digital mapping and environmental characterization of National Wild and Scenic River Systems. Oak Ridge National Laboratory 2013 Final Report. ORNL/TM-2013/356. September 2013.
- Johnson G.E., M.S. Bevelhimer, K.B. Larson, J.D. Tagestad, J.W. Saulsbury, **R.A. McManamay**, C.A. Duberstein, C.R. DeRolph, S.L. Hetrick, B.T. Smith, and S.H. Geerlofs. 2013. The Integrated Basin Scale Opportunity Assessment Initiative: Phase 1 methodology and preliminary scoping assessments for the Connecticut River and Roanoke River Basins. Pacific Northwest National Laboratory Annual Report 2013. PNNL 22807. September 2013.
- McManamay, R.A., and M.S. Bevelhimer. 2013. A holistic framework for environmental flows determination in hydropower contexts. Oak Ridge National Laboratory, 2013 Project Report. ORNL/TM-2013/159. April 2013.
- Vernon, C.R., E.V. Arntzen, M.C. Richmond, **R.A. McManamay**, T.P. Hanrahan C.L. Rakowski. 2013. GIS Framework for Large River Classification to Aid in the Evaluation of Flow-Ecology Relationships. *Pacific Northwest National Laboratory Report PNNL-22296*. February 2013.
- Bevelhimer, M.S, and **R. A. McManamay**. 2012. Minimizing the environmental impact of variable flow regimes while maintaining the value of hydropower peaking. *Hydrovision International 2012 Annual Meeting Proceedings*. Louisville, KY. July, 2012. Available at: http://s36.a2zinc.net/clients/pennwell/HVI2012/Custom/Handout/Speaker9395_Session2511_1.pdf
- Hadjerioua, B., S-C Kao*, **R.A. McManamay**, M.D. Fayzul, K. Pasha, D. Yeasmin, A.A. Oubeidillah, N.M. Samu, K.M. Stewart, M.S. Bevelhimer, S.L. Hetrick, Y. Wei, and B.T. Smith. 2012. An assessment of energy potential from new small hydro development in the United States. Initial Report on Methodology. *Report by Oak Ridge National Laboratory to the Department of Energy*. August, 2012. http://nhaap.ornl.gov/sites/default/files/NSD_Methodology_Report.pdf
- McManamay, R.A., D.J. Orth, J. Kauffman. 2011. Ecological responses to flow alteration in the South Atlantic Region: A literature review and meta-analysis. *Report to the Southeastern Aquatic Resources Partnership*. November 2011. Available at: <http://filebox.vt.edu/users/dorth/>
- McManamay, R.A. 2008. Stream restoration service learning class-Fall 2008. *College of Natural Resources Engagement Matters* 1(4): 4-5. December 2008.

Lowe, K., and **R.A. McManamay**. 2009. Restoring stream habitat for native trout. New River Valley Magazine. May/June: 36-38.

Funded Proposals (Total \$830k):

McManamay, R.A., M. Doyle, M. Fork, J. Heffernan. Enriching the spatial and temporal resolution of water quality sensor networks in urban environments. Oak Ridge National Laboratory GO! Program Supplemental Funding. November 2014.

McManamay, R.A., S. Surendran Nair, R.N. Stewart, S-C Kao, B.T. Smith. Fine-resolution Modeling of Urban-Energy Systems' Water Footprint in River Networks. Oak Ridge National Laboratory Director's Research and Development Proposal. October 2014.

McManamay, R.A. Stream Classification Tool. Department of Energy Water Power Program. FY14 Annual Operating Program. October 2013.

Anderson, M. G., A. Olivero, **R. A. McManamay**. A stream classification system for the Appalachian Landscape Conservation Cooperative. Appalachian Landscape Conservation Cooperative RFP. November 2012.

<http://applcc.org/projects/stream-classification>

Orth, D.J., **R.A. McManamay**, and J. Kauffman. Ecological responses to flow alteration in the South Atlantic Region: Literature review. Southeastern Aquatic Resources Partnership, May 2011.

Orth, D. J., **R. A. McManamay**, J. Henriksen, and J. Heasley. Stream flow classification for environmental flow standards and analysis. Virginia Department of Game and Inland Fisheries. 2010.

McManamay, R.A., T. Lowe, J. Williams, and B. Pierce. Riparian restoration of Wright Branch, an extirpated headwaters stream, for reintroduction of Eastern brook trout through the Trout in the Classroom program. (Embrace-A-Stream Grants, Trout Unlimited, 2010).

Lowe, T., **R.A. McManamay**, D. Kirk, J. Williams, and J. Ross. Stony Creek within the Glen Alton Tract (Giles County, VA): Stream and Riparian Habitat Restoration, Stabilization, and Reconnection. Awarded (Embrace-A-Stream Grants, Trout Unlimited; Southeastern Aquatic Resources Partnership; National Forest Foundation). February 2008.

McManamay, R.A. The effect of morphological restoration of the fish and macroinvertebrate assemblage structure in a fragmented river system. Sigma Xi, Scientific Research Society, January 2008.

Mentored Students/Post-Docs:

Post-Doc:

2014-Current: Matthew J. Troia, Oak Ridge National Laboratory

- Stream Classifications, Environmental Analyses

Undergraduate Students:

2013- 2014: Clement O. Oigbokie II. (University of Tennessee). Oak Ridge National Laboratory.

- Building Hydropower Dam and Operation Database.

2013 Peter Bonsall, National Park Service Intern, Oak Ridge National Laboratory

- Digital mapping and environmental characterization of Wild and Scenic Rivers

2012 Evan B. Robinson (Morris College, SC), Oak Ridge National Laboratory.

- Instream Flow Requirements for Hydropower Developments. Formal Advisor: Dr. Brennan Smith.

2011 Constantin C. Scherelis (University of Tennessee). Oak Ridge National Laboratory.

- Classifying Dam Modes of Operation. Formal Advisor - Dr. Mark Bevelhimer.

2010 James T. Young (Virginia Tech). Virginia Tech

- Observations of White Sucker Spawning. Formal Advisor - Dr. Donald Orth.

Graduate Committees:

2013- Current: Ryan Hathaway. Virginia Tech National Capital Region

- Temperature Regimes in Regulated Rivers.

Presentations (** invited)

Prioritizing Streams as Hydrologic Reserves in the Eastern US. *Southern Division American Fisheries Society Annual Meeting*, Savannah, GA. January 2015.

Optimizing Win-Win Scenarios Between Hydropower Development and Environmental Improvements by Thinking Outside the Project Boundary. *American Fisheries Society Annual Meeting*, Quebec, Canada. August 20, 2014

The Basin Scale Opportunity Assessment: Finding win/win scenarios in improving the environment while increasing hydropower energy. *Western Division American Fisheries Society Annual Meeting*, Mazatlan, Mexico. April 10, 2014.

Hydrologic structuring of fish life history strategies across the US: Implications of losses in flow variation on fish assemblages. *Southern Division American Fisheries Society Annual Meeting*, Charleston, SC. January 2014.

**The complicated nature of dams: Is a general framework for ecologically sustainable instream flow protection possible? *Virginia Chapter American Fisheries Society Annual Meeting, Continuing Education Workshop, Instream Flow – What it is and why it matters*, Virginia February 27, 2013.

**US hydrologic classification applied to fish traits: A framework for developing flow-ecology hypotheses. *Virginia Chapter American Fisheries Society Annual Meeting, Continuing Education Workshop, Instream Flow – What it is and why it matters*, Virginia February 27, 2013.

Environmental attribution for the National Hydropower Assess Assessment Program. 2012. *American Fisheries Society, Annual Meeting*, St. Paul, MN. August, 2012.

**Methodology Review: Environmental attribution for the National Hydropower Assess Assessment Program. *Department of Energy Peer Review Panel*, Washington D.C., June 18-19, 2012.

Sampling considerations: difficulties detecting fish responses to flow restoration. McManamay, R.A. and D. J. Orth. *Tennessee Chapter American Fisheries Society Annual Meeting*. March 13, 2012. Fall Creek Falls State Park, TN.

**Ecological responses to flow alteration in the South Atlantic region: a literature review and meta-analysis. *Southern Division American Fisheries Society Annual Meeting*, Biloxi, MS. January 2012.

A tail of two tailwaters: Constraints to effective mitigation with environmental flow restoration. *Ecological Society of America Annual Meeting*, Austin, TX. August, 2011.

Do dams affect streams the same? A step towards generalizing regulated stream flow patterns.” *North American Benthological Society Annual Meeting*, Providence, RI, May, 2011.

**Providing a restoration template for regulated rivers. 2011. *Seminar, Oak Ridge National Laboratory*, Oak Ridge, TN. March 2011.

Fish Community Restoration in a Regulated River. When Reality Hurts. 2010 *Southeastern Fishes Council Annual Meeting*, Athens, GA, November, 2010.

Classifying flow regimes in seven states: Implications for regional environmental flow standards and management. *American Fisheries Society Annual Meeting*, Pittsburg, PA, September, 2010.

Classifying flow regimes: Implications for regional environmental flow standards and management. *Virginia Chapter American Fisheries Society Annual Meeting*, Pittsburg, PA, September, 2010.

Investigating Fish Responses to Flow Restoration in the Cheoah River: Implications of Detection Probability on Conclusions. *Southern Division of the American Fisheries Society Annual Meeting*, Asheville, NC. February 2010.

Stony Creek Restoration Project: A Collaboration and Success. Poster. *Virginia Chapter American Fisheries Society Annual Meeting*, Lexington, VA. March, 2009.

Cheoah River Flow Restoration and Gravel Addition. *Stream Restoration Conference*, Asheville, NC. November 2008.

The Effects of Nutrient Availability on Fish Nutrient Excretion. *North American Benthological Society Annual Meeting*, Columbia, SC. June 2007.

The Effects of Stream Resources on Macroinvertebrate and Fish Composition and Nutrient

Cycling. *Virginia and North Carolina Joint Chapter American Fisheries Society Meeting*. February 2007.

Service and Outreach:

- 2014: Symposium Organization (Chair) - American Fisheries Society 2012 Annual Meeting, Quebec, Canada
- 2014: Student Oral Presentation Judge, Southern Division American Fisheries Society Meeting 2013 Annual Meeting, Charleston, SC
- 2013: Professional Meeting Organization and Planning - Southern Division American Fisheries Society Meeting 2013 Annual Meeting, Nashville, TN
- 2012: Symposium Organization - American Fisheries Society 2012 Annual Meeting St. Paul, MN
- 2010: Trout Stream Sensitivity Study Director, New River Valley Chapter, VA, Trout Unlimited
- 2009: Southern Instream Flow Network Research Agenda Development, Nashville, TN
- 2009-2010: Vice President, Fisheries and Wildlife Graduate Student Association, Virginia Tech, Blacksburg, VA
- 2008-2010: Conservation Director, New River Valley Chapter, VA, Trout Unlimited
- 2007-2008: Outreach Committee, American Fisheries Society, VA chapter
- 2006-2008: President New River Valley Chapter, Trout Unlimited, VA

Reviewer for Journals:

- Bioscience; River Research and Applications; Ecohydrology; North American Journal of Fisheries Management; Global Change Biology; Science of the Total Environment; Marine and Coastal Fisheries; Journal of Hydrology; Springer Plus

Honors and Awards:

- 2015: Outstanding Contribution Performance, Oak Ridge National Laboratory, Jan 2015
- 2014: Incentive Performance Award, Oak Ridge National Laboratory, December 2014
- 2014: Oak Ridge National Laboratory Significant Event Award (SEA)---Team Award, April 2014
- 2010: Jimmie Pigg Outstanding Student Achievement Award, Southern Division of the American Fisheries Society, Annual Meeting, Asheville, NC, Feb. 26, 2010.
- 2009: Sussman Fund Internship, US Fish and Wildlife Service, May – August 2009.
- 2007: American Fisheries Society Student Presentation Award: Virginia Chapter Meeting, Danville, VA, February 2007.
- 2006: VA Council of Trout Unlimited Certificate of Appreciation for New River Valley Chapter, Graves Mountain Lodge, Syria, VA, November 2006.

Software Applications, Web-sites, Data Products:

- 2012-13 Environmental Attribution for National Hydropower Asset Assessment Program.
HydroGIS <http://nhaap.ornl.gov/content/hydrogis-0>
New Stream-Reach Potential <http://nhaap.ornl.gov/nsd>
 - Developed web-accessible GIS layers of environmental information to inform conservation planning for fisheries protection
- 2011 Virginia Environmental-flow Software
 - Developed classification of stream flows and statistics for streams across Southeastern US
 - Assisted E-flow Specialists in multivariate analyses within backdrop of software