

# Marcus W. Beck, Ph.D.

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## *Education*

**Ph.D., Conservation Biology, Fisheries and Aquatic Biology track      Jun. 2013**  
**Statistics minor**

Conservation Biology Graduate Program, University of Minnesota, Twin Cities, MN  
Thesis title: Minnesota macrophytes: Linking aquatic plants, lake health, and human activities

Advisors: Drs. Bruce Vondracek, Lorin Hatch

**M.Sc., Conservation Biology, Fisheries and Aquatic Biology track      Jun. 2009**

Conservation Biology Graduate Program, University of Minnesota, Twin Cities, MN  
Thesis title: Development of an ecological assessment method for Minnesota lakes

Advisor: Dr. Lorin Hatch

**B.Sc., Zoology *summa cum laude*      Dec. 2006**

Department of Zoology, University of Florida, Gainesville, FL

Thesis title: Reproductive characteristics of the green treefrog *Hyla cinerea*: effects of agricultural contaminants.

Advisor: Dr. Krista McCoy

**A.A., Zoology      Apr. 2004**

Santa Fe Community College, Gainesville, FL

## *Professional Appointments*

**Post-Doctorate Research Fellow      Jul. 2013 - Present**

Oak Ridge Institute for Science and Education, Ecosystem Dynamics and Effects Branch,  
Gulf Ecology Division, United States Environmental Protection Agency

**Research Fellow      Sep. 2012 - Jun. 2013**

Water Resources Center, Conservation Biology Graduate Program, Department of  
Fisheries, Wildlife, and Conservation Biology, University of Minnesota

**Research Assistant, University of Minnesota      Sep. 2007 - Sep. 2012**

Conservation Biology Graduate Program, Department of Fisheries, Wildlife, and  
Conservation Biology, University of Minnesota

**Intern      Jun. 2009 - Aug. 2009**

Minnesota Department of Natural Resources

**Creel Clerk**

**Jan. 2007 - May 2007**

Florida Fish and Wildlife Conservation Commission

**Undergraduate Researcher**

**Jan. 2006 - Dec. 2006**

Department of Zoology, University of Florida

**Biological Technician**

**summer 2006**

Florida Integrated Science Center, United States Geological Survey

*Peer-reviewed Publications*

1. Bajer, P.G., **Beck, M.W.**, Cross, T.K., Koch, J., Bartodziek, B., Sorensen, P.W. **In review.** Biological invasion by a benthivorous fish reduced the cover and species richness of aquatic plants in most lakes of a large North American ecoregion. *Global Change Biology*.
2. **Beck, M.W. In review.** SWMPPr: An R package for retrieving, organizing, and analyzing environmental data for estuaries. *The R Journal*.
3. **Beck, M.W.**, Hagy, J.D., Murrell, M.C. **In press.** Improving estimates of ecosystem metabolism by reducing effects of tidal advection on dissolved oxygen time series. *Limnology & Oceanography: Methods*.
4. **Beck, M.W.**, Hagy, J.D. 2015. Adaptation of a weighted regression approach to evaluate water quality trends in an estuary. *Environmental Modeling and Assessment*. 20(6):637-655.
5. **Beck, M.W.**, Tomcko, C.M., Valley, R.D., Staples, D.F. 2014. Analysis of macrophyte indicator variation as a function of sampling, temporal, and stressor effects. *Ecological Indicators*. 46:323-335.
6. **Beck, M.W.**, Wilson, B.N., Vondracek, B., Hatch, L.K. 2014. Application of neural networks to quantify utility of indices of biotic integrity for biological monitoring. *Ecological Indicators*. 45:195-208.
7. Vondracek, B., Koch, J.D., and **Beck, M.W.** 2014. A comparison of survey methods to evaluate macrophyte index of biotic integrity performance in Minnesota lakes. *Ecological Indicators*. 36:178-185.
8. **Beck, M.W.**, Vondracek, B. Hatch, L.K. 2013. Between- and within-lake responses of macrophyte richness metrics to shoreline development. *Lake and Reservoir Management*. 29(3):179-193.
9. **Beck, M.W.**, Vondracek, B., Hatch, L.K., and Vinje, J. 2013. Semi-automated analysis of high-resolution aerial images to quantify docks in glacial lakes. *ISPRS Journal of*

*Photogrammetry and Remote Sensing*. 81:60-69.

10. **Beck, M.W.**, Vondracek, B., and Hatch, L.K. 2013. Environmental clustering of lakes to evaluate performance of a macrophyte index of biotic integrity. *Aquatic Botany*. 108:16-25.
11. **Beck, M.W.**, Claassen, A.H., and Hundt, P.J. 2012. Environmental and livelihood impacts of dams: Common lessons across development gradients that challenge sustainability. *International Journal of River Basin Management*. 10(1):73-92.
12. **Beck, M.W.**, Hatch, L.K., Vondracek, B., and Valley, R.D. 2010. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Ecological Indicators*. 10:968-979.
13. **Beck, M.W.**, and Hatch, L.K. 2009. A review of research on the development of lake indices of biotic integrity. *Environmental Reviews*. 17:21-44.

### *Software and Websites*

1. **Beck, M.W.** 2015. WRTDStidal: Evaluating long-term chlorophyll trends in tidal waters, v0.0.14.9000. R package. ([link](#))
2. O'Brien, T.D., **Beck, M.W.** 2015. Time series and data analysis information and tool resource for NERRS/SWMP. Website. ([link](#))
3. **Beck, M.W.** 2015. Trends in SWMP parameters. Shiny Web Application. ([link](#))
4. **Beck, M.W.** 2015. Monthly and annual summary of SWMP parameters. Shiny Web Application. ([link](#))
5. **Beck, M.W.** 2015. SWMPPr: An R package for the National Estuarine Research Reserve System, v2.0.0. R package. ([link](#))
6. O'Brien, T.D., **Beck, M.W.** 2014. NERRS/SWMP data analysis workshop for time series. Website. ([link](#))
7. **Beck, M.W.** 2014. NeuralNetTools: Visualization and Analysis Tools for Neural Networks, v1.3.1. R package. ([link](#))

### *Outreach Documents*

1. **Beck, M.W.** 2012 - Present. R is my friend - numerous posts. R-bloggers: R news and tutorials contributed by R bloggers. ([link](#))
2. **Beck, M.W.** 2012. 2nd annual bike across Minnesota fundraiser June 1<sup>st</sup> through 4<sup>th</sup>: Mission accomplished! The Cons Bio Blog, Conservation Biology Graduate Program, University of Minnesota. ([link](#)).

3. **Beck, M.W.** 2012. Biking for bread. The Cons Bio Blog, Conservation Biology Graduate Program, University of Minnesota. ([link](#)).
4. **Beck, M.W.** 2011. Are values and conservation inseparable? The Cons Bio Blog, Conservation Biology Graduate Program, University of Minnesota. ([link](#)).
5. **Beck, M.W.** 2011. What I do: An exercise in hyperbole. The Cons Bio Blog, Conservation Biology Graduate Program, University of Minnesota. ([link](#)).

### *Invited Presentations*

1. **Beck, M.W.**, Hagy, J.D. 2015. Adaptation of a weighted regression approach to evaluate water quality trends in an estuary. *Oral presentation*. Coastal and Estuarine Research Federation Biennial Conference, Portland, OR.
2. **Beck, M.W.**, O'Brien, T.D. 2015. SWMPrats: A community of practice for NERRS data analysis. *Oral presentation*. NERRS research coordinators virtual meeting, USEPA NHEERL ORD, Gulf Breeze, FL.
3. **Beck, M.W.** 2014. The search for truth in numbers: Quantitative approaches for evaluating trends in water quality data. *Oral presentation*. Biology Department seminar (PCB 3930/4922/5924), University of West Florida, Pensacola, FL.
4. **Beck, M.W.**, Vondracek, B., Wilson, B., and Hatch, L.K. 2013. Understanding indicators of lake health and the utility of a plant-based index. *Oral presentation*. Gulf Ecology Division seminar series, USEPA NHEERL ORD, Gulf Breeze, FL.
5. **Beck, M.W.**, Vondracek, B., Hatch, L.K., and Wilson, B. 2013. Minnesota macrophytes: Linking aquatic plants, lake integrity, and human activities. *Poster presentation*. Doctoral Research Showcase, University of Minnesota, Minneapolis, MN.
6. **Beck, M.W.**, Vondracek, B., and Hatch, L.K. 2012. Between and within lake responses of macrophyte richness metrics to shoreline development. *Oral presentation*. MN Department of Natural Resources Fall research meeting, Itasca State Park, MN.
7. **Beck, M.W.**, Vondracek, B., Hatch, L.K. 2011. Biological assessment of aquatic macrophytes in Midwest glacial lakes. *Oral presentation*. University of Minnesota Water Resources Graduate Program student symposium, Stillwater, MN.
8. **Beck, M.W.** 2009. Perspectives on sustaining Minnesota's lakes: Biological monitoring, IBIs, and stressor identification. *Oral presentation*. University of Minnesota Water Resources Graduate Program seminar, St. Paul, MN.
9. **Beck, M.W.** 2009. The Minnesota macrophyte IBI for lake assessment. *Oral presentation*. Habitat research meeting, Minnesota Department of Natural Resources, St. Paul, MN.

10. **Beck, M.W.**, Hatch, L.K., Vondracek, B., Valley, R.D. 2009. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Oral presentation*. Aquatic plant assessment meeting, Minnesota Pollution Control Agency, St. Paul, MN.
11. **Beck, M.W.**, Hatch, L.K., Vondracek, B., Valley, R.D. 2009. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Oral presentation*. Fisheries research meeting, Minnesota Department of Natural Resources, Cloquet, MN.

### *Contributed Presentations*

1. **Beck, M.W.** 2015. An overview of Shiny applications using R and RStudio. *Oral presentation*. USEPA Data Analytics and Visualization Community of Practice, USEPA NHEERL ORD, Gulf Breeze, FL.
2. Hagy, J.D., **Beck, M.W.**, Murrell, M.C. 2015. Improving estimates of ecosystem metabolism by reducing effects of tides on DO time series. *Oral presentation*. Coastal and Estuarine Research Federation Biennial Meeting, Portland, OR.
3. Bundy, M.H., **Beck, M.W.**, O'Brien, T.D. 2015. Synthesis of NERRS System-Wide Monitoring Program data: Using integrated analysis tools to detect trends. *Oral presentation*. Coastal and Estuarine Research Federation Biennial Meeting, Portland, OR.
4. **Beck, M.W.** 2015. SWMPPr: An R package for estuarine water quality time series. *Oral presentation*. USEPA R User Group meeting, USEPA NHEERL ORD, Gulf Breeze, FL.
5. **Beck, M.W.**, Hagy, J.D., Murrell, M.C. 2014. A novel approach for evaluation of water quality trends in Gulf Coast estuaries. *Oral presentation*. Bays and Bayous Symposium, Mobile, AL.
6. Murrell, M.C., Hagy, J.D., Aukamp, J., **Beck, M.W.**, Beddick, D., Craven, G., Duffy, A., Jarvis, B.M., Marcovich, M., Yates, D., Caffrey, J. 2014. Environmental drivers of ecosystem and plankton metabolism in Pensacola Bay, Florida. Bays and Bayous Symposium, Mobile, AL.
7. Hagy, J.D., Jarvis, B.M., Murrell, M.C., **Beck, M.W.** 2014. Modeling remediation of aquatic life impacts of episodic and diel cycling hypoxia via nutrient loading rate reduction. Bays and Bayous Symposium, Mobile, AL.
8. **Beck, M.W.** 2014. ggplot2 redux. *Oral presentation*. USEPA R User Group meeting, USEPA NHEERL ORD, Gulf Breeze, FL.
9. **Beck, M.W.**, Tomcko, C.M., Valley, R.D., and Staples, D.F. 2014. Analysis of macrophyte indicator variation as a function of sampling, temporal, and stressor effects. *Poster presentation*. Joint Aquatic Sciences Meeting, Portland, OR.
10. **Beck, M.W.**, Hagy, J.D. 2014. Adaptation of a weighted regression approach to

- evaluate water quality trends in Tampa Bay, Florida. *Oral presentation*. National Water Quality Monitoring Council annual meeting, Cincinnati, OH.
11. **Beck, M.W.**. 2014. The nuts and bolts of Sweave/Knitr for reproducible research. *Oral presentation*. USEPA R User Group meeting, USEPA NHEERL ORD, Gulf Breeze, FL.
  12. **Beck, M.W.**, Vondracek, B., Hatch, L.K., and Wilson, B. 2013. Evaluating the utility of a plant-based index of lake condition using neural networks. *Oral presentation*. Ecological Society of America annual meeting, Minneapolis, MN.
  13. **Beck, M.W.**, Vondracek, B., Wilson, B., and Hatch, L.K. 2013. Understanding indicators of lake health and the utility of a plant-based index. *Oral presentation*. Conservation Biology Graduate Program seminar, University of Minnesota, St. Paul, MN.
  14. Vondracek, B., Koch, J.D., and **Beck, M.W.** 2013. A comparison of survey methods to evaluate macrophyte index of biotic integrity performance in Minnesota lakes. *Oral presentation*. Minnesota chapter of the Am. Fisheries Society annual meeting, St. Cloud, MN.
  15. **Beck, M.W.**, Vondracek, B., Wilson, B., and Hatch, L.K. 2013. Understanding indicators of lake health and the utility of a plant-based index. *Oral presentation*. Conservation Biology Graduate Program seminar, University of Minnesota, St. Paul, MN.
  16. **Beck, M.W.** 2012. Effects of shoreline development on aquatic macrophytes: Summary of analyses. *Class lecture*. Ecological Modeling (FW 8200), University of Minnesota, St. Paul, MN.
  17. **Beck, M.W.**, Vondracek, B., Hatch, L.K., and Vinje, J. 2012. Image analysis techniques to evaluate effects of lakeshore development on aquatic habitat. *Oral and poster presentation*. Am. Fisheries Society annual meeting, St. Paul, MN.
  18. **Beck, M.W.**, Vondracek, B., Hatch, L.K., and Vinje, J. 2012. Image analysis techniques to evaluate effects of lakeshore development on aquatic habitat. *Oral presentation*. Water Resources Conference, St. Paul, MN.
  19. **Beck, M.W.**, Vondracek, B., Hatch, L.K., 2012. Identifying covariates of a lake assessment index to improve biological assessment. *Oral presentation*. Minnesota chapter of Society for Conservation Biology annual meeting, St. Paul, MN.
  20. **Beck, M.W.**, Vondracek, B., Hatch, L.K. 2011. Image analysis techniques to evaluate effects of nearshore lake development on aquatic macrophytes. *Oral presentation*. Midwest Fish and Wildlife Conference, Des Moines, IA.
  21. **Beck, M.W.** 2011. R is my friend: Or how I learned to stop worrying and love the machine. *Oral presentation*. Conservation Biology Graduate Program breakfast seminar, University of Minnesota, St. Paul, MN.

22. **Beck, M.W.**, Vondracek, B., Hatch, L.K. 2011. Image analysis techniques to evaluate effects of nearshore lake development on aquatic macrophytes. *Poster presentation*. Water Resources Conference, St. Paul, MN.
23. **Beck, M.W.**, Vondracek, B., Hatch, L.K. 2011. Image analysis techniques to evaluate effects of nearshore lake development on aquatic macrophytes. *Oral presentation*. Am. Fisheries Society annual meeting, Seattle, WA.
24. **Beck, M.W.**, Vondracek, B., Hatch, L.K. 2011. Image analysis techniques to evaluate effects of nearshore lake development on aquatic macrophytes. *Oral presentation*. Minnesota chapter of the Am. Fisheries Society annual meeting, Sandstone, MN.
25. **Beck, M.W.**, Hatch, L.K., Vondracek, B., Valley, R.D. 2010. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Poster presentation*. Midwest Fish and Wildlife Conference, Minneapolis, MN.
26. Koch, J.D., **Beck, M.W.**, Carlin, J. 2010. A comparison of survey methods to evaluate macrophyte index of biotic integrity performance in Minnesota lakes. *Poster presentation*. Midwest Fish and Wildlife Conference, Minneapolis, MN.
27. **Beck, M.W.**, Hatch, L.K., Vondracek, B., Valley, R.D. 2010. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Oral presentation*. International Congress for Conservation Biology, Edmonton, Alberta.
28. **Beck, M.W.**, Vondracek, B., Hatch, L.K. 2010. Assessing the health of Minnesota's lakes using indices of biotic integrity. *Oral presentation*. Joint meeting of the Minnesota chapters of Am. Fisheries Society, Society for Conservation Biology, and The Wildlife Society, Nisswa, MN.
29. **Beck, M.W.**, Hatch, L.K., Vondracek, B., Valley, R.D. 2009. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Oral presentation*. Water Resources Conference, St. Paul, MN.
30. **Beck, M.W.**, Hatch, L.K., Vondracek, B., Valley, R.D. 2009. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Poster presentation*. Land Conservation and Clean Water Summit, Chaska, MN.
31. **Beck, M.W.**, Hatch, L.K., Vondracek, B., Valley, R.D. 2009. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Oral presentation*. Symposium for best student paper, Am. Fisheries Society annual meeting, Nashville, TN.
32. **Beck, M.W.**, Hatch, L.K., Vondracek, B., Valley, R.D. 2009. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Oral presentation*. Minnesota chapter of the Society for Conservation Biology annual meeting, St. Paul, MN.

33. **Beck, M.W.**, Hatch, L.K., Vondracek, B., Valley, R.D. 2008. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Poster presentation*. Water Resources Conference, St. Paul, MN.
34. **Beck, M.W.** 2008. The index of biotic integrity: A review. *Class lecture*. Water quality and natural resources (ESPM 4061), University of Minnesota, St. Paul, MN.
35. **Beck, M.W.**, Hatch, L.K., Vondracek, B., Valley, R.D. 2008. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Oral presentation*. Conservation Biology Graduate Program seminar, University of Minnesota, St. Paul, MN.
36. Hatch, L.K., **Beck, M.W.**, Vondracek, B. 2007. Ecological assessment method development for Minnesota lakes. *Oral presentation*. North Am. Lake Management Society annual meeting, Orlando, FL.

## *Service*

### **Reviewer**

*Acta Oecologica*, 2015 • *Aquatic Botany*, 2011, 2014 • *Aquatic Sciences*, 2015 • *Development in Practice*, 2012, 2013 • *Ecological Indicators*, 2010 • *Ecological Research*, 2012 • Elsevier book chapter, 2014 • *Environmental Management*, 2010 • *Environmental Modelling & Software*, 2015 • *Estuaries and Coasts*, 2014, 2015 • *Hydrobiologia*, 2012 • *International Journal of Tropical Biology and Conservation*, 2013 • *International Journal of River Basin Management*, 2013 • *Journal of Applied Phycology*, 2015 • *Journal of the North American Benthological Society*, 2011 • *Lake and Reservoir Management*, 2013, 2014, 2015 • *Limnology & Oceanography*, 2013 • *Marine Ecology*, 2014 • *Marine Pollution Bulletin*, 2014 • Minnesota Department of Natural Resources, 2011 • *North American Journal of Fisheries Management*, 2010, 2011, 2012 • *Polar Biology*, 2011 • *Remote Sensing*, 2014, 2015 • *Science of the Total Environment*, 2011 • USEPA Office of Research and Development, 2014, 2015 • *Water Research*, 2015

### **Graduate student representative**

**Jan. 2013 - May 2013**

Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota

### **Student Activities Committee Co-Chair**

**Jun. 2010 - Aug. 2012**

2012 annual meeting of the American Fisheries Society

### **Fundraising Coordinator**

**spring 2011, spring 2012**

Conservation Biology Graduate Program, University of Minnesota

### **Seminar Coordinator**

**2009, fall 2011, spring 2012**

Conservation Biology Graduate Program, Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota



**Student Representative** Aug. 2009 - Aug. 2012  
Minnesota Chapter of the American Fisheries Society

**Student Club Officer** Sep. 2010 - May 2012  
Fisheries and Wildlife Club, Department of Fisheries, Wildlife, and Conservation Biology,  
University of Minnesota

**Lab Volunteer** summer 2005  
Florida Museum of Natural, University of Florida

### *Teaching Experience*

**Workshop Co-Instructor** Oct. 2015  
An Introduction to SWMP, System Wide Monitoring Program, National Estuarine  
Research Reserve System, NOAA. ([link](#))

**Workshop Co-Instructor** Nov. 2014  
NERRS/SWMP Data Analysis (Time-series) Workshop, System Wide Monitoring  
Program, National Estuarine Research Reserve System, NOAA. ([link](#))

**Workshop Co-Instructor** May 2013  
Using Available Software for Basic Analysis, Restoring Minnesota, University of  
Minnesota. ([link](#))

**Primary Instructor**, University of Minnesota Jan. 2012 - May 2012  
FW 5604 (Fisheries Ecology and Management), Department of Fisheries, Wildlife, and  
Conservation Biology, University of Minnesota

**Undergraduate Advisor**, University of Minnesota Mar. 2009 - May 2011  
Justine Koch (Gustavus Adolphus College), Kristan Maccaroni (University of Minnesota)

**Teaching Assistant**, University of Minnesota Sep. 2008 - Dec. 2008  
ESPM 4061/5061 (Water Quality and Natural Resources), Department of Environmental  
Sciences, Policy, and Management, University of Minnesota

### *Honors and Awards*

ORISE post-doctorate research highlights ( <a href="#">link</a> )	Feb. 2015
LaBounty Best Paper Award nomination, N. Am. Lake Management Society	Oct. 2014
Interdisciplinary Doctoral Fellowship, University of Minnesota <b>\$22500</b>	Sep. 2012
Best student paper award, MN chapter for Society of Conservation Biology	Mar. 2012
Carolyn Crosby Fellowship, University of Minnesota <b>\$1000</b>	Jan. 2012
Travel award, Conservation Biology Graduate Program <b>\$300</b>	Sep. 2011
Best student paper award, MN chapter of Am. Fisheries Society <b>\$200</b>	Feb. 2011
Travel award, Minnesota chapter of Am. Fisheries Society <b>\$65</b>	Feb. 2011

Fenske Memorial Award finalist, Midwest Fish and Wildlife Conference	Dec. 2010
Travel award, Strategic Env. Research and Development Program <b>\$700</b>	Jul. 2010
Travel award, Conservation Biology Graduate Program <b>\$300</b>	Jul. 2010
Travel award, Graduate and Professional Student Assembly <b>\$200</b>	Jul. 2010
Travel award, Minnesota chapter of Am. Fisheries Society <b>\$103</b>	Mar. 2010
Finalist in best student paper symposium, Am. Fisheries Society	Sep. 2009
Travel award, Conservation Biology Graduate Program <b>\$400</b>	Sep. 2009
Travel award, Graduate and Professional Student Assembly <b>\$165</b>	Sep. 2009
Conservation Biology Graduate Program summer fellowship <b>\$3500</b>	summer 2008
Phi Beta Kappa Honor Society	Dec. 2006
Dean's list for academic excellence duration of undergraduate education	2004 - 2006
Florida Bright Futures undergraduate scholarship <b>\$5250</b>	2003 - 2006

### *Professional Society Membership*

Coastal and Estuarine Research Federation	Sep. 2013 - Present
Midwest Aquatic Plant Management Society	Jan. 2012 - Present
Minnesota Native Plant Society	Mar. 2011 - Present
Society for Conservation Biology	Feb. 2008 - Present
American Fisheries Society	Feb. 2008 - Present

### *Technical Training and Additional Experience*

Workshop participant, Master R Developer, San Francisco, CA  
 Webinar participant, The Grammar and Graphics of Data Science  
 Workshop participant, New Tools for Water Quality Data Access and Trend Analysis. An Overview of the USGS R Packages: dataRetrieval and EGRET  
 Webinar participant, Revolution Analytics Introduction to R for Data Mining  
 Workshop participant, An Introduction to the Fundamentals of Linear Quantile Regression in R  
 On-line course, Principles and Techniques of Electrofishing, US FWS  
 Workshop participant, Simple Tools for Lake and Watershed Trophic Assessment (FLUX32, Bathtub, TASTR), St. Paul, MN  
 Workshop participant, Aquatic Plant Identification, Itasca State Park, MN  
 CPR and first aid certification