National Water Monitoring News

NWQMC

Highlights

The National Water Quality Monitoring Council brings together scientists, managers, and citizens to ensure information about the quality of our water resources is accurate, reliable, and comparable. The Council fosters collaborative and cost-effective approaches to improve and advance the science of water-resources monitoring.

Students from the Ocean Research College Academy measuring dissolved oxygen and collecting samples for nutrient analysis in Puget Sound. *(Photos courtesy of Katherine Dye, Everett Community College.)*

National Water Quality Monitoring Council

Working together for clean water

Words from the Council Co-chairs

Welcome to the 14th edition of the National Water Quality Monitoring Newsletter!

Since our last newsletter, the Council has continued to make progress and initiate new projects that support Council goals. A focal point for this progress was a face-to-face meeting of the Council held last December in Indianapolis at the Indiana Department of Environmental Management; we thank Martha Clark-Mettler and her staff for being such gracious hosts! At the meeting, the Council discussed future directions and a number of issues and activities were identified and then prioritized. Champions were selected to lead teams that would report to different Council work groups; the highest priority topics/actions identified for attention this year were:

- Council-based training Program for New Water Quality Professionals
- Improve Communication with the Volunteer Monitoring community
- Communicate National Findings on Nutrients and HABs to Public and Decision Makers
- Improve Quality of Data and Metadata in the Water Quality Portal
- Facilitate Communication between the Monitoring Communities and those Responsible for Developing Water Quality Standards

More information on the discussions, presentations, and subgroups formed at this meeting are available in the meeting notes posted on the Council website. We are always looking for additional help with our work group activities and would love to hear from you if you are interested in assisting with any of our work.

These recent activities are in addition to the continuing efforts of the Council's longstanding work groups and committees. The Methods and Data Comparability Board and the Aquatic Sensors work group continue to support the National Environmental Methods Index (NEMI), which is now directly linked to the Water Quality Portal; update the field deployment guide for water-quality sensors; and participate in multi-agency challenges to develop affordable sensors for nutrients and arsenic.

The Water Information Strategies (WIS) and Water Quality Portal work groups celebrated the approval of the Water Quality Portal Strategic 5-Year Plan at the February 21-22 meeting of the Advisory Committee on Water Information (ACWI, the Council's oversight committee). The plan focuses on increasing data submission to the Portal and on increasing the quality and accessibility of the water-quality data that can be accessed. The National Network of Reference Watersheds (NNRW) is focused on two goals in 2017: increasing the number of reference sites and related data in the NNRW, and communicating the NNRW website's capabilities.

Efforts to publicize all work of the Council continue under the Collaboration and Outreach work group through a variety of methods including Council-hosted webinars (six webinars over the past six months) and various forms of social media. The recently formed Volunteer Monitoring Work Group has begun updating an inventory of active volunteer monitoring and citizen science groups and is looking to expand Council communication with this increasingly important group of stakeholders.

The need to monitor the quality of the Nation's and world's waters continues and we hope the information presented in this newsletter is of use in your current work. Please continue to submit your water-quality news, announcements, successes, challenges, and findings to our newsletter editors for the Fall 2017 Newsletter (deadline for submission is September 1st, 2017).

Best Regards,

Gary Rowe, USGS Co-Chair
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Susan Holdsworth, EPA Co-Chair
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National Council Highlights

Water Quality Monitoring: A Guide for Informed Decision Making Fact Sheet Series now available on the NWQMC Website!!

Do you need help in explaining water monitoring to a non-technical audience? Are you working with decision makers who are confused by the array of monitoring programs, water data portals and tools to collect and interpret water quality information? The Water Information Strategies workgroup has developed a series of fact sheets intended to help explain and clarify differences in water quality monitoring designs. Each fact sheet is organized to answer the "how," "what," and "when" questions of monitoring design – How is the program implemented? What types of questions does this design answer? When is this particular design appropriate?

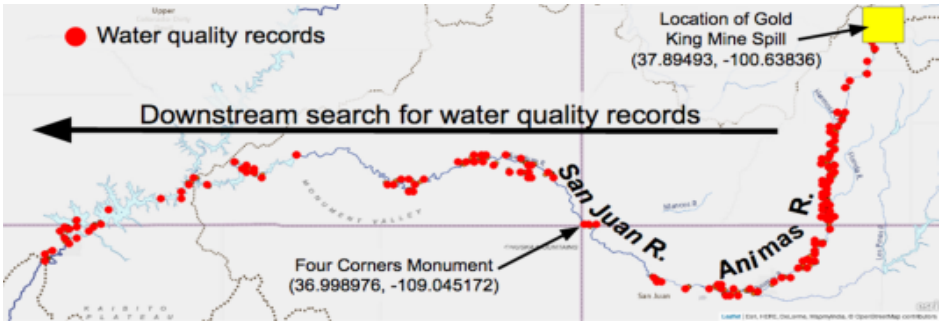
Examples from existing programs are provided to help guide the reader, and quick links provide more in-depth information for each topic. Additionally, topics on the Water Quality Portal and tools such as Water Quality Indices and Report Cards are available to help guide you in the management and use of water quality data. Available fact sheets on Statistical (Probabilistic) Surveys, Targeted Monitoring, Rotating Basins, Water Quality Indices and Report Cards, and the Water Quality Data Portal are available at acwi.gov/monitoring/pubs/.

More Data, More Features, and More Users for the Water Quality Portal

Over the last year, there has been a dramatic increase in the use of the National Water Quality Portal (Portal). Significantly more water data, as well as multiple new options for accessing and discovering data, are now available. There are now over 307 million result records in the Portal that cover all 50 states, with data from over 450 partner organizations. Every month, over 8,000 users download 1-2 billion records from the portal or its web services.

One of the most notable new features of the Portal is the ability to search for sites upstream and downstream from another feature of interest, such as a USGS stream gage. By taking advantage of the Network Linked Data Index, derived from the NHDPlus, users without GIS expertise can easily find other hydrologically-relevant sites. Another major feature of the Portal is the addition of site summary pages. As these pages were indexed by search engines such as Google, thousands of additional users who otherwise would have not been able to find the Portal and its data have been able to do so. An example site page is here: bit.ly/2mJz4aO

The Portal is a cooperative effort by the U.S. Geological Survey (USGS), the U.S. Environmental Protection Agency (EPA) and the National Water Quality Monitoring Council to bring together chemical, physical and biological data from the USGS's National Water Information System (NWIS), the EPA's Storage and Retrieval Data Warehouse (STORET), and the USDA STEWARDS database.

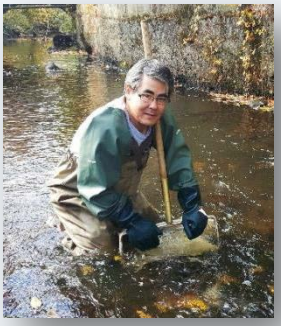


Schematic of a WQP NHDPlus query for water quality observations along the Animas and San Juan Rivers, 700 km downstream of the Silverton, Colorado Gold King Mine spill. This query returned 738 sites and 466,662 water quality results. Figures are derived from this paper and data were accessed on October 7, 2016 from www.waterqualitydata.us/

NWQMC Membership Updates

Welcome New Council Members!

Chris Bellucci, EPA Region 1 Representative



Chris Bellucci is the new EPA Region 1 state representative. Chris is a Supervising Environmental Analyst with the Connecticut Department of Energy and Environmental Protection. He has worked for CT DEEP for more than 23 years in the Inland Fisheries Division, TMDL Program, and in his most current role as Supervisor of the Water Monitoring and Assessment Program. Chris has also worked with the Florida Game and Fish Commission where he was a Regional Fish Biologist in the Everglades Region of South Florida. He received an MS in Renewable Natural Resources from the University of Connecticut and BS in Biology from Southern Connecticut State University.

Tim Asplund, EPA Region 5 Representative

Tim Asplund currently serves as the chief of the Water Resources Monitoring Section with the Wisconsin Department of Natural Resources. His role is to oversee implementation of all surface water monitoring activities with the Department, including citizen monitoring of lakes and streams, Clean Water Act monitoring for integrated reporting, evaluation monitoring for the 319 program (non-point effectiveness), National Aquatic Resource Surveys, and supporting other department programs including wastewater permitting, aquatic invasive species, and source water assessment program. He has held that position since July 2012. Prior to that, he worked as a water resource specialist in the lakes and groundwater management programs, serving as technical liaison between DNR staff, researchers, and citizen groups on a variety of water resource management issues. They include water quality monitoring, biological indicators, shoreland habitat assessment, aquatic invasive species, water levels, and climate change. Tim holds degrees in Water Resource Management and Limnology from UW-Madison.

The Council Bids Farewell to Michele Wheeler

Michele Wheeler is retiring from her service on the Council. Since 2014, Michele has worked for the Wisconsin Department of Natural Resources as the Lake Superior Coordinator. In that role, she works with binational partners around the lake to set water quality goals, and then works within the DNR and with local partners to implement projects to help achieve those targets.

Michele joined the Council as the Great Lakes Representative in 2015. “Being on the Council was a fantastic experience for me,” says Michele. “I so very much value what the Council works for: to support professionals in improving not only the science and technical aspects of water quality monitoring, but also enhancing the ways we communicate and utilize our work.” Michele served on the Water Information Strategies workgroup of the Council. Although she found planning the Council’s biannual conference rewarding, she was most excited about supporting the Water Quality Portal. “Before I joined the Council, I didn’t know much about the Portal,” says Michele. “I’ve come to appreciate what a powerful tool it is. We all want access to available data in our area of interest. By combining datasets from federal, state, tribal and NGO partners through NWIS, STORET, BioData and STEWARDS, the Portal compiles and delivers a tremendous amount of information in a fast and easy to use interface. It’s awesome.”

In the Spotlight

Team Effort Key to National Groundwater Monitoring Network Growth

The Subcommittee on Ground Water (SOGW) continues to make great strides in implementing the National Ground-Water Monitoring Network (NGWMN). It has been a wonderful team effort, combining the initiative and hard work of representatives from state government, federal agencies, the private sector, and academic institutions. Recent milestones include the following:

Photograph from the SOGW/NGWMN Meeting at NGWA Groundwater Week.

- The Network is providing support for new data providers in 18 states, and continued Network participation or Network enhancement in 17 states.
- The increased participation of Network data providers is shown directly by an increasing density of sites with data available through the NGWMN Data Portal (cida.usgs.gov/ngwmn/). While most of the effort to date has focused on enlisting new data providers and streamlining the processes required for their participation, continual improvements are being made in other aspects of the Data Portal, including several features for easing access to the ever-widening array of available data.
- The NGWMN Program Board was formed to evaluate proposals and provide advice on priorities. It is composed of representatives from data providers, federal agencies, and the SOGW, and is the recommended oversight and management structure of the Network.
- The SOGW reached consensus in late 2016 to update its Terms of Reference (TOR) to reflect an expanded role on groundwater issues in support of ACWI. The updated TOR was presented to and approved by ACWI at the 2016 ACWI annual meeting held February 22nd - 23rd.

The SOGW continues to maintain strong ties and collaborative interactions with the NWQMC as demonstrated by the integrated development of the NGWMN Data Portal and the NWQMC Water Quality Portal. Although these are separate products designed to serve different purposes, there has been a concerted effort to share data and links between the two portals, to increase efficiency and to reduce redundancy. For more information, please contact Lauren Schapker (lschapker@ngwa.org).

Collaboration Through Partnerships

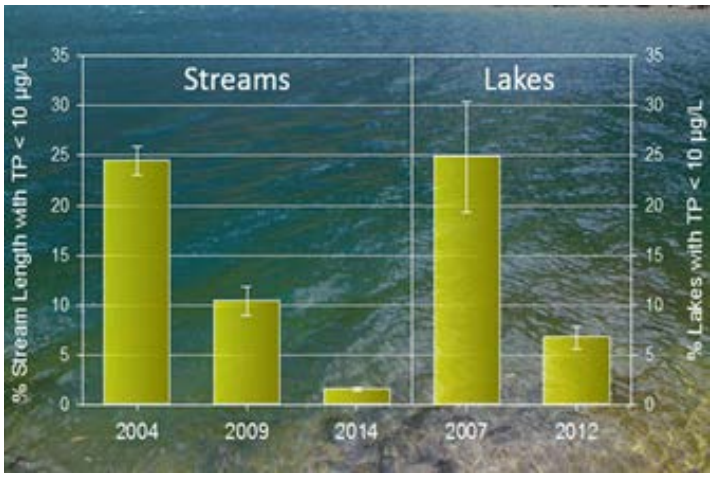
Federal Partnerships

Nutrient and Microcystin Findings from Four Recent National Aquatic Resource Surveys

The U.S. EPA, states and tribes conduct National Aquatic Resource Surveys (NARS) using a statistical survey design to answer key questions about the condition of the nation's waters. In 2016, the U.S. EPA released four NARS reports, completing an assessment of each of the water resource types (lakes, rivers and streams, coastal waters, and wetlands). Highlights of nutrient and microcystin findings are presented below.

Extent of waters with high levels of nutrients

The most recent reports show that at least 35% of U.S. lakes and 40% of rivers and streams have excessive levels of nutrients. High levels of nutrients can contribute to algal blooms, which may lead to low levels of oxygen and harm to aquatic life. Lakes and rivers/streams with excess phosphorus were two times more likely to have poor biological quality, as measured by the health of macroinvertebrate communities. Phosphorus was also found to be the most widespread stressor assessed in coastal systems, with 20% of coastal and Great Lakes waters rated poor for excess phosphorus.



From "Continental-Scale Increase in Lake and Stream Phosphorus: Are Oligotrophic Systems Disappearing in the United States?" by Stoddard, J.L., Van Sickle, J., Herlihy, A.T., Brahney, J., Paulsen, S., Peck, D.V., Mitchell, R., & Pollard, A.I. *Environmental Science & Technology*. 2016 *50* (7), 3409-3415. DOI: 10.1021/acs.est.5b05950.

Change in phosphorus levels

In addition, recent analysis of NARS data by Stoddard, et al. describes increases in lake and stream total phosphorus concentrations between 2000–2014. The increases were most notable in sites where phosphorus levels were initially low – relatively undeveloped catchments that suggest increasing concentrations cannot be attributed entirely to common point or nonpoint sources.

Algal toxins in lakes and wetlands

The lakes and wetlands surveys included sampling for an algal toxin, microcystin. Microcystin is a potent liver toxin produced by multiple species of cyanobacteria (blue-green algae) and can be harmful to humans, pets, and wildlife. About one-third of the nation's lakes had cyanobacteria present above World Health Organization levels of concern for recreational exposure (levels >20,000 -- moderate or high risk of exposure). Microcystin was detected in 39% of lakes, a 9.5% increase in detection from the initial 2007 lakes assessment; it was also detected in 12% of wetlands nationally. Of waters with microcystin detected, concentrations of microcystin rarely exceeded the World Health Organization recreational level of concern of >10 ug/l -- moderate or high risk of exposure (exceeded in less than 1% of the lake or wetlands surveyed). Additionally, the lakes survey measured the density of cyanobacteria cells, which can produce cyanotoxins, as an indicator of toxic exposure risk. The analysis reveals worsening conditions, with 8.3% more lakes in the most disturbed condition in 2012 than in 2007. Surveys of rivers/streams in 2013/14 and coastal waters in 2015 also included microcystin sampling; results will be discussed in upcoming reports. For more information on the findings of the four NARS reports, visit www.epa.gov/national-aquatic-resource-surveys.

Integrating Citizen Science into EPA Mission and Programs

In 1988, the U.S. EPA established the National Advisory Council for Environmental Policy and Technology (NACEPT or Council) to provide independent advice to the U.S. EPA Administrator on a broad range of environmental policy, technology and management issues. NACEPT helps the U.S. EPA gain broad points of views from academia, business and industry, non-profits, and local, state and tribal that would otherwise be unavailable to the U.S. EPA. NACEPT's 28 members typically research a topic provided by the U.S. EPA Administrator for two years and produce two reports. The first report contains high-level recommendations and the second flushes out concepts, recommendations and questions generated from the first report.

In September 2014, the U.S. EPA charged NACEPT with helping the U.S. EPA integrate citizen science into its mission and programs. On December 13, 2016, the NACEPT formally submitted *NACEPT 2016 Report: Environmental Protection Belongs to the Public, A Vision for Citizen Science at EPA.* The report identifies a set of recommendations that include:

- Embrace citizen science as a core tenet of environmental protection
- Invest in citizen science for communities, partners and the U.S. EPA
- Enable the use of citizen science data at the U.S. EPA
- Integrate citizen science into the work of the U.S. EPA

The report provides program examples of how citizen science is assisting a range of decision makers and providing diverse outcomes, results and impacts. It addresses citizen science monitoring both water and air; citizen science is more mature in water but has few large-scale networks, while large-scale networks exist for air monitoring but local citizen science lags. For more information, contact Barb Horn (barb.horn@state.co.us).

Citizen Scientist collects a fish sample.

A New Perspective on Great Lakes Water Quality

U.S. Forest Service researchers led a project funded by the Great Lakes Restoration Initiative that parsed the vastness of the Great Lakes using satellite data to estimate water quality in different basins. This information can identify which areas are likely to receive high nutrient inputs – which can cause harmful algae blooms and dead zones – and where resource managers should invest in restoration efforts.

The researchers analyzed satellite imagery for vegetation changes and land use (agriculture, urban, forest, etc.) around Great Lakes basins and watersheds for which water quality data already existed. By doing so, they could determine which watershed conditions and land uses result in various downstream water conditions. They applied this cause and effect information to unmonitored basins and watersheds to estimate their water quality based on surrounding land use, providing information to help prioritize monitoring and restoration. These estimates demonstrate how different land uses and changes in forest coverage affect the natural filtering of nutrients or pollutants from water.

Projects such as these provide ways to prioritize monitoring and restoration efforts to benefit not only natural ecosystems, but also to everyone who lives nearby and relies on them for drinking water, jobs, and recreation. For more information on this project, contact Charles "Hobie" Perry (charleshperry@fs.fed.us), or visit the project's blog.

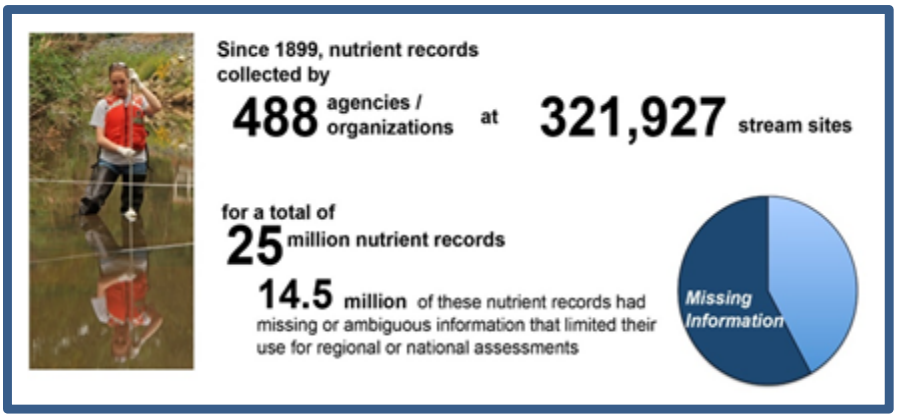
Challenges Remain in Combining Data from Multiple Agencies to Assess the Quality of Our Nation's Streams and Rivers

A new U.S. Geological Survey study reports that almost 60 percent of previously collected nutrient water-quality records for U.S. rivers and streams have missing or ambiguous supporting information. This inconsistency limits the use of these data for assessing water quality across large river basins.

The study found that nearly 14.5 million of the 25 million records collected since 1899 by 488 public and private organizations at 321,927 sites across the country had missing or ambiguous metadata—the standard descriptive information needed to determine the amount of a chemical present in the sample.

Because individual monitoring organizations understand their own data well, they are able to use the data locally to meet the original goals of data collection. The problem arises when trying to combine data from multiple sources to assess water-quality conditions in large watersheds, such as the Potomac or Mississippi River Basins. Monitoring organizations often report the same metadata elements differently.

The adoption of standard metadata practices across all monitoring organizations in the United States could increase the amount of water data that can be used to assess water management actions in large watersheds, potentially leading to important water-quality insights that would not otherwise be possible. For more information, contact Lori Sprague at lsprague@usgs.gov.



Benefits of Agricultural Conservation in the Upper Mississippi River Basin Quantified by New USGS-USDA Study

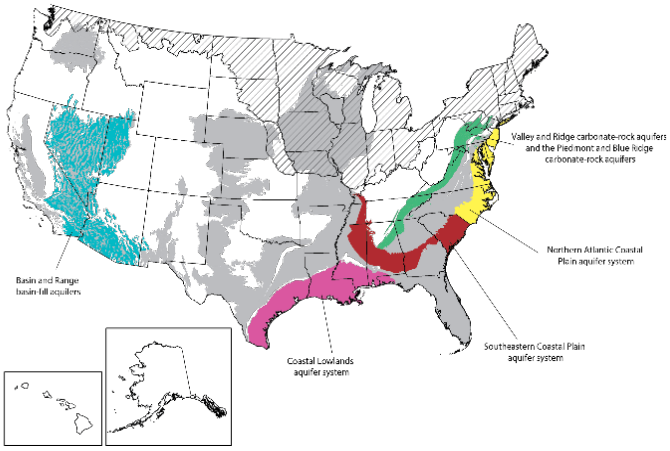
Nutrient reductions attributable to agricultural conservation practices in the Upper Mississippi Basin ranged from five to 34 percent for nitrogen and from one to ten percent for total phosphorus, according to a new study published in the journal *Environmental Science and Technology*.

The study integrated conservation science and farmer survey information obtained by the USDA Conservation Effects Assessment Project (CEAP) with the USGS SPARROW water-quality model to determine the extent to which stream nutrient levels were affected by the use of conservation practices on farms.

Additional information on the USGS SPARROW modeling approach and a nutrient mapper for the Mississippi River basin are available online. For additional information on the study, contact Ana Garcia (agarcia@usgs.gov).

Quality of the Nation's Groundwater: Progress on a National Survey

About half of the nation's population relies on groundwater for drinking water. As the nation's population grows, the need for high-quality drinking-water supplies becomes even more urgent.



The USGS has identified 68 principal aquifers, or regionally extensive aquifers, that can be used as a source of drinking water, across the nation. Groundwater pumped from these aquifers provides nearly 50 percent of the nation's drinking water. Twenty of these principal aquifers account for about 75 percent of the nation's groundwater pumped for public supply and 85 percent of the groundwater pumped for domestic (private) supply. These 20 principal aquifers are being intensively evaluated by the USGS National Water-Quality Assessment Project between 2012 and 2023. Summary results for five principal aquifers are recently completed and now available online.

USGS scientists are assessing water quality in source (untreated) water from wells in principal aquifers. This comprehensive sampling is focused on public-supply wells that tap deeper groundwater. Along with detailed information on geology, hydrology, geochemistry and chemical and water use, this data can be used to explain how and why aquifer vulnerability to contamination varies across the nation.

These regional aquifer studies provide water utilities and resource managers with information about:

- Regulated and unregulated constituents from natural or human sources,
- Pesticides, pharmaceuticals, hormones and other constituents of concern for human health,
- Present groundwater quality, to be compared with future conditions,
- Regional and national statistics on water quality, as context for individual wells,
- Water quality in the shallow and deep parts of aquifer systems,
- Environmental tracers that can be used to understand sources and sustainability of groundwater supplies, and
- Improved understanding of local, regional and national hydrogeology.

For additional information, contact Marylynn Musgrove (mmusgrov@usgs.gov).

Do you have water-quality monitoring topics or issues you would like to see in the next edition of the newsletter or covered in a webinar? Are there topics you would like the National Water Quality Monitoring Council to address in coming months and years? If so, feel free to reach out and let us know about your ideas.

Please contact us by emailing NationalMonitoringCouncil@gmail.com with "Suggestion Box" in the subject line, or visit our website to submit a suggestion. We will do our best to address concerns and issues that are raised by our audience.

Spotlight on States

Delaware River Basin Commission Report Now Available

The Delaware River Basin Commission (DRBC) compared baseline water-quality data initially collected from 2000-2004 to the assessment period of 2009-2011 at 24 sites located on the Delaware River and tributaries. For most water quality parameters at most locations, there were no measurable changes to existing water quality; however, nutrient concentrations were reduced at most sites. DRBC's Special Protection Waters (SPW) program is designed to prevent degradation in areas where existing water quality is better than the established water quality standards, using management and control of wastewater discharges and reporting requirements.

Chloride was one of the few parameters where a measurable increase did occur at several locations, but the monitored results remained well below levels that would impact the aquatic environment. This upward trend, which is not unique to the Delaware River, is likely caused by winter road salting in the watershed.

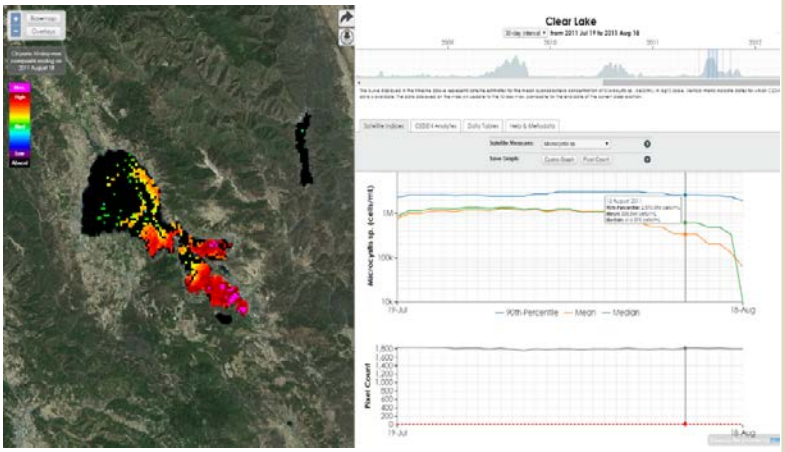
The report and details about the SPW program are available online. For more information on this project contact Robert Limbeck (Robert.Limbeck@drbc.nj.gov).

DRBC Senior Aquatic Biologist Robert Limbeck collects a water quality sample from the Delaware River as part of DRBC's monitoring program for SPW. *(Photo by DRBC.)*

California HAB Portal Has New Feature

A new feature will appear on California's Harmful Algal Bloom portal that displays satellite imagery designed to detect both emerging and historical blooms. Using data and algorithms provided by the National Oceanic and Atmospheric Administration's National Centers for Coastal Ocean Science, the San Francisco Estuary Institute developed a new tool under the guidance of California's Bio-accumulation Oversight Group. The map interface uses satellite data to display estimated concentrations of cyanobacteria in large water bodies to better understand potential risks to public health. Data are displayed on a map to show the spatial extent of blooms and are also viewable in long and short timelines to show how concentrations vary over time. Additionally, field data can simultaneously be displayed from the California Environmental Data Exchange Network to provide users a combination of information sources to better understand the status and trends of blooms and the potential risks to public health.

The new tool will be available by June 2017 and offers water managers and the public the opportunity to review and compare remote imagery and discrete water sample sources of information in an exploratory interface. Near-real-time satellite imagery will soon be readily available, which will increase the tool's value for decision-making. For more information on this tool and its applications, please contact Randy Turner at randyt@sfei.org.



Basemap image provided by ESRI. Bloom data furnished by NOAA and the San Francisco Estuary Institute.

Shale Gas Volunteer Monitoring Case Study Published in Inaugural Issue of Citizen Science Journal

In response to community requests, the Alliance for Aquatic Resource Monitoring (ALLARM) developed a volunteer-friendly protocol in 2010 to monitor water quality (conductivity, barium, strontium, and total dissolved solids) and physical conditions (stream stage and visual observations) prior to, during, and after shale-gas well development.

A volunteer conducts weekly monitoring on a stream in Pennsylvania. ALLARM shale gas volunteers monitor streams for physical and chemical parameters in order to collect baseline data and report possible violations to authorities.

ALLARM has published an article documenting their shale-gas volunteer monitoring program in the newly-formed Citizen Science Association's open-access, peer-reviewed journal *Citizen Science: Theory and Practice*. This case study describes the protocol and examines three years of water quality results from hundreds of monitoring sites in Pennsylvania and New York.

The majority of watersheds monitored are small, forested, headwater streams. Results indicate that mean conductivity in streams is positively related to the percentage of development and the percentage of limestone in the watersheds. Mean conductivity is not significantly related to the number or density of drilled wells; however, the dataset did not lend itself to finding a signal from shale gas activities because only 20% of the watersheds had wells drilled at the time of sampling. This fact enables the use of these data as baseline data for future documentation of shale gas impacts on water quality. Volunteers have reported multiple cases of visual pollution related to shale gas activities, but have not identified water contamination events based on stream water chemistry.

The results of the volunteer dataset were compared with results from the scientific literature, affirming the credibility and usefulness of the data. Lessons learned from this project include the importance of strong and timely support to volunteers to ensure accurate reporting in real-time; the unique role that citizen scientists can play in a rural landscape where well sites are remote and government oversight is not practical; and the importance of customizing a citizen science operational model to fit the goals and scale of the project. For more information, please contact Candie Wilderman (wilderma@dickinson.edu) or Jinnie Monismith (monismij@dickinson.edu).

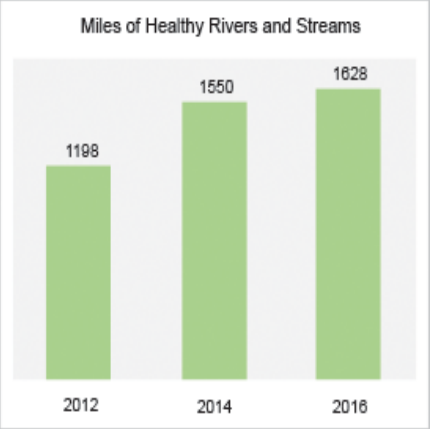
Story Maps Illustrate Threat to Appalachian Trout

Since 2010, Trout Unlimited (TU) volunteers have been monitoring for impacts related to energy development in Central Appalachia. Through this program, hundreds of volunteers have collected data at more than 800 monitoring locations in Pennsylvania, West Virginia and Virginia. To highlight the efforts of their volunteers, TU has developed an interactive story map on its Atlantic Coast Pipeline monitoring efforts.

This map has proven to be an effective tool. TU volunteers have said that seeing their sites with others along the pipeline route drove home their connection to the bigger picture. The story map has also proven to be an effective tool in partner outreach, connecting the dots to show the why, where, and how TU's program works to engage volunteers to monitor streams along natural gas pipeline routes. Story maps can be built online for free.

Volunteers search for Connecticut's "Most Wanted" Taxa

Connecticut's Riffle Bioassessment by Volunteers program (RBV) is a volunteer water-quality monitoring protocol developed and administered by the Water Monitoring Program at the Connecticut Department of Energy and Environmental Protection (CT DEEP). The Program was initiated to increase the spatial coverage of monitored waters in the state, to provide a mechanism to educate citizens about watersheds and biological monitoring, and to link to CT DEEP's assessment work.



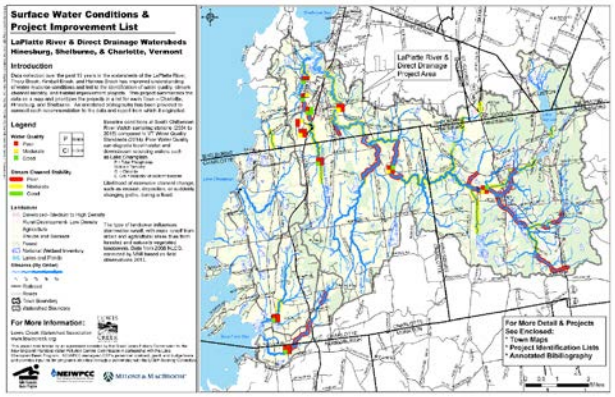
The RBV program has helped to increase the miles of monitored healthy waters in the state and has also has the added value of educating citizens about water quality and stream health.

Each fall, volunteers from across the state participate in a 'treasure hunt' to find Connecticut's healthiest streams. By documenting the location and condition of healthy streams, CT DEEP and volunteers can work to identify and better protect and preserve them. The RBV Program helps DEEP and local residents understand resources from a stream health standpoint while providing additional spatial coverage of monitored sites in the state. The data collected from the RBV Program are used by CT DEEP for Clean Water Act 305(b) assessments. If volunteers find four or more sensitive macroinvertebrate taxa ("most wanted" taxa), then a site can be considered for a healthy stream assessment (i.e. fully supporting aquatic life goals).

The Program has been communicating general information and monitoring results, providing tools for site selection, and distributing a list of "most wanted" taxa in a web interface format. For more information on this project, contact Meghan Lally (Meghan.lally@ct.gov) or Chris Bellucci (Christopher.bellucci@ct.gov).

South Chittenden River Watch Scorecard Mapping Tool

The South Chittenden River Watch (SCRW) is a Vermont volunteer water monitoring group that has been collecting water quality data in the LaPlatte River watershed region since 2004. The SCRW'state and EPA-approved data results aim to help towns and landowners understand why, when, and where nutrients such as phosphorus are entering local streams, and ultimately Lake Champlain. Lake Champlain is facing an overload of phosphorus and other pollutants. This overload is accelerating lake eutrophication and causing negative ecological effects that are damaging to the local and state economies.



In 2015, the Lewis Creek Association (LCA) created the "LaPlatte Scorecard Map" as tool for citizens, counties and municipalities to understand the quality of their local streams. This map allows LCA and others to display trends and identify catchment areas where phosphorus and stormwater treatment practices will have meaningful impacts.

The annually-updated scorecard map shows water quality status, trends, and stream corridor conditions across Vermont's southern Chittenden County watersheds. LCA's Ahead of the Storm (AOTS) program selected fourteen water quality demonstration sites based, in part, upon the results of this scorecard map. These AOTS project sites involve LCA-property owner partnerships, site assessments and recommendations, treatment designs and costs, implementation and long term stewardship plans. All sites are available for educational visits. For more information, contact LCA Program Manager Krista Hoffsis, 513 470 7554, mkhoffsis@yahoo.com.

Monterey Regional Stormwater Monitoring Program Finds Water Quality Improvements

Monterey Bay National Marine Sanctuary Foundation staff train volunteers.

The Monterey Regional Stormwater Management Program (MRSWMP) has advocated for citizen science and community involvement in order to cost-effectively meet stringent stormwater permit requirements under the Clean Water Act and municipal MS4 NPDES permits. A recent comprehensive trend analysis of long-term monitoring data conducted by the Monterey Bay National Marine Sanctuary's Citizen Watershed Monitoring Network shows improvements in storm water since the introduction of NPDES MS4 Phase II permits in 2007.

The study presents five separate statistical analyses which assess changes in storm water quality in the Monterey Bay. It includes pre-permit data collected between 2000 and 2006 and volunteer data collected post-permit. Twenty-three storm drain outfalls exceeding 18" in diameter were selected as monitoring sites. Volunteers collected grab samples from each of these sites to amass dry run, first flush, second flush, and spring/summer run data. They measured conductivity, pH, temperature, and transparency on-site. Samples were sent to the laboratory to determine concentrations of nutrients, total metals, total suspended solids, and bacteria.

The findings suggest a correlation between a decrease in pollutant concentrations from storm water outfalls and efforts conducted by local municipalities. These efforts include outreach, implementation of best management practices, planning and development guidelines, and additional NPDES stormwater permit requirements.

A copy of the *Monterey Regional Stormwater Program Summary Data Analysis and Graphic Display* report can be found online. For more information, contact Jeff Condit, Program Manager of the MRSWMP, at jeff@mrwpca.com.

Plates vs. Nets: Are Wadeable and Non-Wadeable Benthic Macroinvertebrate Sampling Techniques Comparable? A Citizen Science Study

The Charles River Watershed Association (CRWA) has been working to expand its monitoring effort beyond traditional physical and chemical indicators of water quality to include biological indicators.

Multi-plate sampling device weighted with a brick and marked with a buoy (not shown) in Bogastow Brook, Massachusetts. *(Photo credit: Alexandra Flowers)*

Since 2013, CRWA has been training volunteers to use dip nets to collect benthic macroinvertebrates from the upper Charles River and its tributaries, identify the organisms they find, and calculate water quality scores. This approach led to biological monitoring at about 10 sites every summer. However, volunteers were not able to collect biological data for the lower 65 miles of the 80-mile Charles River because it is too fast and deep to wade. During the 2015 and 2016 field seasons, CRWA deployed multi-plate sampling devices at select locations and also sampled for benthic macroinvertebrates using dip nets to assess the viability of using these techniques to monitor sites that have different hydrologic conditions.

Multi-plate sampling devices offer several potential advantages over dip net sampling. They can be hung from docks or other structures or suspended between weights and buoys, allowing them to be used in non-wadeable waters. Because the plates are left in the field for 3-6 weeks, the field team does not need to spend as much time sampling. However, because one device only collects macroinvertebrates in one place, multi-plate devices do not capture as much spatial diversity in sampling as volunteers do using dip nets.

The data CRWA collected in 2015 and 2016 showed that this spatial diversity may contribute significantly to water quality scores calculated using the U.S. EPA's Stream Biotic Index (SBI), which uses the types and abundance of macroinvertebrates present to classify a site as having good, fair, or poor water quality. While all three of the samples collected by volunteers using dip nets resulted in fair water quality scores, most of the samples collected using multi-plate sampling devices resulted in poor water quality scores. Results showed that multi-plate samplers had a tendency to collect fewer types of Class II organisms. CWRA anticipates using multi-plate samplers in the future to help determine what types of organisms are present at different locations, but not for calculating water quality scores.

For more information, contact Elisabeth Cianciola (ecianciola@crwa.org) or visit Charles River Watershed Association's website.

Audubon Naturalist Society's Water Quality Monitoring Program Report on Stream Health in Montgomery County, MD

The Audubon Naturalist Society (ANS) has sponsored a volunteer water-quality monitoring program in Montgomery County, MD and Washington, DC for the past 25 years. Approximately 180 volunteers visit permanent stream sites four times a year to collect and identify benthic macroinvertebrates to the taxonomic family level and to conduct habitat assessments.

Last year, ANS published a report of stream health in Montgomery County from 2010-2015. Data show that water quality is declining in many streams. Although Montgomery County has set aside Special Protection Areas to protect water quality, even in some of these protected areas the stream reaches are not healthy. Causes of reduced water quality throughout the area include high volumes of polluted runoff coming off paved surfaces after rainstorms, which leads to streambank erosion and channel destabilization; disruption from repairs to sanitary sewers buried in the streams; low baseflows (i.e. streams run lower than they did historically); loss of forested buffers along the streambanks; presence of algae which clouds the water and reduces oxygen available to fish and insects; occasional high pH; and invasive plants. The summary report can be found here.

Tribal News

Keeping Forested Wetlands Forested: A Pilot Project Addressing Invasive Species and Climate Change Impacts

The emerald ash borer (EAB), an invasive beetle native to Southern Asia, is now found in dozens of states and has killed millions of ash trees across the U.S. Recently it was discovered near the Fond du Lac Band of Lake Superior Chippewa's Reservation boundary, in Northern Minnesota.

Shannon Kesner, Fond du Lac Wetlands Specialist, collects forestry data.

Minnesota has more ash trees than any other state and the Fond du Lac Forestry Department has mapped over 1,400 acres of black ash-dominated depressional wetlands on the Reservation. Black ash is used for many cultural purposes including basketry, snow shoe frames, ceremonial hand drum shells, toboggans, sleds, and ceremonial pipe stems. The reservation has already experienced decline in many of its black ash stands due to hydrologic impacts from roads, and anticipates further stress from climate change impacts.

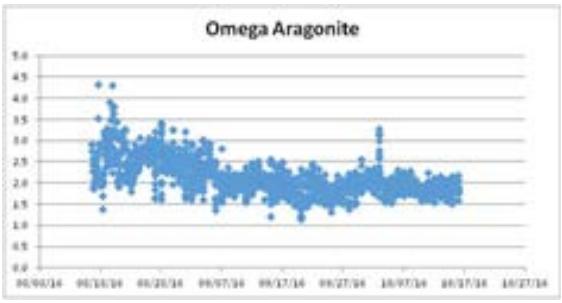
Black ash trees transpire significant volumes of water, maintaining a relatively low and stable water table during the summer months and a specific hydrologic regime. The Band is concerned that EAB infestation could kill all the ash trees growing in these monotypic swales. Infestation may convert these valuable, high-functioning forested wetlands to non-forested wetland types through encroachment from non-native narrow-leaf cattail. It may also negatively impact critical hydrology in watersheds of culturally and ecologically important wild rice lakes, or decrease water quality in river reaches where lake sturgeon have been successfully reintroduced.

Fond du Lac is in its second year of a 3-year EPA grant-funded pilot project to determine viable replacement tree species that can be successfully grown in existing black ash stands. If these non-ash species can tolerate the unique conditions of the black ash stands, they may be able to transpire enough water to keep hydrological functions intact, even if all the ash are killed by EAB. Five different tree species were planted in several black ash wetlands, with their growth, survival, and health assessed semiannually. Piezometers were installed on the exterior and interior of each site to determine hydraulic gradients and to conduct water chemistry sampling, allowing assessment of wetland functionality (depth/duration/frequency/seasonality of saturation, interaction with ground water, hydrologic inputs and outputs). Results of this pilot can inform successful future tree species underplantings in forested wetlands, and identify black ash swamps that could be targeted for intensive systemic insecticide treatment to prevent EAB infestation.

For more information, contact Christian Nelson or Shannon Kesner of the Fond du Lac Resource Management Office at 218-878-7101. A report with the first year's results is available.

Using Sensors to Understand Carbonate Chemistry in a Coastal System

One of the goals for Friends of Casco Bay, a marine stewardship organization founded in 1989 to improve and protect the environmental health of Casco Bay, Maine, is to develop a better understanding of the variability and drivers of carbonate chemistry in a coastal system. As part of this effort, a pCO_2 sensor with a Submersible Logger was deployed in July, 2016 alongside a multi-parameter data sonde providing temperature, salinity, dissolved oxygen, chlorophyll, and pH data. Both instruments collect measurements hourly and are secured to a platform in about four meters of water at high tide; the station should remain in place year-round. From the pH and pCO_2 data, analysts are able to estimate dissolved inorganic carbon, total alkalinity, and omega aragonite.



Estimated Omega Argonite from August 8th to October 17th, 2016

A very preliminary look at data collected so far reveals predominately seasonal variability with occasional weather-related influences. A strong negative correlation between dissolved oxygen and pCO_2 suggests that a dominant control of pCO_2 is the balance between productivity and respiration. In addition, the saturation state (omega) of aragonite shows episodic dips below 1.6, a threshold critical in the development of bivalve shells. Generally, these dips occurred during rain events and higher values prevailed under drier conditions. For more information, contact Mike Doan at mdoan@cascobay.org.


Friends of Casco Bay Research Associate Mike Doan prepares to deploy the pCO2 sensor.

Nutrient Sensor Challenge Winners Announced at ASLO Conference

Market Challenge Aimed to Accelerate Development of Affordable, Accurate Nutrient Sensors

The winners of the Nutrient Sensor Challenge were announced at a special awards session at the Association for the Sciences of Limnology & Oceanography Aquatic Sciences (ASLO) meeting in Honolulu, Hawaii, on Thursday, March 2, 2017.

Launched in December 2014, the Nutrient Sensor Challenge aimed to accelerate the development, production, and use of affordable, reliable, and accurate nutrient sensors. These sensors will enable automated and high-resolution nutrient monitoring in aquatic environments ranging from freshwater lakes and streams to the coastal ocean. Nutrient pollution is one of the nation's most difficult environmental challenges. While nutrients are essential compounds for functioning ecosystems and the production of food, fiber, and livestock feed, excessive nutrient levels can dramatically alter aquatic environments and threaten economic and human health.

An independent judging panel selected Systea S.p.A. as the winner for both nitrate and phosphate sensors. The Systea instrument represents a cost-effective, commercially-available solution for measuring both nitrate and phosphate in an integrated package. It uses a wet chemistry approach and performed well in lab testing and across the three field deployments, including 72 days in the Chesapeake Bay.

The judging panel awarded an Honorable Mention for Innovation and Potential to the National Oceanography Centre (NOC) team. The NOC sensor represents a fundamentally new approach to the wet chemical in situ analyzer method, using chip-based microfluidics technology. Though some engineering challenges need to be addressed for continuous, full-scale field deployment, the sensor performed well in the lab and maintained accuracy and precision across a wide range. The sensor is also forecast to be near the Challenge goal for purchase price.


Denice Shaw from EPA Office of Research and Development presenting award to Pompeo Moscetta of Systea.

The Nutrient Sensor Challenge was launched by the Challenging Nutrients Coalition, a collaboration between government agencies, NGOs, and academia that uses open innovation and incentive prize approaches to advance nutrient pollution management and reduction. The Coalition partnered with the Alliance for Coastal Technologies (ACT) to stimulate these new innovations. The challenge goal was for new, more accurate, precise and reliable technologies to be commercially available by 2017 for less than $5,000, with other significant savings in cost-of-ownership. All instrument performance testing results will be available in a series of individual verification reports published on the ACT website in April 2017.

More information on the nutrient pollution issue, the Nutrient Sensor Challenge, and the winners can be found at www.nutrients-challenge.org.

Upcoming Conferences and Workshops

River Rally

River Rally is a national conference sponsored by the River Network that attracts hundreds of river and watershed protection enthusiasts and experts, conservation professionals, and thought leaders from across the country and the world to learn from each other, share what works, get inspired, and celebrate success. River Rally 2017 will take place May 8-11 at the Amway Grand Plaza Hotel in Grand Rapids, MI.

International Conference on Instrumentation, Control, and Automation

The 12th International Water Association (IWA) Specialized Conference on Instrumentation, Control and Automation (ICA) will provide a forum to exchange methodologies and international experiences on all aspects of sensor technology, instrumentation, control and automation for water and wastewater treatment and transport systems. Specific topics will include sensors and instrumentation, modeling and simulation for control, control systems, detection and early warning systems, diagnosis systems, life cycle analysis, practical experiences with instrumentation and control, internet of things, cyber security, big data. This conference will take place June 11-14, 2017 in Quebec City, Quebec, Canada.

Tribal Lands and Environment Forum: A National Conversation on Tribal Land and Water Resources

The annual Tribal Lands and Environment Forum (TLEF) will be taking place at the COX Business Center in Tulsa, Oklahoma, August 14-17, 2017. The Forum will feature special trainings, field trips, and breakout sessions focused on solid/hazardous waste management, brownfields, UST/LUSTs, Superfund sites, and emergency response. Tribal water program topics will also be included with breakout sessions, trainings and field trips related to tribal water programs – water quality, drinking water, and habitat restoration (including wetlands, streams and fisheries).

37th International Symposium of the North American Lake Management Society: Finding Balance

The annual Symposium of the North American Lake Management Society (NALMS) will take place on November 6-9, 2017 at the Westin Westminster, in Denver, Colorado. The theme for this conference is Finding Balance -- the key to managing our lakes, reservoirs, watersheds, and even day-to-day relationships with people. The Call for Abstracts is now open; NALMS encourages the submission of papers addressing topics of broad interest to the lake and reservoir management community.

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Recent webinars include:

- Changing Pesticide Use: Challenges for Water-Quality Monitoring and Ecological Implications
- Introduction to Environmental DNA (eDNA)
- Volunteer Monitoring: Starting Strong

Webinars are hosted frequently and cover a broad range of topics. New webinars are uploaded to this site shortly after the initial broadcast, and slides are available on the NWQMC's website. Subscribe to our Webinar Announcement Listserve on our webinar page.

Editorial Board

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