Potomac Basin
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C. Dalpra

Whitewater boating on the North Branch Potomac and Savage rivers is one of several popular uses that is affected by reservoir operations.

Getting the Most from the River's Flows

As the population of the Potomac River basin continues to grow at a rapid pace in many areas, so do the demands we place on the river. The basin's population depends on the watershed's rivers and related groundwater for drinking and household use. Treatment plants along waterways treat wastes from people and industries before returning the treated water to the river. Large groups of people use waterways to fish and boat. Whitewater paddlers frequent high-gradient headwaters and time their trips with releases of water from upstream reservoirs to increase the thrill factor. These and other uses are growing in popularity, with more users looking for more opportunities. Recreational use of the river is a very important and growing economic factor, particularly in the upper basin. These uses also depend on a healthy river ecology that underpins the appreciation of the resource.

The volume, quality, and timing of these activities are affected by how the river is managed, particularly operation of upstream reservoirs that supply water during droughts, provide for minimum flows to enhance water quality during the summer months. Releases from two major reservoirs—Savage River Reservoir and Jennings Randolph Reservoir on the North Branch Potomac River—can have a significant impact on how the river is used downstream, especially in the summer. The rules used to guide these operations are flexible enough that small changes are made on a regular basis, but the growing use of the river has made a basic review of operating rules attractive.

Our mission is to enhance, protect and conserve the water and associated land resources of the Potomac River and its tributaries through regional and interstate cooperation.

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Working closely with the Baltimore District of the U.S. Army Corps of Engineers, the Upper Potomac River Commission, and stakeholders throughout the basin, the ICPRB Section for Cooperative Water Supply Operations on the Potomac (CO-OP), which helps manage reservoir operations during times of drought, has initiated a study to redesign the operational rules for these two reservoirs. The goal of the study is simple: to find ways to operate Savage and Jennings Randolph reservoirs that maximizes the many uses of the river.

The study came about through ICPRB CO-OP's involvement with a committee called the North Branch Advisory Group. This group is composed of professionals and volunteers interested in recreation, fisheries, and water quality on the North Branch Potomac and Savage rivers. The group formed to provide input to the Corps, which operates the reservoirs, about the flow levels needed to support fishing and whitewater boating activities. After about two years of meetings and regular email communications, the group reached a consensus on a general schedule of reservoir releases that could meet these objectives in a balanced way. The Corps agreed that it would try to adhere to the proposed release schedule, but they made it clear that any kind of drought or risk of flood would make it difficult to do so. Unfortunately, conditions have been quite dry for the last several months, requiring the Corps to deviate from the proposed release schedule.

The North Branch Advisory Group has done some excellent work developing general recreation goals for downstream of the reservoirs, although the recent dry conditions showed that more work needs to be done. A detailed investigation about how these recreation goals can be addressed without harming other priorities for the reservoirs, such as supporting water quality, is needed.

Several other issues suggest the need for a new comprehensive evaluation of North Branch operations. The most important is water quality on the North Branch, which has improved significantly since the 1980s. The Corps has adjusted its operations as conditions have improved, but more can be done. Many of the communities that rely on the Potomac for water supply are growing, as will their need for more water. This includes the Washington, D.C., metro area, whose water suppliers jointly own nearly half of the storage in Jennings Randolph Reservoir. Finally, recreation on Jennings Randolph Reservoir itself has increased over the years, and is strongly impacted by reservoir operations. Studying how changes in operations affect these issues and identifying the tradeoffs between them will help ICPRB, the Corps, and stakeholders find a new way of

operating the reservoirs to better balance all of the major objectives.

What's the best way to facilitate a technical evaluation process that will involve multiple stakeholders and resource managers? Nearly 30 years ago, researchers at ICPRB and The Johns Hopkins University were faced with a similar problem as they investigated how the metropolitan-area water suppliers could meet their long-term water needs. Back then, the researchers took a novel approach by using interactive computer models in meetings with stakeholders so that they could collaboratively design and test water supply alternatives. This built trust among the stakeholders and researchers, and eventually led to the development of the ICPRB Section for Cooperative Water Supply Operations on the Potomac (CO-OP), which coordinates water supply planning and management for the metro area water suppliers. Those researchers–especially Rick Palmer, now with the University of Washington, and Dan Sheer, who founded Hydrologics, Inc.– have continued to improve their interactive modeling approach and have developed a community of professionals around the country with expertise in this area. Two of those professionals–Erik Hagen and Mark Lorie–now work on the CO-OP program at ICPRB and will lead the study on Potomac reservoir operations.

One specific technique for this interactive modeling approach is called "Shared Vision Planning." The thrust of Shared Vision Planning is to prevent technical issues (how does the system work?) from getting in the way of constructive debate about values (how should the system be managed?). If stakeholders and resource managers do not agree on the basic facts, it is very difficult for them to reach an understanding on the broader issues. But by building and using a model together, participants develop a "shared vision" for how the system works. Everybody develops a common understanding for how the reservoirs are operated in different situations and the resulting impacts. Once they have this common understanding, participants can debate what should be done in different situations, such as how much water to release during the early part of a developing drought. Without this common understanding, debates about the basic facts may get in the way of finding constructive solutions to the real problems.

The ICPRB will use the shared vision planning approach for the North Branch project. The ICPRB already has detailed models of the reservoir operations and plans to use these models as the basis for the study. Stakeholders and various experts will be consulted for input on how reservoir operations affect all the interests. Based on this input, functions will be added to the model to predict the impacts of operational changes. The model will be structured for ease of use so that all stakeholders have an understanding of the process and can understand how different management scenarios affect river uses. The goal is to make sure everybody understands the model well enough that they can endorse it as an accurate representation of the reservoirs, the river, and the impact that operations have on all the issues. The ICPRB can then begin working with the Corps and stakeholders to design new operational rules.

This will be a labor intensive process. The ICPRB and the stakeholders will invest a lot of time in meetings, model development, and running workshops. It is important to make this investment, however. Water management problems almost always have a technical element—sound science and good engineering are necessary for solving these problems. But they have a social element as well. The North Branch Advisory Group has already begun addressing this social element. The ICPRB will build on this foundation and add the technical elements that will allow everyone to learn more about the North Branch system and how it affects the issues people care about. The payoff will be in developing relationships among stakeholders and a shared understanding of how the river works and all the demands placed on it. Ultimately, we hope to develop operating rules that are endorsed by all stakeholders and the Corps of Engineers. "This is exactly the kind of work a river basin commission should be doing," said Bill Haines, a hydrological engineer at the Corps' Baltimore District. "The issues in the North Branch Potomac cross jurisdictional boundaries and affect multiple stakeholder groups that have competing, and sometimes conflicting interests. The ICPRB is well-placed to help identify and define these interests, and then to develop the necessary tools for evaluating whether existing water management procedures can be improved," he said.

In fact, this work has already begun. The ICPRB began meeting with stakeholders and plans to hold the first modeling workshop in the fall. There is considerable enthusiasm among those involved so we are off to a great start. We hope that this will lead to a successful investigation and, eventually, a better way to operate the North Branch reservoirs.

Chronic Anoxia in Lower Potomac Persists

Every summer, grim reports from the Chesapeake Bay Program highlight the size of a large region of mainstem Chesapeake Bay bottom water that holds so little dissolved oxygen that nothing can survive there for long. A similar region exists around the mouth of the Potomac River, where oxygen levels decrease to near zero in the summer months, a condition known as anoxia.

This season, the anoxic region known as the “dead zone” in the bay is still there, but as of late July had decreased to less than one percent of the bay’s mainstem area. It is the second-smallest July anoxic area measured in 22 years of monitoring, according to the Chesapeake Bay Program. The spring forecast by the program had predicted worse conditions than last summer, and would rank near average overall. That bit of slightly good news didn’t flow over to the mouth of the Potomac, where oxygen levels at the bottom have been nearly devoid of oxygen this summer, near or worse than average.

The general reasons for these “dead zones” are similar for the bay and the Potomac, with the basic ingredients entering the river from land and air. Excess nutrients–nitrogen and phosphorus--enter the water by air deposition and stormwater runoff from agricultural and developed land. The nutrients fuel the growth of algae, which, using the nutrients as fertilizer, grow, bloom, and die. The organic material sinks to the bottom and the bacteria that decompose the algae takes the oxygen out of the water as part of the process. The condition is aggravated by other factors. The higher summer temperatures mean that the water naturally can hold less oxygen. Water in the deepest part of the river (30 feet or more) tends not to mix with the higher-oxygen water near the surface. Rainstorms and wind can help mix the two zones of water together, bringing some oxygen to the bottom. Long periods without rain or breeze are common in Potomac summers. Saltier water from the bay, which is heavier than the fresher waters coming downstream also tend to keep the water in layers that limit mixing of surface and bottom water. The pocket of oxygen-depleted water sits on the bottom until temperature and salinity changes, rain, and wind together or separately mix the water vertically and bring a more uniform level of oxygen. Water clarity in the lower Potomac is significantly worse than normal this year, another sign that nutrients and algae are plentiful.

Generally, healthy water that can support a variety of life should contain at least five milligrams of oxygen per liter of water (mg/l). Stations at the mouth of the Potomac hover near zero during the summer. Water on the bottom in the deep channel off Point Lookout has stayed below 0.5 mg/l this summer, somewhat lower than the average. Oxygen levels usually increase to an acceptable range by October. Other stations that monitor the Potomac mainstem show summer averages of bottom oxygen well below levels needed to support a diverse ecology. Some 50 miles upstream from the river’s mouth, a monitoring station at Maryland Point is the most-downstream site that averages year-round oxygen levels of more than 5 mg/l. That part of the river is shallower (about 30 feet) and less salty.

ICPRB

Die-offs of algae blooms can create zones of anoxic water that can result in localized fish kills.

Beyond the general reasons for the dead zones, the lower Potomac is yielding more questions than answers. The interaction of algae die-offs, weather conditions, nutrient loadings, and changing water salinity is complex. When chronic algae blooms upstream die, their decomposition by bacteria add to the already nutrient-rich waters of the river, exacerbating the poor conditions in the deeper channel downstream. The lower portion of the Potomac must deal with the upstream impacts from activities in the entire watershed. In addition, water from the bay proper moves up the Potomac with the tide, contributing to the problem. Nobody has enough understanding of the system to quantify how all the inputs interact to create the poor conditions.

Researchers from the Maryland Department of Natural Resources (DNR) are adding to the information from fixed

monitoring stations through regular data collection voyages on the Potomac. The thousands of extra data points collected on each cruise add depth to their understanding of the system, and may eventually help to address areas or processes that are helping to create zones of low oxygen or chronic algae blooms. Bruce Michael, a DNR scientist, noted that questions about the dissolved oxygen deficit in the lower Potomac would be one of the topics addressed at an October conference to assess data collected during the summer. Michael hopes that future reductions in nutrient loads to the Potomac can help ease the problem. He added, however, that the deep channels in the bay and the Potomac, its second-largest tributary, will always hold less oxygen than water near the surface. "We won't ever get to 5 mg/l of oxygen in the deep channels–that area of the river naturally would hold less oxygen than shallower areas, but we may be able to get levels up to 1 mg/l," Michael said. Raising the oxygen level in the mid channel would mean that adjacent water also would be in better shape, Michael noted. Getting those levels up will be no simple task, and a better understanding of the processes that cause depleted oxygen is a necessary first step.

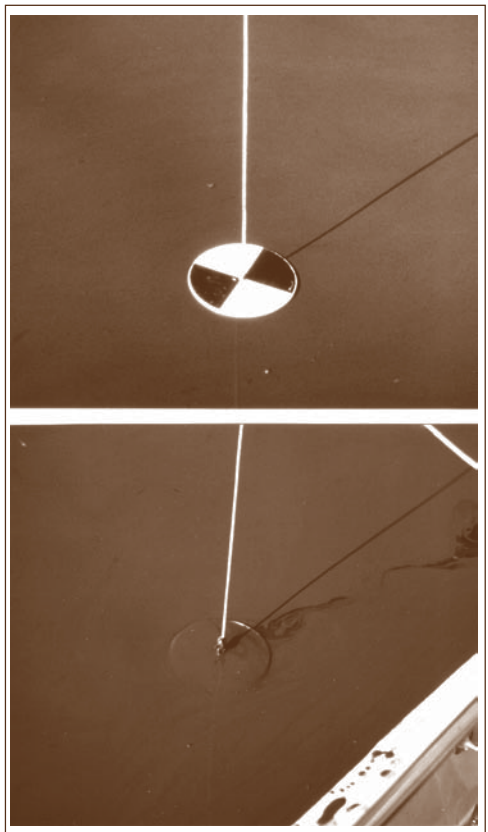
For more information, visit. *http://mddnr.chesapeakebay.net/eyesonthebay/index.cfm* and *http://www.chesapeakebay.net/newsdo101072407.htm*

Harmful Algae Blooms Limited in Potomac This Year

The Potomac River has been spared from blooms of blue-green algae this summer. Large blooms of some blue-green algae species, such as *Microsystis*, are potentially harmful and can release toxins that can sicken or kill fish, and in extreme cases, harm people. While blue-green algae are of particular concern, the river is filled with many kinds of algae. In general, algae blooms, where algae grow and reproduce rapidly, creating a large spike in populations are a problem for the river. The blooms limit sunlight penetration to submerged plants, and when blooms die they fall to the bottom. Their decomposition strips the oxygen of water, creating "dead zones" inhospitable to fish and other organisms.

Microsystis blooms once were common during summer in the upper tidal Potomac. In the 1970s, the Potomac's waters in and downstream of the metropolitan area sported a fluorescent green that resembled a bad paint job as the algae bloomed every summer. Kent Mountford, an environmental historian and author who worked as a biologist on the Potomac in the 1970s and 1980s, remembers those days well. The bright green thick, clumping blooms of algae were "An annual phenomenon," he said. "We would see huge clumps of *Microcystis*–they were incredible blooms." The blooms were accompanied by fish kills every year, he noted. As the river responded to restoration efforts in the 1980s, the frequency and extent of the annual blooms decreased, although 2003 and 2004 were notable exceptions. At the same time, fish populations and aquatic plants rebounded.

Microcystis blooms are a decreasing but still difficult-to-predict problem. The Chesapeake Bay Program had forecast



D. Loveland

A secchi disk, used to determine water clarity by lowering it into the water until invisible, is obscured by a microsystem bloom as soon as it is submerged. This picture was taken in Gunston Cove in 1982.

average blooms in 2007 that would start early in summer, last for one or two months, and extend 10 to 20 miles at their peak. The *Microcystis* never showed up this year, and another algal species caused problems in the saltier downsteam region of the estuary.

The absence of blue-green algae blooms this year is probably because of a combination of factors, according to researchers who study the river's plankton. The lack of rain this summer has decreased

Without Algae, Other Life Would be Impossible

Living at the base of the ecosystem, algae support the entire web above it. What are these organisms? Generally, algae are a diverse group of microscopic organisms that range from drifting single cells to massive colonies that make up giant seaweeds. Most algae are plant-like and contain chlorophyll that is used to photosynthesize food from nutrients and sunlight. Chlorophyll gives rivers a green color when algae in the water–called phytoplankton–are abundant. Some types are more animal-like and have tiny whip-like structures, flagella, with which they are able to swim. These include the dinoflagellates, such as *Karlodinium.* Certain dinoflagellates can produce toxins that can hurt fish or in some cases, people. Another very ancient type, the blue-green algae, can be difficult to classify because they resemble bacteria in some of their functions. In the world of algae, the differences between plant and animal are blurred, and in addition to using photosynthesis, some algae are predators.

Some, but not all of the thousands of kinds of algae serve as an essential food source for other aquatic organisms, and are the base of the food chain. They also are essential in the creation of oxygen. It has been estimated that marine algae are responsible for production of the vast majority of oxygen in the water and air, and far outproduce terrestrial plants. Seasonal algal blooms are a natural and important feature of aquatic life. Frequent and excessively large blooms, however, unbalance the ecosystem that algae support, especially if these systems already are stressed by an overabundance of nutrients. One kind of algae that often blooms in the Potomac during mid-summer, to the detriment of other aquatic life, is the blue-green algae, *Microcystis*, which forms a surface scum resembling brilliant green paint.

the amount of fresh water coming downstream into the tidal river, allowing saltier water in the lower Potomac to travel further upstream, decreasing the habitat for blue-green algae that thrives in fresher water. Other climatic factors and their timing also affect the frequency and severity of blooms.

The large algae bloom in the tidal waters off Colonial Beach, Va., in June is a plausible cause for a fish kill of about 4,000 fish of various species. The Maryland Department of the Environment (MDE) responded to the kill, and noted that very poor oxygen levels below the surface were a likely reason. The die-off of algae from the bloom likely contributed to those conditions.

While blue-green algae was not observed at the site, a different species, *Karlodinium*, was. *Karlodinium* is a different kind of algae, a dinoflagellate that can turn the water a red-brown color. It, too, is considered a harmful algae, as it can produce a toxin with effects on fish ranging from gill irritation to death. One researcher, Allan Place of the University of Maryland's Center of Marine Biotechnology, has implicated *Karlodinium* in the fish kills several years ago that originally were linked to another dinoflagellate, *Pfiesteria,* dubbed the "cell from hell." The link between Karlodinium and the infamous *Pfiesteria* event that closed some bay waters, and the ongoing research by Place and others is highlighted in the most recent issue of the Maryland Sea Grant publication *Chesapeake Quarterly*, available online at *www.mdsg.umd.edu/CQ*. It makes for a fascinating read.

The Colonial Beach area of the Potomac seems to be a chronic site of blooms and dissolved oxygen problems. The area is just downstream of the Harry Nice (Route 301) Bridge. That area generally marks an important boundary: upstream, the Potomac is narrower, faster-moving, and vertically well-mixed, noted ICPRB Associate Director for Aquatic Habitats Claire Buchanan. Downstream, the estuary is wider, slower moving, and more stratified. It typically harbors an extensive summer anoxic zone second only to the Chesapeake Bay mainstem's "deep trench." Peter Tango, a biologist with the Chesapeake Bay Program, agrees, adding that the complexity of the system demands a better understanding of the many processes involved.

Researchers such as Buchanan and Tango are trying to gain a better understanding of the river's plankton communities, including the harmful algae species. Many kinds of algae, or phytoplankton, make up the base of the river's food chain, and are essential to the river's productivity. They consume nutrients, primarily nitrogen and phosphorus, found in the water to produce more cells, and are the major food source for shellfish and he small animals (zooplankton) consumed by fish. Nutrients entering the river from many sources–wastewater treatment plants and septic fields, fertilizers washed off farm fields and suburban lawns, and stormwater from urban areas–presently are so abundant that they frequently fuel algal growth too rapid for the food chain to control. Blooms result and eventually strip the surrounding water of oxygen as cells die uneaten and fall to the bottom and

decompose, where the nutrients again become available (see related dissolved oxygen article). An unbalanced, unpredictable, “bloom-or-bust” ecosystem emerges.

Considering how essential algae populations are to a healthy ecosystem and how seriously out of balance they can become on the Potomac, there is much researchers need to learn. Referring to the widening region of the estuary downstream of the Route 301 Bridge, Buchanan said the lack of water quality data in this poorly understood area severely hinders researchers from recognizing the conditions that favor the formation of algal blooms. Long-term monitoring stations are located near the Route 301 Bridge and approximately 30 miles downstream at Ragged Point. “We have little information on how the blooms form, how different factors come together to facilitate the recurring blooms in this region,” Buchanan said. “It is frustrating to try to understand what the river is telling us when the information we get is so far away from where these blooms are forming,” she said.

Watching the River Flow

Potomac River flows, measured near Washington, D.C., continued to be well below average in June and July, according to provisional data provided by the U.S. Geological Survey.

June river flow averaged about 2.7 billion gallons per day (bgd), or about 57.3 percent of the long-term average. River flow ranged from a high of about 3.6 bgd on June 9 to a low of about 1.8 bgd on June 30. Water withdrawn for metropolitan area water supply averaged about 500 million gallons per day (mgd).

July flows continued the dry trend, running at about 1.6 bgd, or only 53.7 percent of average. Daily extremes ranged from a high of about 2.1 bgd on July 6 to a low of about 1.2 bgd on July 25. Water withdrawn for water supply again averaged about 500 mgd.

Despite the continued dry weather, the need for the release of reservoir water to meet supply demands remains low.

River Loses Protector, Historian with Passing of Stanton

Richard L. Stanton, superintendent of the C&O Canal National Historical Park from 1981-1989, and an ICPRB Maryland commissioner from 1992-1995, passed away on July 18. He was 84.

C. Dalpra

A native Washingtonian, Stanton grew up in the 1930s with the river bank as his playground, and was an eyewitness to the devastating flood of 1936. Professionally, he spent 24 years with the National Park Service, and fulfilled his professional dream and personal muse by spending the last eight of those years as the superintendent of the C&O Canal National Historic Park.

As someone committed to the Potomac, Stanton’s appointment as superintendent was prescient. Stanton focused recovery efforts for the park after the devastating flood of 1985, leading an effort that rallied about 8,700 volunteers. It was an accomplishment of which he was most proud.

In 1987, he organized one of his several trips down the mainstem of the nontidal Potomac, taking park service staff and a large contingent of the ICPRB staff with him. The Potomac River Expedition ran from Cumberland, Md., to Washington. Along the way, the group met with local government officials, river groups, and citizens, painting a unique picture of the Potomac that the paddlers would never forget.

Stanton, always a student of Potomac lore, shared his knowledge and passion with many people through his slide presentations that focused on the nature and history of the nontidal Potomac. Stanton collected many historical photographs and books about the Potomac and its history, and through slide shows transported audiences through Potomac time and space.

While an ICPRB commissioner, Stanton took up an offer from the Smithsonian Institution to write a book about the river, authoring "Potomac Journey: Fairfax Stone to Tidewater," in 1993. Stanton combined his immense knowledge of Potomac history with his personal journals, beginning in 1936 that logged every canoe trip he ever took–more than 9,000 miles paddling, poling, and portaging. It remains a great read.

In the preface to the book, Stanton neatly summed his love of the river: "To know the Potomac you must drink it, swim in it, tremble as lightning strikes it, feel its icy cold, fight against its currents, and all but drown in it. You must feel its pulse through the bottom of a boat, be able to determine the river's speed, understand its telling rock formations, and contemplate the great forces that have caused so many changes in the Potomac over the millennia." Dick Stanton was one of those forces.

Interest in Rain Barrels, Green Landscaping Increasing

C. Dalpra

Rain barrel project coordinator Jennifer Willoughby offloads a barrel at a recent workshop at the Accokeek Foundation.

The ICPRB's efforts to encourage use of rain barrels and landscaping methods to help conserve water and address stormwater pollution at the household level is growing interest in the techniques. Several workshops during the past year has placed 200 rain barrels at homes in Maryland and Virginia. People who attend a workshop to purchase a barrel also learn about rain gardens and other ways to improve their local streams and the Potomac River. Learn more about the project at /www.potomacriver.org/about_ICPRB/rainbarrelinfo.htm

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