To Achieve the Clean Water Act's Goals, Prioritize Upstream Ecology

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PROGRESS TOWARD ACHIEVING THE GOALS OF THE Clean Water Act has slowed, and states are not getting the ecological benefits they demand from their rivers. Attempting to reduce only a few pollutants at regional scales is not working for our largest waterways. Restoring the aquatic health of small rivers should be considered a prerequisite for restoring larger rivers, lakes, and bays downstream. By prioritizing ecological restoration of smaller waterways, we can more precisely target local causes of ecological degradation, more accurately and rapidly measure response, and potentially achieve many more miles of ecological restoration closer to local people who benefit the most.

At Least Our Nation's Rivers Aren't Getting Worse

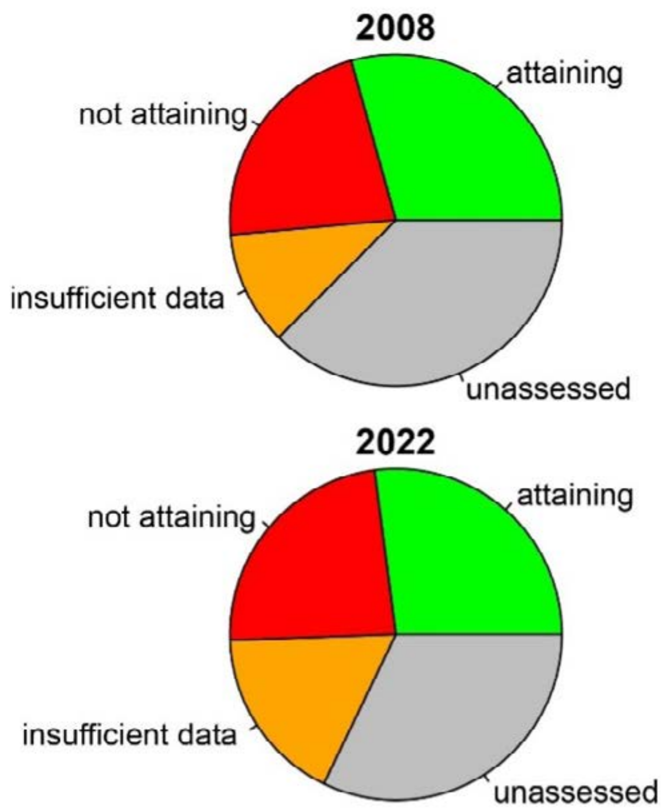
That's what we learned from the National Rivers and Streams Assessment released last year. The good news is that a significant improvement occurred in fish communities across the U.S. between 2013 and 2018. However, healthy fish communities only exist in 35% of river miles. The bad news is that there was no statistical change in the 28% of river miles in good condition for insects and other invertebrates.

A more tailored assessment of our rivers' health is performed every two years by the states. Each state designates specific uses they desire for each waterway, some of which are ecological, like trout reproduction or the ability to sustain aquatic life. If a state finds that those ecological uses are not supported, then they must report it to the EPA. An EPA database allows us to track the progress of how the states are accomplishing their goals.

The States Are Not Getting What They Want From Their Rivers

Our analysis found that in 2022, the states determined that 27% of their collective river miles were providing their ecological uses, down from 29% in 2008. Attainment of designated use increased by 187,573 river miles. Some of this progress comes from previously unassessed rivers, and some, according to the EPA, is due to the implementation of best management practices and restoration activities.

But what about the 209,041 miles of rivers added to the list of rivers not providing their ecological use during this decade? The rise in the number of rivers not attaining their designated use is the result of several factors. First, states have added to the ecological uses they demand from the same stretch of river over time, so attaining all designated uses is a higher bar to reach. Second, expansion of monitoring programs in some states may have added data on previously unassessed river miles that do not meet stated goals. Finally, previously healthy rivers may be lapsing into failure. For example, Pennsylvania's most recent analysis of river use by aquatic life found that 664 miles of previously supporting or unassessed rivers became impaired, while only 254 miles of previously unassessed or impaired rivers became supporting.



Proportion of all rivers in the United States attaining their designated ecological uses according to the EPA ATTAINS database and the analysis performed by the authors. Source: Authors

Cutting Pollution and Restoring Ecology Is Harder Than Expected

Maintaining a net balance between gains and losses

Assuring ecological uses for our headwater rivers, like reproduction of this native brook trout in the Schuylkill Highlands of Pennsylvania, builds the path to ecological restoration of larger rivers downstream. Source: Freshwaters Illustrated

in the miles of ecologically useful rivers might be interpreted as success given the ongoing urbanization and pollution that continually counteract restoration progress. That optimistic scenario assumes that pollutants like nitrogen, phosphorus, and sediment are decreasing enough in some places to allow aquatic life to flourish. Unfortunately, a recent study shows that nonpoint nitrogen and phosphorus control programs implemented under the Clean Water Act have not been successful at a national level. Even within the success story of upgrading wastewater treatment, aquatic life continues to be impacted by chemical pollutants (presumably regulated and unregulated) in effluent-dominated rivers. Beyond pollution control efforts, other approaches to engineer rivers toward a "restored" configuration rarely return the ecological uses we desire from our waterways.

Despite early gains, the U.S. is not accomplishing the CWA's goal of restoring the chemical, physical, and biological integrity of the nation's rivers. Some say we need more time to see the fruits of our labor, others say more refinement under existing policy is needed, and some critique the way the EPA incorporates new science into regulation.

The Chesapeake Bay became a stark example of these challenges with the 2023 announcement that the 2025 pollution reduction goals will not be met. One of the farthest-reaching pollution-reduction programs ever implemented under the CWA, pollution abatement anywhere in the watershed gets at least some credit for improving the Chesapeake Bay. Progress toward the required reductions in nitrogen and phosphorus has slowed, and there has been little improvement in the ecological uses linked to those pollution reductions. This lack of progress is the result of gaps in implementation of management actions, ecological and physical response time lags, fluctuating environmental conditions, and the shortcomings of deterministic modeling. The scientific advisory committee for the program has boldly challenged whether the focus on restoring the Bay's deepwater habitat through pollution control is overshadowing ecological restoration in more accessible shorelines of the Bay. It noted: "The legal requirements of the Clean Water Act (the water quality goal) divert attention away from considering multiple means of improving living resources (support of aquatic life as the designated use) as articulated by the Chesapeake Bay Watershed Agreement." They continue: "This means that the benefits of restoration actions tend to be expressed primarily in terms of nutrient reductions rather than benefits for living resources."

The Fix: Restore Ecology of Waterways From the Shallow End First

Despite its failure to achieve pollution reductions and consequent improvements in ecological use, management of the Chesapeake Bay watershed may reflect a changing paradigm in how we pursue restoration of the ecological uses we want our waterways to provide. River networks, their watersheds, and the factors that degrade ecology are nested within one another. Our current approach treats restoration like repairing a cracked matryoshka (nested doll), in which repair of the largest doll constitutes success even if smaller cracked dolls are left inside. It is not feasible to fix ecological problems in our largest rivers without also fixing smaller ones nested within, for two reasons.

First, the pollutants that impair downstream ecological uses are not always the stressors that impair the waterways upstream. In spite of this, regulatory programs administered under the CWA reward billions of dollars in river restoration projects for reducing the pollutants passing from them without requiring restoration of the ecological uses of the river itself. These engineering projects sacrifice actual restoration of ecological uses in smaller, geographically vulnerable, and vastly more numerous headwater streams in favor of a few larger water bodies far downstream.

Second, as nationwide monitoring data has demonstrated, it is difficult to detect the cumulative effects of widely distributed pollution reductions across large watersheds because of ever-changing land and water use, climate, and ecological systems. In contrast, clustering restoration projects in small watersheds (not within the rivers that drain them) is more likely to produce measurable ecological effects on more precisely identified local stressors. Prioritizing restoration of local ecological uses can more directly and equitably benefit local communities.

The lesson we should learn from our decades-long regulatory effort of the CWA, is that the path of ecological restoration generally flows downhill, not up. Ecological recovery of our largest waterways should naturally follow if each tributary upstream acts as an unbroken chain of ecological health. The need for improving our restoration practices that address multiple pollutants at their source is paramount, and this must begin with prioritizing restoration of upstream ecological uses in our shallow headwater tributaries. ■

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