

Dr. Daniel R. Engstrom
Director Emeritus, St. Croix Watershed Research Station
Science Museum of Minnesota
dre@umn.edu

TO: Representative Jim Knoblach, Chair, House Committee on Ways and Means

RE: HF 3280 (Wild Rice Waters)

Dear Chairman Knoblach:

This letter is written to clarify the scientific conclusions reached in the MPCA Wild Rice Sulfate Standard Study, on which I was one of the lead researchers, along with other scientists from the University of Minnesota, Duluth and Twin Cities campuses, and the PCA itself. During consideration of HF3280/SF2983, I have heard these conclusions stated inaccurately. Simply put, there is no credible scientific evidence to support relaxing or eliminating the existing sulfate standard. If that is to be done for whatever reasons, it needs to be understood that it will put wild rice waters in Minnesota at risk.

During the course of the Wild Rice Sulfate Standard Study and for the last 18 years I served as Director of the St. Croix Watershed Research Station of the Science Museum of Minnesota. My technical expertise is in limnology (the study of lakes and rivers) and specifically lake and sediment geochemistry. I write as an independent scientist and not as a representative of any organization, client, or employer.

This letter reviews the basis for the existing state sulfate standard for the protection of wild rice waters and the results of the recent Wild Rice Sulfate Study. As a result of this research, we now understand the processes by which sulfate affects wild rice and also the reason that some lakes and streams with elevated sulfate can still support wild rice.

The conclusions of the Wild Rice Sulfate Standard Study:

- strongly support both the existing sulfate standard for wild-rice waters, and also the PCA's proposed equation-based revision of that standard;
- are as clear and unambiguous as the results of any environmental research I have ever conducted; and
- have been thoroughly vetted through peer review by a team of national and international experts, with the final products recently published in peer reviewed scientific journals that are among the most highly respected in the scientific world.

The Beginnings: The Existing Sulfate Standard

In 1956 Dr. John Moyle, a biologist with the Minnesota DNR, published results from his Ph.D. research on the distribution of aquatic plants in relation to water chemistry of lakes and streams in Minnesota. His research demonstrated, among other things, that wild rice was abundant principally in the northeastern part of the State in waters with sulfate less than 2 ppm and rare in waters to the south and west with sulfate exceeding 10 ppm.

Based on this scientific evidence, the State of Minnesota in 1973 adopted its current 10 ppm sulfate standard for the protection of lakes and streams supporting wild rice. At a recent hearing on HF 3280, the standard was disparaged as the "antiquated" or "old" standard, implying that it doesn't have much experimental validity today. This is simply not true, as the most current research demonstrates.

Current Research: The 2011 Study

In 2011, the Minnesota legislature directed the PCA to conduct a new set of studies to evaluate this standard and determine whether and how sulfate might affect wild rice growth and survival and whether other factors might be at play.

The Wild Rice Sulfate Standard Study was designed by PCA research staff with input from outside technical experts and affected stakeholders. The study included three major components:

1. A field survey of wild rice habitat in 108 lakes and streams to study physical and chemical conditions correlated with the presence or absence of wild rice.
2. Controlled laboratory hydroponic experiments to determine the effect of elevated sulfate and sulfide on early stages of wild rice growth.
3. Outdoor container experiments using natural sediments to determine the response of wild rice to a range of sulfate concentrations across multiple growing seasons.

These three independent studies came to the same conclusion: the formation of sulfide in the sediments in which wild rice roots is toxic to wild rice.

Toxic sulfide – which is produced as a byproduct of bacterial processing of sulfate in the sediments where wild rice takes root – begins to negatively affect wild rice at concentrations exceeding 120 ppb. However, the amount of sulfate needed to produce that level of sulfide varies among water bodies. If the sediments contain higher concentrations of iron, the dissolved sulfide is converted chemically into a non-toxic iron sulfide mineral. On the other hand, if the sediments contain higher levels of organic matter, increased bacterial action leads to higher levels of toxic sulfide.

Because water bodies have widely-varying levels of iron and organic materials in their sediment, the PCA has proposed a formula-based revision of the sulfate standard that takes into account the levels of sediment iron and organic matter in a given water body – in effect, a site-specific standard.

Importantly, the studies also confirm that the average sulfate concentration that leads to toxic sulfide levels – those exceeding 120 ppb – is very close to 10 ppm – the existing “old” sulfate standard. In effect the existing 10 ppm standard and PCA’s proposed revisions are BOTH reasonably protective of wild rice. The first approach is more easily administered and understood, while the second is more precise.

Finally, and as an additional outcome of this research, we now understand that wild rice is the “canary in the ecological coal mine”, that sulfate produces a cascade of chemical and biological changes that can greatly diminish aquatic diversity, release phosphorus and nitrogen from sediments to fuel growth of unwanted algae, and increase the methylation of mercury leading to higher levels of the toxic metal in our game fish.

Alternative Interpretations are not supported by science

Some critics have suggested that environmental factors other than sulfate govern wild rice distribution and abundance. Among these are turbidity resulting from land-use disturbance and erosion, and water level alterations. While such factors may have historically eliminated wild rice from some water bodies, it is abundantly clear from the current crop of studies that sulfate levels principally determine wild rice survival, especially in the largely undisturbed lakes and streams in the northern part of our state.

Some have used the complex chemical conversion of sulfate to toxic sulfide to argue that sulfate itself is actually benign and should not be regulated, at least to the level of the current 10 ppm standard. There have also been misleading hydroponic experiments offered as evidence that sulfide has no effect – experiments in which the rice seedlings were allowed ready access to oxygen, effectively detoxifying any sulfide present. Such conditions do not exist in the sediment where wild rice grows in its natural environment.

In sum, the conclusions of the Wild Rice Sulfate Standard Study strongly support both the existing sulfate standard for wild-rice waters, as well as the PCA's proposed equation-based revision of that standard. The science supporting both the new and the old standards is far from antiquated. It represents the considered opinion of every independent scientist who has examined the evidence.

Sincerely,

A handwritten signature in blue ink, appearing to read "Dan Engstrom". The signature is fluid and cursive, with a large initial "D" and "E".

Dr. Daniel Engstrom