Trading Nutrients for Fish Using Floating Islands, Moving Water and Microbes

by Bruce Kania

With the January-February article on regional fertilization strategies as backdrop, based here in Montana, we are operating in some of the northern water mentioned. For us, if phosphorus is not quickly transitioned into fish, it becomes an explosion of something less palatable. Think interesting and colorful filamentous algae! Or weed beds of underwater plants which choke out a system.

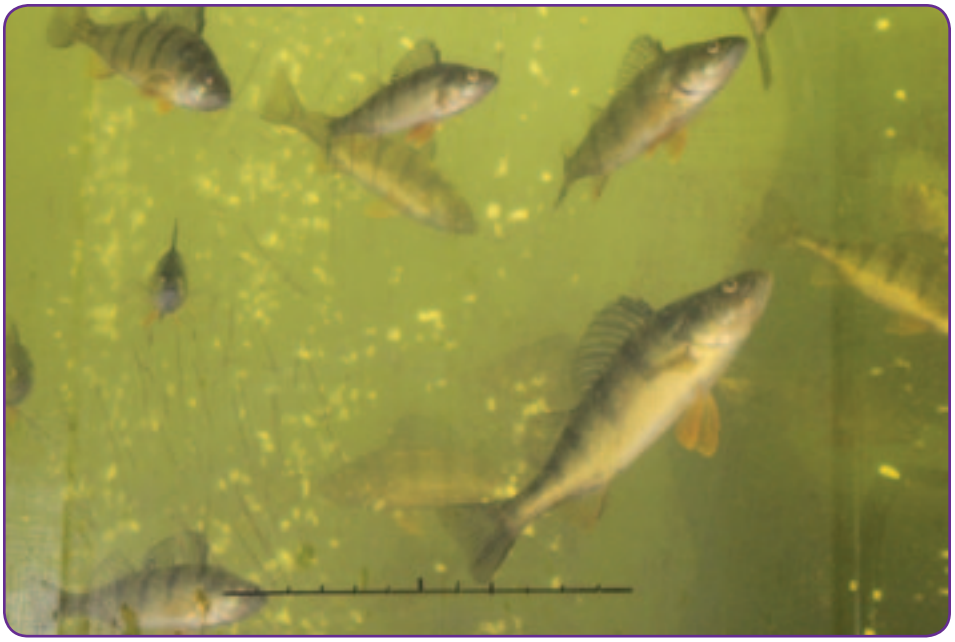
We needed something that grows faster than the undesirable forms of algae and we needed it to be something that works for fish. In our case, the fish are northern yellow perch, black crappie, and Yellowstone Cutthroat trout. The waterway in question is 6.5 acres, 28 feet at its deepest point. We call it "Fish Fry Lake." Before introducing fish into this man-made pond, we measured water temperatures as high as 88 degrees in the top six feet during August, and dissolved oxygen levels in the three parts per million range in the cooler stratified zone below.

As with most pondmeisters, we didn't figure out all the answers at the same time. It's like we evolved into a solution. I run a research and development effort centered on floating treatment wetlands, otherwise known as floating islands. So our floating islands have figured into our strategy of trying to remove or sequester excess nutrients in our water from farming practices in this part of the nation. The islands are made of a plastic filter-like matrix, every cubic foot of which provides over 300 square feet of surface area for beneficial microbial growth. This surface area is habitat for microbes, one of the only life forms that grow faster than algae.

So, armed with some prototype floating islands, we combined the concentrated surface area of the islands with circulation, using a variety of air diffuser systems. This meant that we were able to both aerate and bring water from depth into, and through, the islands. The island matrix grows a coating of biofilm. This is the sticky slime that pretty much covers any surface area under water. Whatever's suspended in the water tends to stick to the biofilm. This includes nutrients, like phosphorus, ammonia, and other forms of nitrogen.

Initially, when we filled Fish Fry Lake, water clarity was fourteen inches. But the islands and their sticky biofilm changed that. In fact, this winter water clarity is at 19 feet. It can vary a bit, but it maintained at around 11 feet all last summer. The change in water clarity is because suspended solids are being captured as our diffusers move the pond water through the islands. This could be a problem in a setting without floating islands. It would set the stage for sunlight to hit the bottom of our system and trigger that underwater plant explosion some of us know about. But here's the trick: the biofilm and particulates that stick to it grow a different form of phytoplankton called diatoms. These guys are a form of phytoplankton that get by under low light conditions. They are perennial and are great oxygen generators. This blend is called periphyton and it provides choice habitat for zooplankton.

In Fish Fry Lake we have fathead minnows, five pronged stickleback, and two forms of chubs. We also have three kinds of snails. The pond is buzzing with a lot of other invertebrates too, including backswimmers, all of which eat periphyton, and all of which we find in fish gullets. The snails are what we find in the perch



the most, also in the trout.

Last summer, three and half years into the pond fi ll-up, we tagged 280 fi sh. We also did both otolith and scale aging. Then, over the course of a four month study, we tracked fi sh growth rates. The home run here is that, based on some extrapolation, we seem to have kept up with our projected phosphorus inflow rate. Of course, this does not account for the phosphorus already present in the pond, and tied up in literally every living cell as well as any organic accretion on the pond bottom. But with the air diffusion going on, we have been able to maintain aerobic levels above 6.5 parts per

million down to 22 feet, maybe even deeper. It just happens that 22 feet is our deepest, easily accessed measurement point. When diving the pond, I can't find any organic accretion.

Bob Lusk was here again this summer. We discussed the pond, and he snorkeled it with me. We have northern milfoil and coontail happening...with about 70 percent coverage. But both of these forms of native underwater plants are staying green. They are perennials. So they aren't decomposing at the same level that annuals would.

Another interesting tidbit from this summer is that we fished the pond hard and we tracked the hours of fishing time. During the four month period, we averaged a fish caught for every two minutes of fishing time. And, in spite of this harvest of 1,920+ fish, we just barely kept up with the calculated phosphorus inflow.

Yes, I love to fish! I love to share the pond with others, too. But this whole experience has me thinking about what we're up against. We don't feed fish in Fish Fry Lake. We really are being gifted with free feed in the form of agricultural nutrients. These mix with carbon, which is very easy to come by here, and now we have this explosion of fish! In fact, young of the year perch grew to 7.5 inches between April and late October, at which time water temperatures dropped below fifty degrees. Per Dave Willis and Mike Brown's article on aquaculture, this means our perch are achieving a harvestable size in roughly six months.

Maybe Fish Fry Lake needs to go commercial?