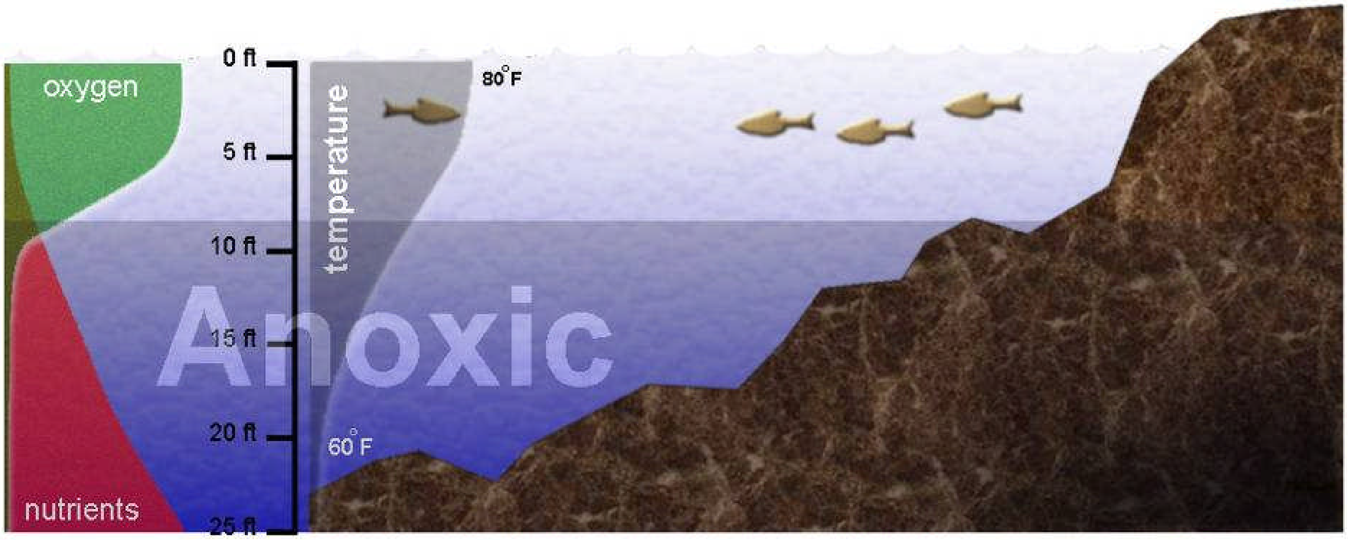


Humans have learned that by increasing the concentration of nitrogen based nutrients like ammonia, ammonium, nitrate, nitrite and urea in a given setting we can boost plant production. We have developed fertilization for farm crops, judging the appropriate levels of concentration in terms of the effect on the crops themselves. What we have mainly failed to do is judge the "downstream" affects of our efforts. The scale of our downstream impact is vast. We have actually created dozens of dead zones in ocean settings, in estuaries that drain major agricultural and urban settings. Some of these dead zones are thousands of square miles in area.

Nitrogen based nutrients as well as others like phosphorus; normally pass through fresh water before flushing into a marine estuary. Water events like rainstorms or natural groundwater flow tend to move them into and through fresh water waterways. Consider the idea that these fresh water systems have dramatically less ability to dilute the effect of such nutrients compared with an oceanic setting.

High concentrations of nutrients initiate a short-term downward life spiral. Algae and other microbial life forms are well positioned to not just survive such nutrient loading scenarios, but can actually thrive in them and develop a monoculture in which higher order life forms, like fish, are disallowed. Another result is that carbon dioxide, methane and other greenhouse gases cycle back into the atmosphere much more quickly in such settings, contributing to global warming A third result is hyper-eutrophication of our waterways – too much nutrient rich water causes acceleration of what is meant to be a very gradual process. Instead of the slow transition from a lake to a pond to a swamp to dry land, as in thousands or even millions of years, in a hyper-eutrophied setting the process can occur in decades.

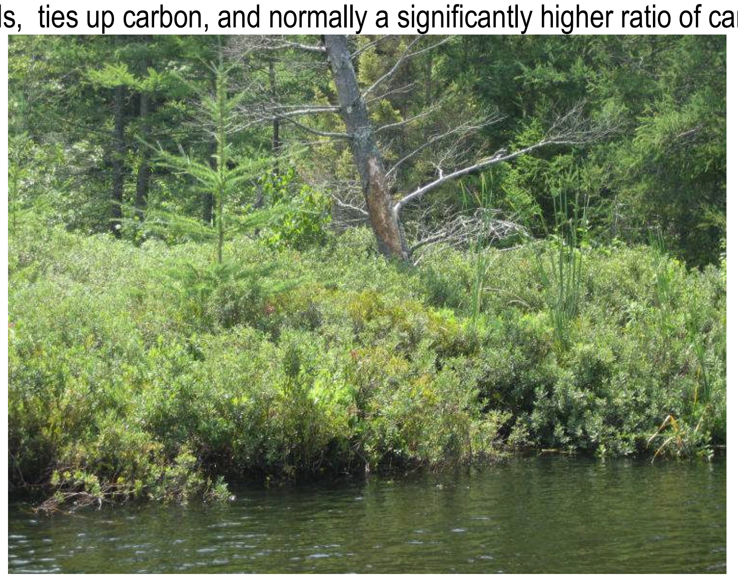
Consider that fresh water systems are naturally more exposed, more vulnerable to such nutrient loading than oceans. In other words, if we can manage to hyper-eutrophy marine settings, what are we doing to our much smaller fresh water systems? The answer is that we have killed many of them. What we refer to as an anoxic zone in fresh water is actually a variation on a dead zone. Certainly there are differences between marine dead zones and fresh water dead zones, but the net results are very similar, except that while in an oceanic setting there is always likely to be an available escape zone for oxygen requiring life forms, like fish, in smaller fresh water systems this may not be the case.

An obvious solution is to slow down human-caused nitrogen loading. Political leaders are a critical cog….and they are charged with responsibility for a most effective tool….taxation. Taxation will represent a means by which to motivate transition towards more sustainable organic agricultural models. When all costs are considered, it is certain that organic production will end up being far less expensive than synthetic fertilizer driven agricultural production. Taxation of synthetic fertilizer is an obvious answer. State legislators and governors are best positioned to enact such a tax. This would be a very strategic, and wise, tax. It represents an important part of an answer.

Human waste and animal manure are concentrated sources of nitrogen, and a single mishap at a sewage plant or animal impoundment can suffocate miles of waterway and destroy it. Again, political leadership is required to drive effective regulatory action. Humans must take responsibility for the life that takes place below us, of which we are stewards. Today, even with precise ability to measure point source polluters, in many instances there are no negative consequences or penalties for gross pollution. Non point source pollution is even less susceptible to consequences or penalties. While it is more difficult to determine sources, even when determined, nothing happens. Responsible stewardship means that we are responsible for holding our political leaders accountable for action. Every state now has a Department of Environmental Quality, charged with enforcement of clean water standards. But without political will such administrative entities are impotent. Their leadership, state governors, must be held accountable. Governors must be held accountable for what their administrations do. Their actions, or their lack of actions, must be made public.

Nitrogen can be inventoried in long lived plant systems as a means of slowing down the nitrogen cycle. This enables nitrogen to be drawn down from the atmosphere and stored in plant mass, including roots and soil before being eventually released back to the atmosphere via decomposition. Moving from an annual plant agricultural focus towards longer term perennials will help. Moving away from larger monoculture farm fields towards smaller fields of longer term perennials will help. Besides less exposure to catastrophic insect and blight infestations, smaller fields also mean lighter farm equipment, which sets the stage for improved soil tilth. It also means more edge habitat, and accordingly more wildlife. Synchronizing wildlife with agricultural production represents a graceful strategy by which to slow down the nitrogen cycle. Indirectly, taxation of synthetic fertilizer will contribute to movement towards perennialization, smaller fields, and wildlife.

Somewhat counter-intuitively, we can also perennialize water-based systems. Peat based, naturally occurring floating islands are an example. They function as floating treatment wetlands, tying up and perennializing nitrogen on a grand scale. Natural land-based wetlands do the same, but take up much more space while doing so. Both floating and natural wetlands can tie up nitrogen in all its forms, for extended periods. Keep in mind that every molecule of nutrient that is tied up while moving through aerobic and anoxic gas exchange life systems, which occur naturally in wetlands, ties up carbon, and normally a significantly higher ratio of carbon than of the nutrient.



A thirty acre large peat based floating island in northern Wisconsin. This eighty year old island is 19 feet thick within thirty feet of its edge, supports tens of thousands of trees, and in the process has naturally biosequesterd an estimated

The "wetland effect" is manifested by a high ratio of surface area to water. Combined with circulation, this is a recipe for healthy water. A deep fish pond with a smooth pond liner on its bottom, minimizes surface area relative to water volume. This is a recipe for unhealthy water. Surface area is a primary limiting variable for microbes. Where phytoplankton can function in open water, microbes prosper on surface area. The microbes that represent the key nutrient uptake element of wetlands function as "first responders". Microbial populations, which can double in minutes, even faster than algae, set the stage for wetlands to contend with the nutrient "surges" so prevalent around agricultural. When we combine a high ratio of surface area with circulation, as in the wetland effect, microbes out-compete phytoplankton and minimize the risk of an algae monoculture.

Wetlands convert nutrients and organic material into biofilm. Biofilm is sticky, and suspended solids that come in contact with it tend to accumulate on its surface. In this form, biofilm becomes periphyton, the base of the food chain in fresh water. It reduces water turbidity. In a deep water floating island setting, it represents a truly elegant, and large, carbon sequestration strategy. It's adhesive affect bonds up algae and other colloidals and suspended solids, including organics as well as heavy metals, occurring in waterways. Periphyton also ultimately transitions into humus. It represents an attractive alternative to a monoculture of algae, which is what many human designed waterways, with their lack of surface area and circulation, tend to bias towards.

Besides microbes, wetlands produce plant mass. In a floating wetland, plant roots further expand the surface area factor, making them particularly strategic. Natural wetlands also incorporate all three dissolved oxygen conditions vital to complete the nitrogen cycle: aerobic, anaerobic and anoxic zones. We humans are very good at biasing towards the anaerobic and anoxic zones but not so good, traditionally, at favoring aerobic activity.

Fortunately, it is not particularly difficult to re-create these natural systems, through constructed wetlands, and the relatively new concept of artificial floating treatment wetlands - using techniques of bio-mimicry. Conventional, land based constructed wetlands are effective but expensive, and have a tendency to “plug up” over time. Floating islands, on the other hand, are usually less expensive, in large part since they do not take up appreciable land space. They can duplicate the wetland effect, even in deep water. In fact, doing so in deep water is particularly effective since huge volumes of organic material, along with other problematic nutrients and heavy metals, can be biosequestered within, on top of, underneath and around them. Both natural peat based floating islands, and biomimetic constructed floating islands of at least eight inches in thickness, also incorporate all three dissolved oxygen conditions associated with the nitrification cycle (aerobic, anoxic, anaerobic). In other words, they can represent a complete nutrient mediation system.

Another advantage of deep water settings for floating treatment wetlands is that the thermal mass offered by a large body of water provides longer exposure to median temperature ranges, and extends the seasonal efficacy of microbes that are responsible for the largest fraction of nitrogen, ammonium and nitrate uptake. Plants are second to microbes in direct nitrate uptake, but as their roots contribute to an expanded surface area, which is a limiting variable for microbes, they can play a dual, critical role in ecosystem health. Plants are also favorably impacted by the extended growing season afforded by the thermal mass of large bodies of water.

Rainbow Trout sheltering from osprey predation under a manmade floating island.

In practical terms, floating treatment wetlands are a modular means by which to counteract pervasive nitrogen loading in waterways associated with human activity. The result of deployment of sufficient acreage of them will be healthier waterways. With this will come additional stewardship responsibilities. For example, some estimates indicate that fish populations may expand by a factor as high as fourteen hundred percent, simply by prevention of extreme anoxic fluctuations. Similarly, other wildlife population expansion will take place. Human interaction with wildlife will represent ongoing, and growing challenges. Such challenges represent a more attractive alternative to turbid, noxious, dead or monoculture dominated waterways.

The answers to how we can interrupt the current dysfunctional nitrogen cycle trend and return to a healthier ecosystem are not particularly complicated. We tax fertilizer, we penalize polluters, including nutrient pollution, we expand the wetland effect and we farm differently. On the other hand, coordinating human activity can be difficult and expensive. However, since about 90% of water is controlled by public entities, a number which holds up around the planet, the key is political will.

Perhaps the meatiest question is how do those interested in proactive movement towards such solutions identify and work with like minded politicians. This topic will be covered in detail at the First Clean Water Symposium, scheduled for July 10 and 11, 2008, at Montana State University, Billings, Montana. Contact Floating Island International for Symposium details.