STACKING FUNCTIONS:

Floating island technology

by Christina Ishoj

We live in an exciting time when ideas from nature can be adapted by a keen mind, developed over time, studied, and then finally made available to the general public for the benefit of humanity. This is “bio-mimicry” in the new millenium, where technology mimics nature. At the centre of this story are Bruce Kania and his invention of floating islands as a tool for purifying water.

As a young boy, Bruce was enthralled with naturally occurring wild floating islands of Wisconsin. He would see them on fishing trips, and as life goes, amidst a successful career inventing prosthetics, he followed his dream of finding a way to manufacture floating islands. What Bruce noticed was that certain lakes that should have been in states of severe eutrophication from nutrient loading were actually biologically diverse and, in fact, had clear water. These lakes had naturally occurring floating islands within their ecosystem. After many trial and errors, Bruce's island design was born, using a recycled polymer matrix base injected with marine foam, and formed in to soil holding, organic shapes.

What Bruce didn't necessarily know at the time was the sheer depth and scope his unique “bio-mimic” inspired invention would have for humankind. The bonus shortlist of floating island environmental benefits goes something like this: microbial, floating wetland factory capable of removing soluble nutrients like phosphorous and nitrogen, creation of critical riparian habitat mass and edge, carbon sequestering, wave mitigation and erosion control, and habitat for flora and fauna. For municipal water managers, this means a new, innovative tool to improve water quality – one that brilliantly mimics nature's own water purifying system, and that is inherently self-sustaining!

Background

First a little story about some wild floating islands in our Canadian neck of the woods. At a fishing convention last year my husband was speaking with an "old-timer" about these new floating islands. In the 1950s when he was young and foolish, this man remembered blowing up several natural floating islands on Lac Waterloo in Quebec because, as he recalled, "they freaked us out". After that, he surmised, the water quality of the lake began to decline and, four decades later, the nutrient rich lake was virtually unstable during the summer months.

Back to Montana, where Bruce Kania was conducting in-house experiments and the Montana Board of research and Commercialization Technology was undertaking a two-year study on these floating islands. Preliminary results were supporting what the "old-timer" suspected. The floating islands do help purify the water. How can this be?

The magic is in the island matrix design, the bio-film, the plant root biomass, and what individual plants can uptake from the water. A floating island's matrix is cleverly designed to maximize surface area that comes in contact with water. Eight-inch thick islands translate into 198 square feet of new surface area for every square foot of top surface area. The matrix alone can host billions of bacteria in the bio-film (that slimy collection of micro-organisms interacting in a complex community, usually on a submerged surface). This is biological sequestration, where microbes have a place to hang out and do their important work up-taking nutrients so that algae can not thrive. Research coming out of Montana estimates 80 percent of soluble pollutant removal is due to bacterial action happening in the bio-film.

Combine the island matrix with the plant's roots that penetrate the substrate and have direct contact with the water (much like hydroponics), and the surface area of the island becomes even bigger. So what? Well, many billions of microscopic bacteria thrive on the root surface too, so more root surface area, more bacteria and more ability to purify water. Depending on what is planted in the microbe rich soil, the root systems can be complex, and able to tie up 20 percent of soluble nutrients. Not only this, the type of plant also matters. Cold water wetland plants are being studied for their ability to uptake specific nutrients (even metals and salt) for specific applications.

Bacteria consume soluble nutrients found in water, and leave protein as a waste by-product. A perfect food chain is created, since fish happen to thrive on the protein rich

by-product created as waste by the bacteria. (This was why Bruce loved fishing near the naturally occurring floating islands.) And, what's more, the island itself is adored by fish, not only for its food source, but for the shade it provides. Add lake-bottom aeration to the formula (because many bacteria thrive in aerobic conditions), and removal rates of these soluble nutrients more than doubles.

Harnessing the Potential

You can see how the floating islands become a brilliant factory of hungry microbes just waiting for nutrients to consume, whose by-product is food for some other creatures in the complex web of a wetland. This is a true sustainability, which seems a far cry from the many engineered and dysfunctional water purifying systems that are common today. For stormwater retention ponds found in every municipality in Canada, the floating islands have magnificent potential to purify nutrient rich water and create critical habitat at the same time. Nature knows how to do the work.

Understanding the habitat potential of the islands alone is mind-boggling. At a recent floral show in Montreal's Old Port district last summer (Flora 2006), the following creatures were photographed on the island archipelago created there in an unusual canal lock: a heron, a beaver, a turtle, a merganser pair, and even a cormorant. This is in downtown Montreal; imagine what could happen in your municipality.

The floating islands may well become the wetland creation tool for the new millenium. The per foot cost and performance of these islands far surpass per foot cost and performance of any constructed shoreline wetland for several reasons. They work directly in the water and are effective within weeks of plantation; they require no purchase of, change, confiscation or manipulation of any kind to the shoreline; they can be moved around to areas that need protection or cleaning up; the plants are not affected by fluctuating water levels (from flooding or drought); and they are affordable. According to the research being conducted in Montana a 250 square-foot island does water purification work equivalent to a 40,000 square-foot constructed wetland.

An impressive review was commissioned by the National Institute of Water & Atmospheric Research (NIWA) based in New Zealand that looked at the Application of Floating Wetlands for Enhanced Stormwater Treatment (2006): “In existing systems, the FTW (floating treatment wetland) may become a low cost option to upgrade existing

stormwater ponds for removal of fine particles and associated metals." It goes on to state that more research is necessary to identify key treatment processes.

The floating islands represent an entirely new field of environmental research. Think of the role municipalities across Canada can play in the development of northern aquatic bio-mimicry, in partnership with conservation authorities or universities. In the foreseeable future, indigenous aquatic plants specific to our bio-regions will be targeted to reach specific water treatment goals. Preliminary research is revealing that the cattail (Typha latifolia) is not the only wetland hero for water purification.

And then there is the carbon sequestering abilities of the microbes, the biofilm and the plants. Together, they tie up carbon dioxide that would otherwise enter the atmosphere. Remember with the islands, you are creating entirely new surface areas that never existed before on the planet. This new real estate can become a key tool toward reaching Kyoto targets, one island at a time.

Water Management Tool for Municipalities

What does this mean for municipalities? The floating islands are a "stacked function tool" for water management. Stacking functions is a "permaculture" term that means you extend a resource (function) by having it contribute in many ways, making it more cost effective and more efficient over time. For a municipality with a stormwater retention pond near the commercial sector of town, for example, an archipelago of floating islands, will do the following stacked functions:

- help to clean up the water by removing soluble nutrients like nitrogen and phosphorous;
- provide habitat for flora and fauna, in a way that is visible and enjoyed by all;
- create new riparian edge that can be planted with indigenous wetland plants;
- help protect and restore eroded shoreline from wave action or slumping;

- mobilize the community to get involved either by planting the islands or helping launch them thereby creating an entirely new form of environmental stewardship;
- sequester carbon and other greenhouse gases;
- provide a new and enriching experience for children to engage in aquatic science and outdoor education;
- offer municipal water managers another tool for water treatment that is cost effective, environmentally beneficial, unobtrusive and beautiful.

Who is using floating island technology and what is being learned about its benefits for the environment? Much like naturally occurring floating islands that are found worldwide, the new floating island technology is being launched in urban areas around the globe. Chicago has invested in two impressive projects, one involving 25 islands in the Chicago River, and another 40 islands in the Diversey Wetland Project. Another project in Chicago, one in New York City, and another in Singapore are examples of several projects in the works right now. The bank of data is coming in from recent projects around the globe, and the results are nothing short of impressive.

The planting, launching and maintenance of the islands are pleasant work. This is where school groups can get involved. The intended use of the island will dictate what is planted where on the island, and also where it will be located in the stream or pond. So, for nesting bird habitat, tall sedges may be planted and the island located in a quiet bay, for example. Depending on the size (starting at 15 square feet and up) the island may require team work to plant and move it from the shore to the water for launching. This is fun and worthy of celebration. The islands can over-winter in the ice to maximize their naturalization. Indigenous species are tough, and many will over-winter quite well. Bird attraction to the islands may be the only maintenance issue to manage in the early stages. Nesting birds can defoliate a newly planted island, so it's conceivable that first-year islands can be launched after nesting times, if the goal is to allow the plants to firmly establish themselves. Even islands that are seeded and launched in late September establish themselves quite well.

What is equally alluring is the potential of these islands to mobilize citizens to get involved in helping troubled waters. The general public loves these islands because they offer a simple, yet effective way to make immediate and positive environmental change. A community of island stewards will surely love photographing how nature moves in and adapts to a new technology that is innovative, beneficial and fun. Municipalities who take the initiative to install islands may very well be inviting the development of rich partnerships between all members of a community, while doing the necessary work of managing our precious urban water resources.

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