Florida Specifier

Beemats: A new tool for effective surface water nutrient removal

By ROY LAUGHLIN

Question: What floats, is black at first, then turns to green, and removes nutrients from water? Answer: A new tool to remove nutrients from surface waters, named by its developers as "Beemats."

Beemats consist of interlocking sections of closed cell foam, which float on water. Hard plastic pieces hold plants in place and bind the modular pieces of mat together. The mats, by modular additions, can be built to any size and shape—circular, grids or irregular.

The Beemats' working parts are emergent native plants supported by the floating mat. Their roots are suspended in the water below the mat. The emergent plants grow hydroponically, taking nutrients directly from the water rather than sediments, as would be the case if they were planted in the usual way.

The inventors are Steve and Forest Beeman, a father-son team, of Beeman's Nursery in New Smyrna Beach. Since the late 1980s, Steve has sold and planted native emergent plants for created ponds and wetlands, many of which are intended to detain runoff to improve water quality.

The Beemat is an engineered phytoremediation system that uses native emergent plants to reduce nutrient loads and concentrations in mitigation systems.

According to Steve Beeman, the use of emergent plants for nutrient removal has two significant limitations. First, when water levels drop below the level of the sediment in which plants grow, their access to and ability to remove nutrients in water is compromised.

"Beemats are islands," he says. They rise and fall with water level, giving plant roots continuous access to nutrients in water, regardless of water level changes.

Second, a planted wetland returns nutrients back into the water column when the plants die. Unless plant biomass is cropped to remove accumulated nutrients, ponds

and wetlands will first be a sink for nutrients and then a source.

The Beemats system enhances plant harvesting for nutrient removal. The mats are reusable. After harvest, plants can be replaced with young, new plants and the cycle repeated. Harvested plant biomass is currently being composted and used in landscaping.

Beemats have been tested in four locations, including a controlled, replicated experiment done independently at Clemson University in South Carolina. Results show that Beemats physically support emergent plants as intended. The plants significantly take up nutrients.

The results show that Beemats, paired with the most effective plants, can remove 1943 pounds of nitrogen and 164 pounds of phosphorus per acre per year. This is an average of the four sites tested, including the controlled, replicated study at Clemson.

The university study also showed that water nutrient concentrations could be lowered to 30 micrograms per liter for nitrogen and 20 micrograms per liter for phosphorus. These lowest values may yield to further reductions by tweaking flow conditions and choice of emergent plants.

The choice of emergent plants is extensive. Preferred plants for fresh water include *Acrostis sp, Canna flacidda, Elocharis montana* and *Juncus effusus*.

Beemats are also being used in salt water in the Bahamas. Saltwater plants include *Juncus, Spartina* and pickleweed species. Plant species can be tailored to the conditions of the water and location being treated.

Herbivory, a form of predation in which an organism consumes principally autotrophs such as plants, and an errant tornado have been the two greatest problems encountered during the development of the Beemats system.

A tornado in central Florida destroyed a Beemat installation in The Villages. It had to be replaced.

But herbivory is specific and avoidable. Grass carp will eat plant roots avidly.

Soft shell turtles eat the plants and roots of the most effective nutrient accumulating plants. Damage is significant only when many soft shell turtles live in the ecosystem with the Beemats.

Beeman also commented that plants in a Beemats system in Orlando's Lake Eola were eaten by swans living around the lake.

Photo by Forest Beeman

Steve Beeman, on bank, directs the placement of a Beemats component as Craig Harris secures newly placed floating plant islands.

Otherwise, the plants currently preferred are resistant to extensive herbivory, and perhaps selection of avoided plants is an option.

On the plus side of biological interactions, fish congregate around the Beemats, and then wading birds come later to feed.

According to Beeman, Beemats are not replacements for existing treatment marshes and ponds. They are an addition to provide a polishing capability for the overall water treatment process occurring in these water bodies. He noted that they are "managed biological filters. It is not something to be put into a lake and forgotten."

Beemats are in use, or could be used in DOT ponds, public and private retention ponds, and in created wetlands intended for water quality management.

Florida's recent adoption of several basin action management plans will increase the need for more effective nutrient removal from surface waterbodies. And the Beemats system may be one of the best tools to get the job done.