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# A seaweed soaks up TNT - and may help clean oceans

**By Mark Clayton** | Staff writer of The Christian Science Monitor

Tucked away in Donald Cheney's office desk is a cookie tin containing six paper-thin sheets of dried porphyra - a type of seaweed commonly known as nori.

It's the same stuff used to wrap sushi.

But the real surprise lies down the hall, where Dr. Cheney, a research biologist at Northeastern University in Boston, has transformed the Japanese treat into a "super sponge." So far, it can sop up and neutralize TNT leaking from unexploded shells in coastal bombing ranges. But if Cheney and other researchers are right, the seaweed has the potential to scrub everything from polluted rivers to oceans.

There's just one catch. The first edition of the cleanup seaweed is genetically engineered. Not only do current regulations prohibit its release into the environment, but some activists want to keep this version dry-docked.

"Whether it's genetically engineered salmon or seaweed, we're looking at biological pollution plain and simple," says environmentalist Brent Blackwelder of Friends of the Earth. "We have every indication from our experience with alien or invasive species that we don't want to go down that road because we don't know the consequences."

Not long ago, Cheney was focused on porphyra's dietary benefits. Then in 2002, the United States Office of Naval Research came knocking, wondering if the professor could possibly modify seaweed to detoxify leftover TNT seeping into the ocean at its coastal-training sites. The Navy was eager to clean up the residues from unexploded bombs dropped in its training sites.

Natural seaweed usually dies in heavily TNT-tainted waters. So Cheney and his graduate students began work on a genetically modified version that would thrive. Last

month at a conference in Washington, D.C., they announced a breakthrough: a new seaweed strain that can absorb TNT and neutralize it 5 to 10 times as fast as any terrestrial plant can. The porphyra actually eats away at the nitrogen molecules that make TNT toxic, lessening its toxicity. So there's no need to gather and dispose of the seaweed.

"It's the first instance of a foreign gene being introduced into seaweed, enabling it to detoxify an ocean pollutant," Cheney says. He dubs this technique "marine phytoremediation," the seagoing version of the land-based process that uses plants to soak up pollutants. The results suggest that seaweed has the potential to be one of nature's best aquatic cleanup tools. He and other researchers are pushing the biological boundaries to develop varieties that can, for instance, filter nutrient pollution from salmon-farm aquaculture.

Even unmodified kelp can act like a pollution sponge when deployed around salmon pens to soak up fish waste and excess nutrients, says researcher Thierry Chopin at the University of New Brunswick at Saint John in Canada. "The Chinese have done this for centuries. We are just trying to refine the process [and] figure out how many tons of seaweed and shellfish we need to achieve a balance."

One of seaweed's more unusual traits is its ability to survive in intertidal zones, where it lives sometimes in salt water, sometimes in fresh. Now, Ira Levine, a University of Southern Maine researcher, is using chemicals to flip the porphyra's internal physiological switch. His idea is to create a full-time freshwater seaweed for upstream salmon hatcheries to absorb excess nitrogen and fish waste that can foul streams.

"It's only one cell thick, like a sheet of paper, but it grows fast," says Dr. Levine. "That's why it can absorb nutrients so quickly." It also gives hatcheries another crop they can harvest for the valuable pigments and fatty acids in porphyra. If successful, the technique could be used in salmon aquaculture around the world. It might also be used to detoxify more widespread pollutants like polychlorinated biphenyls (PCBs).

The US coastline could use a cleanup. River estuaries "are like a sink," Cheney notes, since they receive society's waste, which then becomes buried in sediments. Instead of staying put, though, the toxins often begin working their way into plant life and on up the food chain, as has happened with mercury in fish tissues.

Overall, the nation's estuaries are rated "fair" - with about 8 percent of estuary sediments in the Northeast rated toxic and in "poor condition," according to the 2005 report from the US Environmental Protection Agency. Major pollutants in those sediments include PCBs, mercury, and other heavy metals.

Right now, one of the few techniques for dealing with sediment pollution like this is costly dredging. But that still leaves a mountain of toxic waste to be removed and disposed of. "We are hopeful we might discover or select a native seaweed that can

remediate or detoxify PCBs buried in sediments in river basins around the world," Cheney says.

Ironically, Cheney's TNT-sopping seaweed can't be tested in the wild because it might spread out of control or have some other unintended effect. So the professor and his students are now using natural selection instead of genetic engineering. They've already bred a natural version that is nearly as effective as the genetically engineered variety, he says.

"The professor is wise to think about the ecological considerations with the engineered organism," says Jane Rissler, senior scientist with the Union of Concerned Scientists in Washington. "It's a good idea to keep the genetically engineered version in a bottle if a naturally selected seaweed can do the same thing."

For his part, Cheney harbors hope that he might return one day to studying the nutritional benefits of porphyra. But in the meantime, he's pleased that the seaweed's potential environmental benefits have made the task of attracting top graduate students into his classroom easier.

"These students are eating sushi in the cafeteria - and growing the same seaweed species up here in the lab," he says. "Now they're finding out that nori is the super seaweed that's good for you - and the environment."

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