



Algae advances as 'green' alternative for improving water quality

Algae could be put to use as an eco-friendly option to remove nitrogen and phosphorus in livestock manure runoff, reports US scientist Walter Mulbry of the Agricultural Research Service.

In 2003, Mulbry set up four algal turf scrubber (ATS) raceways outside dairy barns in Beltsville, US. The shallow 30.5 m raceways were covered with nylon netting that created a scaffold where the algae could grow.

For the next three years, from April to December, a submerged water pump at the end of the raceways circulated a mix of fresh water and raw or anaerobically digested dairy manure effluent over the algae. Within two to three weeks after the ATS system was started up every spring, the raceways supported thriving colonies of green filamentous algae.

Algal productivity was highest in the spring and declined during the summer, in part because of higher water temperatures and also because the raceways provided snails and midge larvae ample opportunity to graze on the algae.

Wet algae was harvested every 4 to 12 days, dried and then analysed for nitrogen and phosphorus levels. Mulbry's results indicate that the ATS system recovered 60% to 90% of the nitrogen and 70% to 100% of the phosphorus from the manure effluents.

He also calculated that the cost for this capture was comparable to other manure management practices – around US\$5 to US\$6 for each pound of nitrogen that was recovered and around US\$25 for each pound of phosphorus that was recovered.

To read more about this research Visit: <http://www.ars.usda.gov/is/AR/archive/may10/algae0510.htm>

Scientists study ecological impact of Katrina

Hurricane Katrina, which caused widespread devastation in 2005, has left behind significant ecological damage, according to US scientists.

The study, published in a special issue of *Environmental Toxicology and Chemistry*, reveals how chemical concentrations across coastal areas

varied, but within New Orleans elevated concentrations of lead, arsenic and other chemicals were found, particularly in the most disadvantaged areas of the city following Hurricane Katrina.

The Hurricane remains the costliest and deadliest hurricane ever to hit the US. When the category five hurricane hit land, the resulting surge extended six miles inland, breaching the levees of New Orleans and causing flooding to 80% of the city to depths of 6 m. Around 1 800 people died, with at least 700 declared missing and one million people displaced.

To discover the impact of chemical contamination, Dr George Cobb from Texas Tech University led a team who



studied 128 sampling sites from across the city. Maps were then compiled from the resulting data to reveal chemical distribution across the city.

Elevated concentrations of arsenic and lead were demonstrated to exist throughout New Orleans, with the highest concentrations observed in soils from the poorer sections of the city. The team also discovered that lead concentrations exceed the regulatory threshold for safety, with the highest concentrations found in the older parts of the city. This poses a significant health risk to the residents who returned to their homes following evacuation, especially children.

While the team's findings indicated

that the levels of lead frequently exceed regulatory threshold, further research showed that many of the contaminants were present in high concentrations before the storm season and that lead may have posed a significant risk to New Orleans residents for years

before Hurricane Katrina. The results also revealed elevated concentrations of arsenic in surface soils and flood sediments across New Orleans, caused by sediment deposition or from flooded buildings materials.

"Our evaluation of contaminants in New Orleans was critical in determining whether storm surges and resultant flooding altered chemical concentrations or distribution," concluded Dr Cobb. "Our results show how long-term human health consequences in New Orleans are difficult to attribute to chemical deposition or redistribution by Hurricane Katrina and Rita, yet reveal how chemical contamination is a historical problem for old cities in the US."

Ocean salinities show an intensified water cycle

Evidence that the world's water cycle has already intensified is contained in new research by Australian scientists.

The stronger water cycle means arid regions have become drier and high rainfall regions wetter as atmospheric temperature increases. The study shows the surface ocean beneath rainfall-dominated regions has freshened, whereas ocean regions dominated by evaporation are saltier. The research also confirms that surface warming of the world's oceans over the past 50 years has penetrated into the ocean's interior changing deep-ocean salinity patterns.

"This is further confirmation from the global ocean that the Earth's water cycle has accelerated," notes CSIRO scientist Paul

Durack. "These broad-scale patterns of change are qualitatively consistent with simulations reported by the Intergovernmental Panel on Climate Change. While change in salinity would be expected at the ocean surface (where about 80% of surface water exchange occurs), sub-surface measurements indicate much broader, warming-driven changes are extending into the deep ocean," he reports.

The study finds a clear link between salinity changes at the surface driven by ocean warming and changes in the ocean subsurface which follow the trajectories along which surface water travels into the ocean interior.

The ocean's average surface temperature has risen around 0.4°C since 1950.

As the near surface atmosphere warms it can evaporate more water from the surface ocean and move it to new regions to release it as rain and snow. Salinity patterns reflect the contrasts between ocean regions where the oceans lose water to the atmosphere and the others where it is re-deposited on the surface as salt-free rainwater.

"Observations of rainfall and evaporation over the oceans in the 20th century are very scarce. These new estimates of ocean salinity changes provide a rigorous benchmark to better validate global climate models and start to narrow the wide uncertainties associated with water cycle changes and oceanic processes both in the past and the future," says Durack.

Unprecedented warming threatens Lake Tanganyika

Lake Tanganyika's surface waters are currently warmer than at any time in the previous 1 500 years, according to US researchers.

The rise in temperature during the 20th century is driving a decline in the productivity of the lake, which hosts the second-largest inland fishery in Africa. "People throughout south-central Africa

depend on the fish from Lake Tanganyika as a crucial source of protein," reports Prof Andrew Cohen of the University of Arizona. "This resource is likely threatened by the lake's unprecedented warming since the late 19th century and the associated loss of lake productivity."

This is the first detailed record of temperature and its impacts on a tropical African ecosystem that allows scientists to compare the last 100 years with the previous 1 400 years, says Cohen. The team attributes the lake's increased temperature and the decreased productivity during the 20th century to human-caused global warming. "We have got a global



phenomenon driving something local that has a huge potential impact on the people that live in the region and on the animals that live in the lake."

The annual catch of Lake Tanganyika fishery is estimated at about 198 000 t/year. The nations of Burundi, Tanzania, Zambia and the Democratic Republic of Congo border the lake, which is the longest lake in the world and the second deepest.

Lake Tanganyika's surface waters are its most biologically productive part. For the 1 400 years before 1900, those waters were no warmer than 24°C. Since 1900, the lake's surface waters have warmed,

reaching 26°C in 2003, the date of the researchers' last measurement.

The researchers used sediment cores from the lake bed to reconstruct the 1 500-year history of the lake. The cores were analysed for chemicals produced by microbes and left in the sediments to determine the lake's past temperature and productivity. The instrument record of lake

temperatures from the 20th century agrees with the temperature analyses from the core, reports Cohen.

As Lake Tanganyika warms, the upper waters become less dense. Therefore, stronger winds are required to churn the lake waters enough to mix the deeper waters with the upper layer. As a result, the upper layers of the lake are becoming increasingly nutrient-poor, reducing the lake's productivity.

Other lakes in Africa are showing similar effects to those the team found in Lake Tanganyika, says Cohen. The findings have implications for lakes in more temperature climates.



Household detergents may form harmful substance in wastewater

Scientists are reporting evidence that certain ingredients in shampoo, detergents and other household cleaning agents may be a source of precursor materials for formation of a suspended cancer-causing contaminant in water supplies that receive water from sewage treatment plants.

The study sheds new light on possible environmental sources of this poorly understood water contaminant, called NDMA, which is of ongoing concern to health officials. William Mitch and colleagues from the Department of Chemical Engineering at Yale University report that scientists have known that NDMA and other nitrosamines can form in small amounts during the disinfection of wastewater and water with chloramines. Although nitrosamines are found in a wide variety of sources – including processed meats and tobacco smoke – scientists know little about their precursors in water.

Past studies with cosmetics have found that substances called quaternary amines, which are also ingredients in household cleaning agents, may play a role in the formation of nitrosamines.

Mitch's laboratory research showed that when mixed with chloramines, some household cleaning products – including shampoo, dishwashing detergent and laundry detergent – formed NDMA. Sewage treatment plants may remove some of quaternary amines that form NDMA. However, quaternary amines are used in such large quantities that some still may persist and have a potentially harmful effect in the effluents from sewage treatment plants.

Climate threatens trout and salmon

Trut and salmon are among the world's most familiar freshwater fishes, but numbers have fallen over recent decades – in some areas, dramatically.

Pollution, habitat loss and over-fishing have all been blamed in the past, but new evidence from Cardiff University in the UK shows that climate change could be a major factor, putting both species at risk. The scientists studied populations of young salmon and trout in the River Wye in Wales, traditionally one of the UK's best angling rivers. Prof Steve Ormerod and colleagues from the Cardiff School of Biosciences found salmon numbers fell by 50% and



trout numbers by 67% between 1985 and 2004 – even though the river itself became cleaner.

The fish were hardest hit following hot, dry summers such as in 1990, 2000 and 2003. The results suggest that warmer water and lower river levels com-

bine to affect both species. As both salmon and trout favour cool water, they face potentially major problems if climate warming continues as expected in the next few decades.

"Huge efforts have been put into bringing salmon back into Europe's formerly polluter rivers such as the Taff, Thames, Clyde, Seine and Rhine, so these results are a major worry," reported Prof Ormerod. "Salmon and trout fishing also generate many jobs and large economic benefits. In Wales alone, salmon fishing contributes around £90-million annually."

A paper on the findings has been published in environmental journal *Global Change Biology*.