

New fish farm designs mimic nature

Noreen Parks

Industrial-scale fish farming has earned strong criticism over the past three decades, because of various environmental and health concerns. However, ongoing research suggests that rearing multiple species in concert provides considerable biomitigation, while potentially boosting aquaculture's bottom line.

A chief complaint about aquaculture is its production of excess feed and copious fish wastes, which degrades the coastal environment. Realizing the potential for recycling this output into food for other organisms, marine biologist Thierry Chopin, of the University of New Brunswick (Saint John, Canada), and colleagues have pioneered the development of integrated multitrophic aquaculture (IMTA).

Inspired by ancient Asian practices, IMTA aims to create balanced systems



IMTA site in the Bay of Fundy, New Brunswick: salmon (left), mussels (right foreground), and seaweeds (right background) are cultivated in proximity.

by combining varieties of finfish (or shrimp) with organisms that absorb inorganic nutrients (think seaweeds) and organisms such as shellfish, which dine on organic matter. "The concept is feasible on land as well as offshore, for both marine and freshwater systems. What's critical is selecting the appropriate organisms, based on their ecosystem functions", Chopin explains. His extensive collaborative research has shown that kelp and mussels absorb fish-generated waste when grown near salmon pens, resulting in a

50% increase in kelp and mussel growth rate. Mussels are also capable of inactivating the virus that causes infectious salmon anemia. A new project will investigate whether shellfish can remedy another aquaculture-related plague: sea lice. Other researchers are working on integrating sea cucumbers and urchins to increase waste uptake.

Meanwhile, the concept has been adopted by the business world; IMTA systems are successfully operating in Canadian waters, at five commercial sites in the Bay of Fundy and one off Vancouver Island. China, Chile, Israel, and South Africa also have operations at or near commercial scale, and IMTA is firmly on the radar screen of the UN Food and Agriculture Organization.

While some aquaculture critics propose moving all fish farms to land-based sites, Chopin points out that this would require pumping and aerating seawater (which has its own footprint) and effluents would still have to be treated. "IMTA is no silver bullet, but using the services of different species to balance the system is one promising strategy toward sustainable aquaculture", he concludes. ■

BPA causes environmental concerns

Johanna Polsenberg

In late March 2010, the US Environmental Protection Agency (EPA) announced immediate actions to address the potential effects of bisphenol A (BPA) in the environment, especially with regard to its impact on aquatic species. BPA – a reproductive, developmental, and systemic toxin, as well as a possible endocrine disrupter in animals – is often used to harden polycarbonate plastics, such as some baby bottles, reusable water bottles, and food-can linings.

While humans are primarily exposed to BPA via contamination from food and drink containers, less than 5% of the BPA produced in the US is used in food applications. The EPA estimates that environmental releases of BPA exceed 450 000 kg per year, and the

two areas with the most potential for direct environmental releases and exposure are manufacturing and processing. Mary Dominiak (EPA, Washington, DC), project manager on the BPA Action Plan, says "[The] EPA is proposing to add BPA to their Concern List as a substance that may present an unreasonable risk of injury to the environment, marking the first time EPA is using this authority under the Toxic Substances Control Act of 1976". The EPA will also initiate further regulatory actions, including an investigation of thermal and carbonless paper coatings.

Thermal paper, used to print receipts, airline, and event tickets, contains free BPA. When handled, this easily transfers to skin, and residues on the hand may then be ingested. Use of BPA in paper may also be a major vector for BPA presence in landfills. There are adequate

alternatives, so eliminating its use in paper could reduce both human exposure and environmental releases.

Another possible route of environmental BPA contamination, reported in late March by Katsuhiko Saido (Nihon University, Tokyo, Japan) at an American Chemical Society meeting, is by leaching into the marine environment – from the breakdown of hard plastic debris and epoxy resins used on the hulls of ships. Saido and his team analyzed sand and seawater from more than 200 sites in 20 countries and found BPA in every sample. "We were quite surprised to find that polycarbonate plastic biodegrades", admits Saido. He calls it, "a finding that challenges the belief that hard plastics remain unchanged in the environment. Recent studies have shown that mollusks, crustaceans, and amphibians could be affected by BPA, even in low concentrations". ■

Climate-change initiative goes up in flames

Claire Miller

An ambitious initiative to reduce Australia's energy consumption by insulating homes has been scrapped after it was linked to four deaths and more than 120 house fires. The AU\$2.4 billion Federal Homeowner Insulation Program was billed as the largest energy-efficiency rollout in Australian history, when introduced in May 2009. "We have been advocating a substantial retrofitting program for existing homes to be more energy smart, and this was a significant initiative", says Monica Richter (Australian Conservation Foundation, Sydney). "We welcomed it."

The program promised to install ceiling insulation in 2.9 million homes, cut electricity bills by up to 40%, and create thousands of jobs in manufacturing, distribution, and installation during the global financial crisis. "This invest-

ment is a critical measure in our journey to a more energy-efficient, sustainable Australia", Peter Garrett, Australia's Minister of Environment Protection, Heritage and the Arts, said at the time, despite many warnings from electricians, regulatory agencies, and independent assessors that the program's fast rollout compromised safety.

The warnings proved well-founded, with dubious operators attracted by generous rebates that could be claimed without proof of actual costs. Tighter controls introduced in November failed to curb widespread malpractice, with an increasing number of house fires linked to incorrectly installed foil insulation.

The program was finally scrapped in February, after it was revealed that four inexperienced tradesmen had been electrocuted while installing foil insulation. The Minister was demoted and a parliamentary inquiry initiated. Richter is disappointed that a good idea was soured in its implementa-

tion. "It is a real shame that we have had to deal with this potential loss of public confidence, because what we do see with these various sustainability initiatives – rainwater tanks, ceiling insulation, and so on – is a real hunger for these programs. People want to feel they can make a difference in their lives." She believes that the government tried to move too quickly, using a bureaucracy with little project implementation experience. "Being more efficient with energy is one of the most practical and effective measures we can take to reduce greenhouse-gas emissions. But we need better design of schemes and better scrutiny of the operators."

The Australian Government is now paying for safety checks in 200 000 of the 1.1 million homes that had the insulation installed under the program, and is developing a better regulated replacement scheme, slated to be introduced later this year. ■

Dress for less environmental impact

Robin Meadows

The clothing industry is moving beyond bamboo, hemp, and other environmentally friendly textiles to the greenest fiber source of all: recycled cloth. Making new fashions from old ones is called "upcycling" by boutique manufacturers like e-ko logic (Troy, NY), which transforms discarded clothing into one-of-a-kind garments. "All of the clothes we use as raw materials are 100% post-consumer", explains e-ko logic's Charlie Tesnakis. "Our supplier sorts approximately 96 000 pounds of clothing a day."

The environmental benefits of repurposing waste fabric include reductions in the amount of fertilizer and pesticides used to grow fiber crops, savings in energy and water used in manufacturing, and a decrease in water pollutants (eg bleach and dyes). Producing one cotton t-shirt requires 150 grams of pesticides, according to the US Environmental Protection Agency, and Americans discard more



This dress, designed by From Somewhere for Tesco, is made entirely of waste fabric.

than 11 million tons of cloth goods each year, accounting for 5% of landfill waste. The environmental group Water Footprint Network (Enschede, The Netherlands) have calculated that making a t-shirt also requires 2700 l of water.

"Upcycling slows down overproduction in the textile industry, addressing the balance between consumption and disposal", says Polly Hibbert of

From Somewhere (London, UK), which creates dresses from pre-consumer waste fabric. The biggest environmental gains will come from large-scale cloth recycling. A new dress line designed by From Somewhere and mass produced by UK retail giant Tesco (Cheshunt, Hertfordshire) will turn out 375 000 pieces this year, from cloth that would otherwise be junked, including fabric roll ends and damaged or obsolete stock.

Only about 5% of castoff clothing is completely unusable. Of the rest, about half can be reworn as is, a fifth remade into new clothes or cleaning cloths, and a quarter reused to make new fabric, according to textile recycler U'SAgain (Chicago, IL), which operates in 14 states and collects half a million tons of clothing per year.

Barriers to large-scale textile recycling include a dearth of municipal collection programs, in contrast to the many that exist for paper, glass, and plastic. "Almost 85% of discarded clothing ends up in the trash", comments U'SAgain's Butch Davenport. "There's a huge opportunity there." ■

Do invasive mussels drive *Cladophora* blooms?

Janet Pelley

Cladophora – the filamentous green algae that piled up in stinking rows on Great Lakes beaches in North America between the 1950s and 1970s – is back, despite lowered nutrient levels in lake water. New research pins the blame for this resurgence on invasive zebra and quagga mussels, *Dreissena polymorpha* and *bugensis*. *Cladophora* grows on rocky lake bottoms and thrives in clear water with plenty of phosphorus. Improvements to sewage treatment plants and bans on phosphates in household detergents rid the lakes of the nuisance algae in the 1980s and 1990s, but *Cladophora* biomass has increased to six times the level considered acceptable, following the introduction of the mussels to the Great Lakes, according to limnologist Harvey Bootsma (University of Wisconsin-Milwaukee). He and environmental engineer Martin Auer (Michigan Technological University, Houghton) uncovered the mechanism behind the blooms by



H. Bootsma

Researchers may have uncovered the mechanism behind massive blooms of algae in the Great Lakes.

combining lab and field work with models for Lake Michigan.

Dreissenid mussels have boosted the clarity of Great Lakes water by filtering out plankton and other particles; Bootsma and Auer believe that increased light levels, which enabled the algal “crop” to live at greater depths, was the critical factor behind the resurgent algal blooms and a more important driver than phosphorus. “Since we can’t make the lakes cloudier, we are left with controlling phosphorus as a management tool – but should we reduce phosphorus, and by how much?” asks Bootsma.

Cladophora has achieved what some

environmental activists can only dream of – it has partially shut down two nuclear plants in Ontario due to clogged pipes. The blockages have cost Ontario Power Generation CDN\$30 million over the past 12 years, says Bootsma. “In Monroe County [NY], people moved out of their Lake Ontario waterfront homes because the smell from rotting *Cladophora* was so bad”, he recalls.

The findings present a conundrum for resource managers: if they cut nutrients to curb algal blooms, the lakes may no longer produce trophy-size sport fish. Even though total phosphorus levels in the lakes have not changed much, the concentration of nutrients and abundance of plankton in offshore waters have dropped, leading to declines in forage fish and the salmon and trout that feed on them. The mussels are the likely cause of these changes, but more research is needed, to fully understand phosphorus dynamics in the lakes, says Auer. Nevertheless, he believes that cutting phosphorus loads would likely help reduce the algal blooms and curb other lake problems. ■

Good intentions lead to reef damage

Madeline McCurry-Schmidt

In December 2009, the Hawaii Department of Land and Natural Resources (DLNR) dropped 1400 slabs of concrete into the Pacific Ocean off the west coast of Maui, with the aim of expanding the Keawakapu Artificial Reef. Unfortunately for the reef, 125 blocks accidentally fell on living coral. Creating an artificial reef is a delicate process. Isolated concrete blocks do no good; the trick is to drop material close to the existing reef without damaging the coral. “This was the first time any [concrete] modules hit coral in Hawaii”, says DLNR chairperson Laura Thielen (Honolulu, HI).

In March this year, the US Fish and Wildlife Service (USFWS) and

the National Oceanic and Atmospheric Administration released the *Keawakapu preliminary injury assessment*. According to this report, some of the Z-shaped slabs slid across areas of coral, while others showed signs of “substantial collision force with the substrate”. Thielen explains that choppy ocean conditions caused the slabs to drift off course when released.

Jeff Phillips, a biologist with USFWS (Honolulu, HI) and co-author of the report, says that when a reef is damaged, organisms typically reappear in succession, until the reef is back to full strength. “It’s kind of like [succession following] a forest fire”, says Phillips. Just as grasses appear soon after a wildfire, algae are quick to colonize damaged marine substrates, followed by coralline algae, which recruit hard corals. Phillips observed algae grow-

ing on the new slabs in January.

According to the assessment, several slabs ended up balanced on the live reef. Although shade will kill coral, some species that can switch feeding habits may survive. David Vaughan, Director of the Center for Coral Reef Research at Mote Marine Laboratory (Sarasota, FL), says certain corals can adapt to reduced light by switching from photosynthetic symbionts to planktivory as their primary energy source, a process that occurs within 30 to 90 days. “It takes them a while to produce different enzymes”, explains Vaughan.

Removing 125 stray slabs of concrete could cause further damage to the fragile coral. After holding a public information meeting with Maui residents in March, Thielen says the community favors the “middle ground” of partial removal. ■

Indian rickshaw pullers demand their due

Dinesh C Sharma

Cycle rickshaws are important modes of transportation in India, yet they are being squeezed off of the roads in cities, due to the growing volume of motorized vehicles and lack of interest among government agencies. Citing congestion on roads, New Delhi's Municipal Corporation intended to ban rickshaws in some areas and to cap licenses at 99 000. This would have left thousands jobless, given that the city has an estimated half a million rickshaws already. Striking down this decision, the Delhi High Court has asked the administration to prepare an integrated traffic plan that provides space for non-motorized vehicles.

Six million motorized vehicles clog the New Delhi roads; of these,

4 million are cars and sport utility vehicles, that serve the transport needs of just 20% of the capital's residents. "Road space cannot be appropriated or monopolized by one form of transport, particularly when the bulk of the population depends on public transport", the Court ruling noted. "Rickshaws are environmentally, socially, and economically a very sustainable means of transport for commuting and hauling light goods short distances. Banning them would create bigger environmental and socioeconomic problems in Indian cities", says Nalin Sinha, the convener of the Save Cycle Rickshaw Campaign (New Delhi). "The solution lies in integrating rickshaws with other modes of transport in urban areas and creating segregated lanes for bicycles as well as rickshaws." A survey conducted by the Initiative for Transport and Develop-

ment Programmes (New Delhi) revealed that rickshaws save over 100 million short-distance motorized trips every day in India, resulting in large reductions in carbon emissions and decreased air pollution and fuel consumption.

"Rickshaws can play a positive role in modern transport systems when mobility and a clean environment are the basic concerns of policy makers", explains Pradip Kumar Sarmah (Centre for Rural Development, Noida, India). "But when their requirements are poorly understood and facilities are not built for them, the result is congestion and inconvenience for all vehicles." In addition, efforts will be made to improve and modernize the design and technology of rickshaws – to make them more efficient, comfortable, and aesthetically pleasing, as well as lighter and safer. ■

Protecting the Wadden Sea

Adrian Burton

Coastal areas along the Wadden Sea – a critical ecosystem between the Netherlands, Germany, and Denmark – could be set to enjoy improved government protection. A Ministerial Council Declaration (the Sylt Declaration) made at the 11th Trilateral Governmental Conference on the Protection of the Wadden Sea (Westerland, Isle of Sylt, Germany, 17–19 March) sets the scene for renewed international cooperation to manage the area, already a high-profile conservation region for all three countries, as a transnational ecological unit.

The Wadden Sea includes a vast system of intertidal sand and mud flats that stretch from Den Helder in the Netherlands, across the north-eastern German coast, to Blavands Huk in Denmark. Recently declared a UNESCO World Heritage Site, the Wadden Sea supports nearly 10 000 animal and plant species, and is a critically important stopover point for the 12 million waterfowl that migrate annually via the "East



The shifting landscape of the Wadden Sea.

Atlantic flyway" corridor between Greenland or western Siberia and western and southern Africa. For 34 bird species, this ecosystem is an indispensable roosting area, while harbor and gray seals use the area's sand banks and beaches for breeding and molting, and harbor porpoises inhabit the coastal waters. The Wadden Sea Plan 2010, to be implemented by the newly commissioned Wadden Sea Board, sets out targets and policies with the aim of reducing threats from shipping, human recreational pressures, commercial fishing, petroleum and natural gas exploration, wind farm infrastructure, higher sea levels, and invasive alien species, among others. The plan seeks not to prohibit human

activity but to try and harmonize it with ecological needs.

"Together with our Dutch and Danish partners, we have placed the Wadden Sea Cooperation [the previous cooperation framework] on a new footing and made it fit for its future tasks", says Ursula Heinen-Esser, Parliamentary State Secretary for the German Federal Environment Ministry and signer of the Sylt Declaration. "This includes working with regional and local authorities to examine how we can develop the Wadden Sea into a climate-neutral zone by 2030."

"The Wadden Sea Plan 2010 is a positive step forward, and BirdLife welcomes the fact that most of the concerns we raised in our report *Wadden Sea: a vision for the conservation of a natural heritage* [have been] taken into account", says Boris Barov, European Conservation Manager with BirdLife International (Brussels, Belgium). "However, like any plan, it contains a lot of good intentions and proposals; we must keep watch to make sure good intentions become good actions." ■

Battle for the 'a'o

Alison Gillespie

Four different conservation groups – Hui Ho'omalulu I Ka 'Aina, the Conservation Council for Hawaii, the Center for Biological Diversity, and the American Bird Conservancy – joined together to file suit against the Kauai Island Utility Cooperative (KIUC) in Hawaii on March 24. The suit aims to force KIUC to take quick action to protect a bird known as 'a'o, or Newell's shearwater (*Puffinus auricularis newelli*). The groups say that KIUC's prolonged inaction has caused the Kauai population of 'a'o birds to decrease dramatically.

The birds, which are unique to the Hawaiian Islands, were once common throughout the state, but exotic predators greatly reduced their numbers several decades ago. On Kauai,

however, the 'a'o population remained relatively strong until increasing development brought more nighttime lighting to the island. Fledglings often become confused by artificial lights, which cause them to fly into power lines and other obstacles.

The 'a'o was federally classified as a threatened species in 1975. According to George Wallace of the American Bird Conservancy (The Plains, VA), the birds' population declined 75% between 1993 and 2008, with more than 30 000 injured or killed in powerline collisions since the 1970s. Wallace believes that the large numbers involved may make this one of the biggest cases of "incidental take" (accidental killing or harming of a listed species) in the history of the US Endangered Species Act.

"We know where the major flyways

are and the power lines that need to be [buried underground]", says Don Heacock, a biologist and member of the Conservation Council for Hawaii (Lihue, HI), adding that KIUC is aware of this as well but is reluctant to make the necessary changes; company press releases have stated that projects meant to save the birds would "cost the ratepayers/member-owners more money". But Randall Hee, KIUC's CEO (Lihue, HI), claims that his company has been cooperating with officials from various agencies for years.

Many believe that funding could be obtained to move the power lines belowground, and that solar power and wind turbines could be designed to minimize bird collisions. "These animals are culturally, ecologically, and economically important to Hawaiians", says Heacock. "What right do we have to not value them?" ■

Axis of weevil

Virginia Gewin

An outbreak of mountain pine beetle (*Dendroctonus ponderosae*) has so far devastated 14 million ha of forest in western Canada. However, new research suggests that reforestation strategies need to be carefully considered, to avoid paving the way for another pest. The findings, reported in the April issue of *Journal of Applied Ecology* (doi:10.1111/j.1365-2664.2010.01797.x), detail higher tree mortality as a result of Warren root collar weevil (*Hylobius warreni*) infestation. The data suggest weevils migrate from unsalvaged, mature forest to nearby stands of uniform young trees. "Our work is an example of how a response to one landscape-level insect outbreak creates new challenges to reforestation – in this case, an unanticipated outbreak of an insect that had previously only been a minor nuisance pest", explains lead author Brian Aukema, a research scientist with the Canadian Forest Service (University of Northern British Columbia, Prince George, Canada). Aukema and col-



Secondary invader: an adult Warren root collar weevil (*Hylobius warreni*).

leagues were perplexed when aerial surveys, first conducted 5 years ago, revealed mortality along the edges of clear-cut areas. The affected zones were stands of young trees replanted after salvage harvesting and designated as future commercial timber harvest. Matthew Klingenberg, Aukema's graduate student, found that tree mortality decreases with distance from the edge of the clear cut.

The adult Warren root collar weevil typically does little damage when nibbling on mature pine trees; it is the larvae "girdling" (stripping the bark off) young trees that causes mortality. Aukema's data reveal that the weevil is

a widespread problem and is causing an increase in the rate of tree mortality.

Ken White, a forest entomologist with the British Columbia Ministry of Forests and Range (Smithers, Canada), says forest managers are discussing how best to deal with both pest outbreaks. Strategies to increase the density or diversity of an individual tree stand are the most easily adopted. Aukema's team is now investigating whether deciduous plantings would deter the weevils. More politically charged control strategies, such as harvesting larger cut blocks to minimize the weevil's entry points into stands, could conflict with wildlife management objectives. Fire is perhaps the most controversial management tool – despite the fact that decades of fire suppression encouraged the devastating outbreak of mountain pine beetle. However, an increasing number of ecologists support the use of fire to mimic natural disturbance regimes.

White says forest managers need findings like Aukema's to help make tough management decisions. "The mountain pine beetle infestation was a wake-up call for forest managers." ■

Message on a bottle

Pete Mooreside

Selecting a “good” wine – whether at the supermarket or in a restaurant – can be daunting. However, with the advent of organic viticulture, eco-certification, and associated eco-labels, this choice has become even more complicated for consumers.

Researchers at the University of California, Los Angeles and the University of California, Santa Barbara recently examined the effectiveness of eco-labeling strategies in the wine-making industry. Using statistical techniques to analyze relationships between different variables obtained from *Wine Spectator* magazine’s database, Magali Delmas and Laura Grant investigated over 13 000 wines from almost 1500 California-based wineries (*Bus Soc* 2010; doi:10.1177/0007650310362254).

Eco-certified wines – produced through environmentally friendly and/or sustainable practices – are more



Some eco-friendly grapes and wines may be getting a raw deal.

costly to make than wines prepared traditionally. According to Delmas, certified wines made from organically grown grapes were associated with higher relative quality – when controlling for varietal (type of grape), vintage (year bottled), and appellation (naming convention) – and, not surprisingly, came with 13% higher price tags. But, interestingly, not all producers of certified wines put eco-labels on their bottles. “I was surprised that many winemakers were reluctant to use eco-labels”, remarks Delmas. In fact, the relative price of certified wines labeled as such dropped by about 20%, pricing eco-labeled wines

7% below conventional ones.

One possible explanation is that many consumers may fail to recognize that “organic” wine is not synonymous with wine “produced from organic grapes”. Organic wine is derived from organically grown grapes (ie grown without pesticides) but also excludes extra sulfite preservatives, thereby shortening its relative shelf life and making it more susceptible to loss of quality. Most eco-certified wines are technically non-organic, although they rely on organic grapes – by allowing sulfite supplements, however, these wines will likely last longer and be of superior quality.

Apparently, consumers may be negatively biased toward all “green” wines, and many producers have reacted by not labeling their certified products – a problem exacerbated by the use of different eco-labels among rival vintners. But for now, Delmas stresses that “the ‘bad rep’ for certified wine may not be based on real facts, and wine made with organic grapes – especially if it has an eco-label – is a really good deal.” ■

Secrets from an odd pod

Kathryn Senior

The recent publication of a detailed protocol for preparing extracts from seeds of the drumstick tree, *Moringa oleifera*, to clarify and disinfect drinking water has led to claims that seeds from the 13 species within the genus *Moringa* could be a cheap and natural way to provide clean water in the developing world (*Curr Protoc Microbiol* 2010; doi:10.1002/9780471729259.mc01g02s16). But can *Moringa* seeds really help speed progress toward Target 3 of the Millennium Development Goal (MDG), which encourages environmental sustainability? “The new, detailed protocol is useful, but the water purification properties of *Moringa* seeds have been well known for over 20 years; I have never seen them used in any of my many field visits to developing countries”, says Daniele Lantagne, a

safe water system staff engineer at the Centers for Disease Control and Prevention (CDC) in Atlanta, GA.

According to the protocol, the 30 cm-long seed pods need to be cut open to reveal the seeds, which then have to be peeled and crushed. Two grams of crushed seeds are needed to treat 20 l of water, and yields can be low. “*Moringa* seed extracts do definitely work – they contain a polyelectrolyte that can reduce turbidity and lower microbial contamination – but preparing the seeds and then treating the water is labor intensive and time consuming”, continues Lantagne.

The different species of *Moringa* contain varying amounts of the polyelectrolyte, so extracts do not always produce the same results. “The effect of the seed extract on turbidity is also dosage dependent – slightly turbid water can get worse after treatment, and there is little effect on very turbid water; this

adds to the variability”, explains Lantagne. Treating water with *Moringa* extracts means letting water sit for 24 hours – other household methods, such as chlorination, ceramic filtration, slow sand filtration, and solar disinfection, are all quicker and more convenient.

The current MDG aims to halve the proportion of the world’s population without sustainable access to safe drinking water and basic sanitation by 2015, but with less than 5 years to go, the latest UN Children’s Fund figures put the number of people still without safe drinking water at 880 million. Only 20 million are using any of the available household water treatments. “None of the methods we have are perfect, but they can reduce the incidence of waterborne infectious diseases, and working with people to provide easy-to-use options to clean water for drinking would be an important step forward”, Lantagne concludes. ■