

Red tide by day, fish stay away

Johanna Polsenberg

Scientists have long known about ominous patches of “black water” that form off the coast of Florida, but until recently they have had to rely on accounts from fishermen and sporadic sampling of the dark water to determine whether it was simply a plume of muddy river runoff or the beginnings of a toxic algal bloom, or “red tide”.

Now Chuanmin Hu and Frank Muller-Karger, researchers from the University of South Florida (St Petersburg), have developed a way to distinguish between the two. Hu, Muller-Karger, and colleagues used data from Moderate Resolution Imaging Spectroradiometer (MODIS)

instruments aboard two NASA satellites to detect the red glow of a phytoplankton bloom in its early stages (*Geophys Res Lett* 2004; 31: L15307). “Under solar illumination the tiny marine plants emit red light”, explains Hu. “This light is invisible to a human eye, but can be detected with a sophisticated instrument such as MODIS.”

Traditional satellites can only measure ocean color. “The ratio between the reflection of blue and green light would give us some idea of the amount of plant material, but only over the deep sea”, says Muller-Karger. “Oceanographers could not work close to land because plant material could not be distinguished from the usual dissolved organic matter in river runoff.”

“Although there is a lot of specula-

tion, we have no smoking gun linking red tide events to nutrients in river runoff”, continues Muller-Karger. “These satellites provide us with real-time, near-shore images that we can use to develop rapid response monitoring techniques. We can then begin to determine whether there is a connection between patches of black water, land discharge, and nutrients.”

Red tides kill fish, sicken humans, and harm coral reef invertebrates. In 2002, scientists first became aware of a huge black water patch in the Gulf of Mexico when fishermen reported tea-colored water devoid of fish. The black water subsequently moved through the reefs of the Florida Keys. Afterwards, SCUBA divers reported massive die-offs of sponges. “We believe the hypoxic conditions common in red tide events may have killed the sponges, but we have no proof”, explains Muller-Karger. “These satellites will help us look into such events in a more systematic way.” ■

Leaky uranium mine on notice

Claire Miller

The Australian Government has warned the operators of a troubled uranium mine operating within the country’s largest park, Kakadu National Park, to clean up their act or be shut down.

The Government delivered the ultimatum to Energy Resources Australia (ERA) on August 31, after receiving a scathing report from the federal Office of the Supervising Scientist, which monitors the Ranger mine’s operations.

An investigation was launched after a radiation leak in March 2004, which exposed workers to drinking and bathing water containing 400 times the maximum permitted limit of uranium. Twenty-eight workers later suffered headaches, nausea, vomiting, and skin irritations. Further legal action is expected.

Supervising scientist Arthur Johnson (Darwin) found that leaking pipes and broken and corroded valves were common. According to



Uranium Information Centre, Melbourne

The troubled Ranger Uranium Mine.

him, “a degree of complacency had crept in” at the mine, but workers should not suffer long-term health problems, nor would the incident damage Kakadu’s ecosystem or the health of people drinking water downstream from Ranger.

Conservationists and traditional indigenous owners say the mine is a time bomb, and authorities are too soft on ERA, which is owned by British mining giant Rio Tinto. More than 120 leaks, spills, and breaches of regulations have been reported since the mine opened in 1981, including a serious spill in February 2002, when contaminated water leaked into a creek feeding into the park’s pristine wetlands.

In 2003, a Senate report found a

persistent “pattern of non-compliance and underperformance” at the mine. It recommended major changes to work and reporting practices, but Dave Sweeney (Australian Conservation Foundation, Melbourne) says so far the Australian Government has not acted on the report.

Sweeney warns that Ranger’s systemic problems are getting worse as it gets older. “As the pipes get rustier, the risks get greater”, he explains. “ERA has growing problems with water and waste management, and this mine poses a real threat to the health of workers, local communities, and Kakadu National Park, which is no place for one of the world’s most toxic industrial practices.”

ERA suspended operations temporarily in September to address issues raised in the latest report, but the federal Industry Minister, Ian Macfarlane, said operations would be suspended permanently if standards were further breached. Meanwhile, the Northern Territory Government is moving to prosecute ERA for the first time. ■

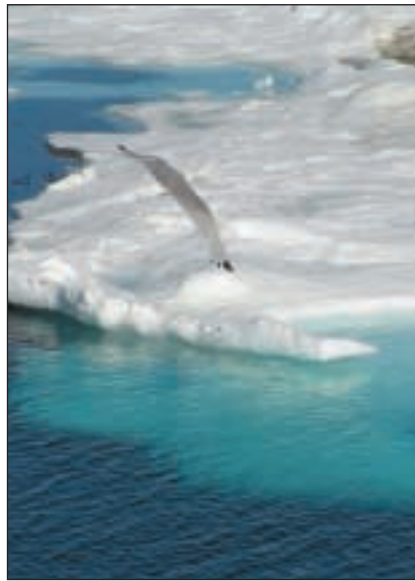
Barents Sea at risk

Nancy Bazilchuk

The arctic waters of the Barents Sea are threatened by overfishing, a projected six-fold increase in oil and gas transportation, nuclear waste storage, and invasive species, according to a United Nations Environment Programme (UNEP) report released in late August.

The report faults the governments of Norway and Russia for inadequate long-term planning and flawed international accords. Some of the risks are the direct result of government action, such as the deliberate introduction of the red king crab in the 1960s by Soviet scientists. Agreements between the two countries have exacerbated matters – for example, leading to the overexploitation of fish stocks. Ironically, some troubles resulted from positive political change: the end of the Cold War led to the creation of the world's largest nuclear waste stockpile in the Murmansk region of Russia.

The report ranks overfishing of Arctic cod and haddock by the Norwegian and Russian fishing fleets as the most serious threat, and blames the two governments for



A seagull patrols Kvitoka island, Barents Sea.

bowing to economic pressures rather than heeding environmental reality when setting quotas. “It’s particularly troubling because Norway and Russia have all the regulating mechanisms in place to control this problem”, says Dag Daler (Scientific Director, Global International Waters Assessment, UNEP).

According to the report, the total allowable catch for cod since 1999

has been set at 50–100% over ecologically acceptable limits, with quotas through 2002 set at just over 400 000 metric tons instead of a more sustainable 110 000 to 260 000 metric tons. Cod stocks are also at risk because of illegal fishing and discards of small-sized fish. Unreported, illegal catches may total an additional 100 000 metric tons or more. The common practice of dumping smaller cod overboard in the hope of catching larger ones further compounds the problem. “Every year, Norwegian vessels alone discard 800 million kroner (\$115 million) worth of smaller cod and other fish caught as bycatch – they throw it away to get medium-sized cod, so they can fill their quota with bigger fish”, explains Dag Nagoda, Barents Sea Ecoregion Coordinator for the Norwegian office of the World Wide Fund for Nature.

Daler believes that the remoteness of the Barents Sea has protected it from some pollutants and ills that plague other great seas, but that failure on the part of governments to act puts the ecosystem in peril. He warns that “if we want to keep and preserve this ecosystem, we have to initiate some actions to do so”. ■

Concern over immunization waste in India

Dinesh C Sharma

The Indian Health Ministry’s decision to switch over to auto-disposable (AD) syringes (single-use syringes, in which the plunger locks after one injection) in its immunization programs from 2005 onwards has evoked strong reactions from environmental groups. The ministry plans to stop using glass and disposable syringes to ensure injection safety, but it has not unveiled any plan for handling the resulting waste. In state-funded immunization schemes, over 210 million injections are given each year.

The government healthcare system at village level is ill-equipped to process medical waste. “Right now, there is no plan for the disposal of

AD syringes”, says Ravi Agarwal of Toxics Link, a New Delhi-based voluntary agency. “Going by the current disposal practices, this huge amount of plastic will either be incinerated or burnt in the open. In either case, it will be dangerous for the environment and in violation of waste handling rules.” The Central Pollution Control Board’s expert panel on biomedical waste ruled out open burning as an option for the disposal of AD syringes.

“Some cost-effective, practical, local solutions which can be easily rooted in the system, need to be worked out”, noted family welfare secretary Prasanna Hota, at a meeting held August 19 in New Delhi to discuss the problem.

According to Merci Ferrar (Asia Coordinator, Health Care Without Harm), measles elimination cam-

paigns in the Philippines have shown that it is possible to dispose of millions of syringes by resorting to options such as deep burial. “The cradle-to-grave management of immunization waste was relatively safe, while complying with the ban on incinerators under the Philippines Clean Air Act.” Under the Stockholm Convention on Persistent Organic Pollutants, in force since May 2004, countries must reduce, and ultimately eliminate, pollutants such as dioxins released by the burning of plastic medical waste.

Every form of waste plastic is recycled in India and plastic medical waste is no exception. A recent study commissioned by the Health Ministry found that an estimated 8% of all used plastic syringes are gathered by rag pickers and find their way back into the health system. ■

Unregulated wells drain water reserves

Virginia Gewin

The full extent of India's groundwater crisis was revealed at the Stockholm Water Symposium in Sweden (August 16–20, 2004) as researchers described the unrelenting development of pump-operated tube wells. At the current rate of one million tube wells drilled annually by subsistence farmers in India, the total number has reached 21 million – an unregulated drain on existing groundwater reserves.

“Many of us have not seen the whole picture”, says Jan Lundquist, a professor at the Stockholm International Water Institute. “We have a much better understanding about surface water schemes that have systematic government regulation.” The tube wells, which harness oil industry technology to reach hundreds of yards below the surface, provide pragmatic, yet hidden, usage. The sheer number of people involved creates an overwhelming problem.

Tushaar Shah, Leader of the International Water Management Institute's Tata Water Policy Program



A farmer in Junagadh District stands beside his well.

Courtesy of T. Shah

in Gujarat, India, says that the lack of government regulation combined with energy subsidies has exacerbated well drilling: “Political leaders know that farmers would be jobless without the wells, which would lead to massive social unrest”.

Ultimately it will be a self-regulating mechanism, says Lundquist. “It will be too expensive once farmers have to drill to a certain depth.” Unfortunately, the damage will have been done. Farmers in Gujarat are already feeling the crunch. According to Shah, they are pumping from 1100–1200 feet down, drawing on water that is 50–60 000 years old – hardly a sustainable practice. Surrounding coastal areas suffer from ris-

ing salinity levels. Despite rich aquifers, the proximity to the sea allows salt water intrusion when the groundwater table goes down. “Crisis here comes swiftly”, says Shah. “This could completely destroy agriculture in this coastal region.”

Some attempts are being made to alleviate pressure on groundwater reserves. As in the western US, some states are trying to import surface water. Planned dams on the Narmada River would provide a source of water that the government could control and transport.

On a smaller scale, local communities are using their own resources to harvest rainwater for groundwater recharge. Shah notes that although it captures only moderate amounts of water, in areas that receive the majority of their rain in a 4-day monsoon, the harvested water will protect crops and keep the regional farming economy alive.

Groundwater quality is also a growing concern in other parts of Asia. According to Shah, arsenic contamination in Bangladesh and fluoride in southern India are now “public health time bombs”. ■

Flame retardants found in food

Jane Bradbury

A market basket survey in the US reveals high concentrations of polybrominated diphenyl ethers (PBDEs), compounds used as flame retardants, in foodstuffs of animal origin. “Last year, we found that women living in Texas had 10 to 100 times the levels of PBDEs in their breast milk as did women in Europe”, explains environmental expert Arnold Schecter (University of Texas School of Public Health, Dallas, TX). “Our new study shows that these levels are mirrored by high PBDE concentrations in fish, meat, and dairy products, suggesting that food is a major route for PBDE intake.”

PBDEs – mainly pentaBDE and octaBDE – are used as flame retardants in textiles and other materi-

als. “PBDEs are everywhere we look – in carpet sweepings, on computer casings, in wild fish”, explains Schecter. While little is known about the impact of PBDEs on human health, chemically they resemble polychlorinated biphenyls (PCBs), and, like PCBs, have been associated with cancer and other health problems in animals.

Could the PBDEs present in human tissues be derived from food? Schecter and co-workers analyzed 30 food types from three supermarket chains in Dallas for 13 different types, or congeners, of PBDE (*Environ Sci Technol*; published online 1 Sept, 2004; DOI 10.1021/es0490830). “As with our human tissue studies, PBDE concentrations in these food samples were higher than those reported elsewhere in the world”, notes Schecter.

“These results surprise me a little”,

says Hannu Kiviranta of Finland's National Public Health Institute (Kuopio). “In our study, we did not see such big PBDE concentrations in Finnish food samples [*Env Int* 2004; 30: 923–32]. However, as in the US, PBDE 47 (a congener containing four bromines) was predominant in fish, while congener 99 (containing 5 bromines) was predominant in meat”.

Action is now being taken to reduce PBDE use. Since August 2004, penta- and octaBDE use has been restricted in the European Union, and manufacturers of brominated flame retardants will voluntarily cut back on penta- and octaBDEs production in the US, beginning on January 1, 2005. “Whether a voluntary agreement will be enough – some states are bringing in regulations – remains to be seen”, says Schecter. ■

Papuan palm oil problem for UK

Adrian Burton

The activities of a 10 000-ha palm oil plantation in northern Papua New Guinea have become a US\$95 million bone of contention between environmentalists and the UK Government. The plantation is run by Higaturu Oil Palms (HOP), a partial holding of the UK Government-owned investment company CDC.

According to the compensation-seeking Ahora/Kakandetta Pressure Group, the plantation is damaging the environment. Sponsored by Friends of the Earth, Ahora/Kakandetta has written to Hilary Benn, UK Secretary for International Development, outlining the environmental and social grievances on which its claim for compensation is based. In a simultaneous communication, the group's lawyer, Damien Ase (Centre for Environmental Law and Community Rights, Boroko, Papua New Guinea), stated

that the HOP had "caused enormous amounts of damage to the land [and] environment and [had polluted] rivers the people rely on for their daily needs". Ase also asserts that HOP activities have resulted in partial deforestation, and that the plantation lacks proper environmental management plans and necessary water use permits, fails to respect required buffer zones, and causes social and cultural degradation. There is also a suspicion that HOP may be dumping potentially harmful wastes into the Ambogo River at night.

Says Robin Webster (Corporates Campaigner for Friends of the Earth, London): "It's shocking that any UK company is involved in environmental destruction and human rights abuses abroad, let alone one that funds its operations with British taxpayers' money. The British Government must face up to the responsibilities of such investments and ensure that all UK companies, and especially those operating in the Government's name, are not destroying the environment or

damaging local communities".

Innes Meek (Corporate Relations Director, CDC, London) emphatically denies the allegations, stating that untreated waste has never been dumped in the Ambogo River, and that while HOP once had a license to discharge treated effluent, the company now has a zero-discharge system. Further, Meeks categorically denies any HOP involvement in logging, and insists that the environmental performance of the plantation is monitored annually by the Papuan Government.

"[HOP] has built and maintained 700 km of roads [and] operates nine schools and 11 medical facilities. It is a well- and responsibly-run company, whose management has treated the environment with care and respect for many years", says Meek. "We have the power to change the management, and if we thought they were doing anything wrong, we would."

HOP is to meet with Ahora/Kakandetta to discuss these issues. ■

Albania's aquatic ecosystems need protection

Leslie Bienen

Albania, though small, contains a surprising diversity of species, much of it found in aquatic ecosystems. Surveys are incomplete, but so far 310 species of fish (6 endemic), 520 species of mollusks (54 endemic), 15 amphibians, 37 reptiles, and more than 70 species of waterbirds have been catalogued. Researchers from Albania and Switzerland report that both biodiversity and human health are threatened by aquatic pollution (*Environment International* in press). According to Reinhard Bachofen (University of Zurich, Switzerland) political and economic forces have played a major role in degrading Albania's waters. "Under communism, chromium and nickel were mined intensively", he says. "Then, Albania's recent rapid transition to an open-market economy occurred with little regulation. Through all of this, water systems were unprotected. The result is signifi-



Courtesy of H.Brandt

Pollution in the Lana River, Albania

cant damage to Albania's aquatic resources."

Rapid development in the early 1990s produced huge increases in solid wastes, and much of the effluent ended up on riverbanks and in temporary dumps. In addition, industrial wastewater (such as that from petroleum plants) and sewage are allowed to enter waterways untreated. "Solid waste is dumped on riverbanks or burned in open fields, harming air quality, water, biota, and human health", laments Bachofen. "Tirana, the capital city, has grown from

200 000 to 700 000 inhabitants in a decade, and the city's waste is discharged untreated into the small Lana River." Other threats to Albania's waterways include massive depositions of solids into mountain rivers due to erosion caused by deforestation, and the push to expand farmland. Bachofen notes that, at peak runoff times, "the amount of suspended solids in most rivers exceeds the European standard twentyfold".

Nor are pressures on Albania's watersheds going to go away, because demands for drinking water, irrigation, and hydroelectric power are increasing. "Albania is lucky to have rich water resources, but the responsibility to protect them must be taken seriously", urges Bachofen. "Albanian researchers have prepared a book on protecting aquatic systems for use in schools, to educate the public, and to put pressure on politicians. With the improved economy, we're hoping for a move towards better environmental regulations." ■

New oilfield approved in Ecuadorian Amazon

Claudia Orellana

The Ecuadorian Environment Ministry has granted Petrobras, Brazil's state-run oil company, permission to start drilling inside Block 31, the largest untouched area of the Yasuní National Park. The Amazonian reserve contains a variety of forests, including flooded and swamp forest, and has one of the world's most diverse tree populations (*Ecology* 2002; 83: 3210–24). The environmental group Acción Ecológica (Quito, Ecuador) reacted to the news by requesting a court injunction to prevent Petrobras from using the permit. Ecuadorian President Lucio Gutiérrez defended the government's action, declaring that while development should not destroy the environment, the state must not leave the country's needs unmet to keep the environment intact.

Charged with achieving this balance, the Environment Ministry argues that technological improvements will prevent previous environmental catastrophes from recur-



Huaorani indigenous people in Yasuní Park.

Courtesy of Acción Ecológica

ring. The saline, oily water that is a byproduct of oil extraction will be re-injected into the earth. Computerized leak detection systems will monitor pipelines, and the forest crown will span the access roads. "We have established a technical unit to monitor the implementation of the environmental management plan", says Vinicio Valarezo Peña (Environmental Quality Secretary, Environment Ministry Quito, Ecuador). "We have insisted the company take out an insurance policy for 20% of the total investment to cover the cost of remediating any possible damage."

Debate about future risks centers on disagreements over the impact of existing oil concessions in Yasuní.

Amanda Jorgenson, the Ecuadorian coordinator for the World Conservation Society (Quito, Ecuador) is attempting to promote conservation by mediating between the government, the oil companies, and the local inhabitants. She notes that "satellite images of Block 16, where Repsol has been operating for 10 years, indicate minimal deforestation beside the Maxus Road, thanks partly to their rigorous control of the highway".

Other NGOs maintain that tight security prevents effective monitoring and enables companies to pollute with impunity. In August, an international fact-finding mission heard accounts of contaminated water from indigenous people in Block 16, before being ejected by company guards. Yasuní is the principal territory of the Huaorani, whose population has fallen tenfold in four decades, to 1500. Alexandra Almeida of Acción Ecológica sees the advance of oil extraction into the remaining ancient forest as the death knell for Huaorani culture. "They are exchanging a life of hunting and gathering for one of total dependence on the oil encampments." ■

Nanoparticles clean-up

Dorothy Bonn

US scientists are using a blood protein to synthesize minute iron particles that will clean up dangerous environmental contaminants. "When the nanoparticles are activated by light they reduce highly toxic and soluble chromium-6 (hexavalent chromium) to less toxic chromium-3 (trivalent chromium)", explained Daniel Strongin (Temple University, Philadelphia, PA) at a meeting of the American Chemical Society in Philadelphia in August, 2004. "And because chromium-3 is less soluble than chromium-6, it can be filtered out of groundwater much more easily."

Nanoparticles of metals, especially iron, are increasingly being used in environmental remediation. "They are catalytic, and because they are so

small they have a much larger surface area and higher surface reactivity than their bulk counterparts", notes Barbara Karn, of the US Environmental Protection Agency. Iron nanoparticles can be made in several ways, for example by mechanical attrition or by growing iron salts as crystals. But Strongin says that nanoparticles produced from ferritin, a protein that stores excess iron in the body, are more stable and less likely to fall apart. Ferritin consists of a protein cage that can encapsulate a tiny amount of iron (as ferric oxyhydroxide). When Strongin and colleague Trevor Douglas (Montana State University, Bozeman) loaded horse spleen ferritin with varying amounts of iron, they found that they could vary the size of the nanoparticles. "Being able to assemble nanoparticles of defined size and

structure is the key to dependable results", says Strongin.

According to Strongin, the findings are so encouraging that their nanoparticles could be used to clean up other toxic materials, such as technetium-7, a radioactive metal that is slowly leaking from canisters of nuclear waste in Washington State. Says Strongin: "People are worried about it getting into the groundwater. Nanoscale ferritin could not remove the radioactivity, but it would probably immobilize the technetium".

"The use of ferritin to assemble iron oxide nanoparticles is a novel and elegant approach", says Sarah Larsen (University of Iowa). The EPA's Karn, however, notes that "a lot of different nanotechnology approaches for environmental remediation are being tried, and it remains to be seen which is the best". ■