

Smarter economics key to restoring fisheries

Jen Fela

Based on current trends, the viability of the world's commercial fisheries is at serious risk, unless fundamental changes are made and "far more intelligent management" is brought to the industry, according to the *Green Economy Report*, which is being compiled by the United Nations Environment Programme (UNEP; Nairobi, Kenya) and economists. The report, to be released later this year, analyzes how "greener" investments across 11 sectors, including energy, forests, and water, are essential to drive economic recovery and tackle serious social and environmental challenges. A preview of three sectors, including fisheries, was presented at a press briefing in New York City.

A successful fishing industry is essential to the physical health and economic well-being of millions of people worldwide. Fish are the primary protein source for approximately 1 billion people, and UNEP estimates that, in 2006, 170 million people were employed in activities directly and indirectly related to fishing. Factoring in an average of three dependents per fisher, the livelihoods of over 500 million people rely on the fishing industry.

However, in certain parts of the world, marine fisheries are facing collapse – defined by UNEP as having a current catch level of less than 10% of the maximum registered catch. The Food and Agriculture Organization of the United Nations (Rome, Italy) estimates that only about 25% of commercial stocks, mostly of low-priced species, are in a "healthy" or "reasonably healthy" condition and that, by 2003, close to 30% of the world's marine fisheries had already collapsed.

UNEP reports that current fishing capacity is 1.8 to 2.8 times what is needed to be sustainable, primarily as a



An entirely new economic fishing model is required to prevent a catastrophic global collapse of fish stocks.

result of mismanagement, lack of enforcement, and "perverse" subsidies – those that lead to overcapacity and overexploitation. According to the *Green Economy Report* preview, fisheries added about US\$17 billion to the global economy in 2005, while the sector received about \$27 billion in subsidies. Subsidizing commercial fishing methods that are unsustainable – to the point that fish stocks cannot replenish themselves – is now threatening the entire fishing industry. Achim Steiner, UN Under-Secretary-General and UNEP Executive Director, says, "We are actually paying ourselves to destroy the very resource on which our whole fishing industry is dependent".

Pavan Sukhdev, Special Adviser and Head of the UNEP Green Economy Initiative, on temporary assignment from Deutsche Bank, where he was a Managing Director in the Global Markets Division, explains, "Economics is the science of scarce resources. What is scarce here as a resource is not fishing capacity – in which every year we invest more, as a result of the subsidies that are targeted largely at the bigger fleets and the trawler fleets. What is scarce here is fish. So if you were to do 'good' economics, you would be focusing your efforts and your investments on increasing the stock of fish, not the stock of fishing capacity. That is the fundamental economic realization that

we are trying to push through this report".

The report estimates that an investment of about \$8 billion per year is needed to "green" the fisheries sector, by rebuilding depleted fish stocks and improving fisheries management. This investment could eventually increase the annual marine fisheries catch from about 80 million metric tons to an estimated 112 million metric tons, which could generate a total annual catch value of about \$119 billion, as compared with the current \$85 billion.

Sukhdev continues, "There is a lot of evidence to suggest that if, instead of targeting fiscal support toward subsidizing trawler fleets, we were to put it toward transitioning the whole fishing model – in other words, if you were to build up reserves in marine protected areas and support fishing communities during the transition period that it takes for fish stocks to revive – that would actually be a much better deployment of the same amount of fiscal resource. The reason this works is biologically and scientifically very simple: if a female fish were allowed to grow to twice its size [before capture], it could produce 10 to 100 times as many eggs."

The report preview highlights four objectives for the fishing industry, to enable the transition to a green economy: (1) reformation of fishery subsidies and other economic distortions; (2) adjustment costs, including vessel buyback programs and retraining of fishers in alternative livelihoods; (3) creation of effective national, regional, and international institutions, specifically to help manage the problems of shared and transboundary fish stocks; and (4) stronger regulatory reform and fisheries management.

Steiner summarizes: "We are not trying to create an alternative school of economics here. What we are trying to correct is an established and deeply entrenched method of resource allocation across the global economy – one that is remarkably inefficient, increasingly irresponsible, and which will ultimately defeat the agenda on sustainable development." ■

A river runs again after 90 years

Claire Miller

The Wimmera River, in the far west of the state of Victoria, Australia, has been revived, with a natural flow running again for the first time in 90 years. The flows were made possible by an ambitious state–federal AU\$688 million project to replace 17 000 km of artificial dirt channels, which lost more than 80% of their water before reaching towns and farms spread across 10% of the state.

In previous summers, all water from the river had to be diverted to meet urban and farming needs, while Ramsar-listed lakes at the end of the closed system have gone without a drink for decades. But the Wimmera Mallee Pipeline Project, completed in April 2010, is bringing the Wimmera and other rivers in the region back to life, with 83 billion



The Wimmera River is again full of water.

liters of water to be saved on average each year for release as environmental flows.

Replacing the channels with 8800 km of pipelines means communities can still be supplied, even if storage levels again drop to the record low (3.7%) experienced in 2007 and 2008, during the worst of the drought. And with the Grampians Wimmera Mallee Water (GWMW) authority no longer needing to divert every drop, the Wimmera River is

already running again – even though the drought has yet to fully break and reserves are still low.

According to John Martin (GWMW authority, Horsham, Australia), the main diversion weir was used to stop all low- and most mid-sized flows passing down the river. In a typical summer, the river was reduced to a series of saline pools, and did not run at all in 2007–08, when water shortages were so acute that some towns were at risk of evacuation. “But thanks to the pipeline, the river started flowing again, even before the project was completed”, Martin explains. “It is amazing seeing a more natural flow regime, particularly low flows. The other end of the flow scale is important for the terminal lakes. While it is hard to know what climate change might bring us, the pipeline is the only way we can get water back into these lakes with big flows down the river.” ■

Europe ends illegal timber imports

Adrian Burton

The European Parliament has voted overwhelmingly to adopt a series of measures designed to put an end to illegal timber imports. “At last, the link between the European market and forests around the world ravaged by illegal logging has been weakened”, says Finnish Member of the European Parliament Satu Hassi, the Parliament’s Rapporteur on the law. “For too long the EU has preached against such logging and the resulting massive deforestation, while simultaneously providing one of the largest markets for illegal timber. This agreement on illegally sourced timber represents a major international breakthrough.”

Indeed, the European Union (EU) has been a huge marketplace for illegal timber, with some 20% of all European imports widely recognized as coming from illegal sources; the profits of this unlawful trade are even believed to have fueled the two most recent civil wars in Liberia. This sit-



A Penan man of Sarawak, Malaysia, watches timber leave his forest home.

uation was in part sustained by weak legislation, such as the Forest Law Enforcement Governance and Trade Action Plan of 2003, which called only for “voluntary partnership agreements” between EU member states and timber-growing nations (which was only ever achieved with Ghana), and for the “promotion” of legally harvested timber.

Good will, however, proved not to be enough. The new legislation demands that all wood imported and later marketed within the EU should be traceable back to the original supplier; that origin be shown by labeling; and that companies exercise due diligence in the face of

potentially illegal shipments, tracing them back to their source. Failure to comply will be punishable by fines proportionate to the economic and environmental damage caused. Setting the size of fines, however, is a potentially weak point of the new legislation, with each EU member country being able to decide what “proportionate” means; Europe-wide minimum fines were not adopted.

The new legislation does not come into force until 2012, and even then there is a 5-year exemption on timber imports destined for the making of printed materials – eg newspapers and books – an apparent victory for lobbyists. “Europeans will soon be safe in the knowledge that the furniture they buy is made from legal wood, but they risk fueling forest destruction by buying books or magazines until 2017”, warns Mark Breddy, EU spokesperson for Greenpeace. “Despite its shortcomings, the new law will eventually create a level playing field, so legitimate companies and customers can act sustainably.” ■

The big carbon footprint of shale gas

Janet Pelley

The shale gas industry in the US is booming, benefiting from the image of natural gas as a low-carbon fuel. The US Environmental Protection Agency (EPA) and the Intergovernmental Panel on Climate Change advocate burning natural gas in place of coal or petroleum, as an interim measure to curb greenhouse-gas (GHG) emissions. But scientists digging into the full impact of drilling, processing, and transporting shale gas find that its total carbon footprint may rival that of coal mined by mountaintop removal.

Increasing natural gas prices – and advances in horizontal drilling and hydraulic fracturing of rock – have companies racing to tap natural gas tightly bound to shale rock more than 3 km underground. “But as

fuels become harder to get, more energy is needed to obtain the fuel and this results in a lot of emissions”, explains ecologist Bob Howarth (Cornell University, Ithaca, NY).

The assertion that – per unit of energy produced – natural gas releases roughly half the amount of GHGs as coal is true, but is only part of the story and very misleading, Howarth points out. He analyzed GHG emissions arising from the use of fossil fuels to build pipelines, truck water, and drill wells for shale gas operations. He also included uncontrolled leaks of methane from wells, compressor stations, and pipelines. Methane is the major component of natural gas and packs a climate-warming punch 72 times that of CO₂.

Howarth found that the total GHG emissions from shale gas are 60% more than those from diesel fuel and gasoline, and not much different than that from coal obtained

by mountaintop removal. Methane gas leakage is the main reason for this dismal performance. “The EPA and other agencies have a very poor handle on how much methane is actually leaked from the oil and gas industry, and industry is not required to report leakages”, he continues.

Researchers carrying a portable spectrometer at shale gas operations around Dish, Texas found methane levels as high as 40–50 parts per million, says Sharon Wilson, a Decatur, Texas organizer with the environmental group Earthworks. According to Wilson, “when a relief valve evacuates a pipeline, as much as 100 mcf [thousand cubic feet] of gas, or more, is vented directly into the atmosphere”. “Methane leakages of less than 5% are probably not detected in most cases, yet leakages of just 1–2% make the GHG warming from shale gas into a huge problem”, Howarth concludes. ■

No more shark fin soup for Hawaii

Alison Gillespie

On July 1, Hawaii enacted one of the nation’s toughest ocean conservation laws, declaring it illegal to possess, sell, or distribute shark fins within the state’s boundaries. The new law went into effect after a long legislative battle that attracted worldwide attention, as professional sports celebrities, Hollywood movie stars, and prominent US politicians stepped forward to defend the marine predators. Although accurate estimates are hard to generate, research indicates that somewhere between 30 million and 100 million sharks worldwide are killed annually for their fins, which have become an increasingly popular item on many upscale Asian menus. In recent years, Hawaii developed into the center of the Pacific market for the product, but many find the practice unnecessarily cruel and wasteful, and warn that it is not ecologically sustainable.



A shop in China selling shark fins.

As arguments over the new law flared up this spring, some tried to defend the eating of shark fins as integral to Asian culture. But Vicky Cayetano – former first lady of the state and notable Chinese American – disagreed vehemently, comparing finning to the binding of women’s feet in China decades ago. “Shark fin soup is not a staple item in China or

anywhere else – it is enjoyed by an affluent few”, argues Inga Gibson, the Hawaii State Director for the Humane Society of the United States (Honolulu). “We don’t want our state to be a hub for this industry, and Hawaii is a critical area for shark conservation.”

Others, however, are dubious about how the new law might affect ocean conservation efforts. Kim Holland, a researcher at the Hawaii Institute of Marine Biology (Honolulu), says that it will be difficult to measure the ban’s impact because the global market for shark fins is so large and diffuse. Holland has also expressed concern that the somewhat loose wording of the law might eventually lead to problems for those conducting research on the animals, especially when sharks are held for short periods of time for study in captivity. “There’s no doubt that shark finning is an egregious activity”, Holland says. “I just thought this was a bit of a blunt instrument.” ■

New lease on life for prairie dogs?

Noreen Parks

Decimated by decades of poisoning, hunting, habitat loss, capture for the pet trade, and sylvatic plague, populations of North American prairie dogs have plummeted to about 5% of their former numbers. Once common across the plains of Canada, the US, and Mexico, prairie dogs now occupy a tiny fraction of their historical range. But a breakthrough project promises to conserve one group of these animals, while also benefiting North America's most endangered mammal, the black-footed ferret (*Mustela nigripes*).

The black-tailed prairie dog (*Cynomys ludovicianus*) acts as a “keystone” species in short-grass prairie ecosystems. Their burrow-digging, excretion, and grazing activities enrich the soil and support a diverse community of plants and animals in and around their colonies. “More than 200 species of mammals, birds, and invertebrates are associated with the



About 500 prairie dogs will be moved to a protected area in Wyoming.

prairie dog”, explains Lindsey Sterling Krank, an environmental scientist and Director of the Prairie Dog Coalition, a program of the Humane Society of the United States (HSUS). Several imperiled species depend directly on this rodent, including ferruginous hawks and the black-footed ferret – which preys almost exclusively on prairie dogs – as well as mountain plovers and burrowing owls, which nest in prairie dog burrows.

The US Forest Service (USFS) has historically used poisons to exterminate prairie dogs on forest lands

where grazing occurs, since cattle could potentially be injured by stepping into burrows. But this summer, the HSUS, Defenders of Wildlife, Biodiversity Conservation Alliance, and WWF have partnered with the USFS to translocate about 500 prairie dogs from two sites slated for poisoning. Their new home: Wyoming's Thunder Basin National Grassland, where they will help to repopulate a recovery area for the black-footed ferret, which requires over 4000 hectares of prairie dog lands for a self-sustaining population. “We've already seen an increase in Thunder Basin prairie dogs, so ferrets could be reintroduced there as early as 2011”, says USFS ranger Misty Hays, manager for the relocation venture.

Hays calls the transfer project “an important first step” in managing prairie dogs differently in areas where their presence conflicts with other land uses. For Krank, “The fact that a federal agency is implementing this nonlethal control strategy is huge. We hope it sets a precedent”. ■

First global map of forest heights

Kathryn Senior

Data from three NASA (National Aeronautics and Space Administration) satellites – ICESat, Terra, and Aqua – have been used to create a new map of tree heights; this is the first time this methodology has been applied on a global scale and it has been welcomed as an important research tool. “The global tree-canopy-height map produced by Michael Lefsky and colleagues is technically impressive and demonstrates the potential of the spaceborne LIDAR [light detection and ranging] instrument to depict variations in forest structure”, comments Liana Anderson of the Environmental Change Institute at the University of Oxford, UK.

“Forest height can be used to help predict the amount of carbon that trees store in their aboveground biomass. Spatial variation in the biomass of forests that undergo clearing is a

major uncertainty in the global carbon budget”, explains Eileen Helmer of the International Institute of Tropical Forestry (San Juan, Puerto Rico). A global map of forest height, she told *Frontiers*, can be used to estimate the amount of carbon stored in trees in each place on Earth. “As we gain data that permit more precise forest-height biomass relationships, estimates of forest carbon storage will improve markedly”, she adds.

According to researcher Lyndon Estes (Princeton University, NJ), the map also sets a baseline and provides a new tool for assessing and comparing deforestation, afforestation, and forest recovery, anywhere in the world. “Until now, such efforts were based on a patchwork of methodologies focusing on particular regions.” Given the close relationships between canopy height, the overall structure of a forest, and the species it can support, the new map may also help predict habitat use and species distribution. “It also provides an

important variable for broader landscape- to global-scale ecological modeling studies. I imagine it would be particularly valuable for studying wide-ranging species' (such as neotropical migrants) ecological requirements, and habitat availability”, continues Estes. Assuming that maps are redone at regular intervals, ecological models that use this predictor can be readily updated to help scientists understand the impacts of changing forest structure on the species in question.

Anderson views the map as the first step toward increasing the accuracy of biomass estimates globally. However, she warns that uncertainties should be well quantified, bearing in mind that the map's spatial resolution (5 km²) may mask forest mosaics within the area being studied. “In terms of biomass quantification, field measurements will be essential for data calibration and validation. Future refinements are expected to decrease this type of uncertainty”, she concludes. ■

Nitrogen pollution alters soil microbial community

Virginia Gewin

Nitrogen may be a valuable, often limiting, nutrient in forest ecosystems, but new research shows that, when deposited in excess, it may actually disrupt carbon storage in forest soils. As nitrogen oxides, formed during combustion of fossil fuels or biomass, enter the terrestrial environment, plant litter decay slows and the amount of dissolved organic carbon, a form easily leached from the system, increases. Donald Zak, a soil ecologist at the University of Michigan (Ann Arbor) has highlighted the microbial community shifts that may be responsible for these changes in the August issue of the *Soil Science Society of America Journal*.

Knowing that nitrogen decreases fungal abundance, the research team believed that other organisms, particularly soil microbes in the phylum Actinobacteria, able to break down tough lignin compounds, would

increase. But that wasn't the case. Instead, they found a 47% decrease in Actinobacteria abundance in the soil. "The results were surprising, because we thought that nitrogen would simply stimulate the growth of existing bacteria, but instead it favored communities containing some normally obscure members", says coauthor Sarah Eisenlord. For example, members of the order Acidimicrobiales increased. Unfortunately, scientists know little about these microbes, given that very few of its members have had their genomes sequenced – and the ones that have been cultured were sampled from aquatic systems. At the same time, well-known lignin degraders, from the family Micromonosporaceae, decreased.

The future of carbon storage in soils under increasing nitrogen deposition remains uncertain. Soil organic matter increases as decomposition slows – which is an initial benefit. But, if the new microbial community breaks down this litter into leachable carbon, the efficiency of organic matter

breakdown decreases. "These field plots, which have been going now for 17 years, are important because they allow us to better understand the mechanisms of decomposition – which will help us predict long-term effects on soil carbon storage", explains Andy Burton, a forest ecologist at Michigan Technological University (Houghton).

Soil microbial communities have long been considered a "black box". But that view is changing, with molecular technologies able to identify the individual species at work. "We're also able to see how active the species' biomass is and what functions [the microbes] are performing – which make a big difference to decomposition rates", continues Burton.

Zak's team is now turning its attention to look at functional genes responsible for organic matter breakdown. "We're looking to see whether nitrogen deposition has an effect on organisms that have these specific genes and how active [those organisms] are in soil", explains Eisenlord. ■

Giant fish threatened by Mekong dams

Jane Bradbury

A new WWF report warns that proposals to build 11 hydropower dams in the mainstream of the Lower Mekong River pose the single most important and urgent threat to several giant fish species endemic to the river. The report – *River of Giants: Giant Fish of the Mekong* (www.worldwildlife.org/what/wherewework/mekong/WWFBinaryitem17481.pdf) – calls for a delay in the approval of these dams, to allow time for a comprehensive study of their likely costs and benefits.

The Mekong River is home to four of the world's largest giant freshwater fish species (fish capable of growing to at least 2 m in length or 100 kg in weight), including the Mekong giant catfish (*Pangasianodon gigas*). "Why so many giant fish species occur in the Mekong is unclear, but may be partly due to the river's size and its



Zeb Hogan (right) and staff from the Cambodia Department of Fisheries tag and release a Mekong giant catfish in the Tonle Sap River, Cambodia.

productivity", says Zeb Hogan, leader of the MegaFishes Project, an initiative – supported by the National Geographic Society – that aims to find, study, and protect the world's largest freshwater fish (<http://megafishes.org>). What's more, points out Marc Goichot, Sustainable Infrastructure Advisor of the WWF Greater Mekong Programme, previously unrecognized "fish species are still being discovered in the Mekong".

In 1995, Cambodia, Laos, Thai-

land, and Vietnam agreed on procedures for the notification, prior consultation, and acceptance of proposals for future dams to be constructed along the main stem of the Lower Mekong River, under the auspices of the Mekong River Commission. So far, no proposals have passed through the established procedures, but, according to Goichot, "we are expecting the Sayabouly dam in Laos to be notified soon".

"Almost all of the limited information we have about the giant fish species living in the Mekong suggests that the Sayabouly dam and the other dams being planned for the mainstream will have serious negative impacts on these fish", warns Hogan. Thus, says Goichot, "we really need to delay building dams on the Mekong until we understand more about giant fish. For now, it would be wiser for the countries of the Lower Mekong to meet their energy needs by building dams on tributaries rather than on the mainstream". ■

Ganges hydroelectric project causes widespread damage

Dinesh C Sharma

A 600-megawatt hydroelectric power project on the Ganges River has become a bone of contention between Indian government agencies and environmentalists. After being forced to suspend the project's completion for over a year, following protests by local peoples and environmental advocates, the government has recently decided to resume the work that so far has already cost six billion rupees (US\$424 million).

The project at Loharinag Pala – a mere 50 km downstream from the Gangotri glacier, in the pristine valley where the Ganges originates in the Himalayas – is one of several hydroelectric operations either planned or under construction in the ecologically fragile region. If all the projects are completed as intended, there could be no free-flowing water along about 250 km of India's holiest river. For most of this distance, the river will be diverted to underground tunnels.

Ganga Ahvaan, a group based in



The Ganges is reduced to a trickle as a result of the Maneri Bhali hydroelectric project.

Uttarkashi, has documented widespread damage that hydroelectric operations are causing in the region. "Tunneling" of the river for long stretches is resulting in the loss of flora and fauna and changing the natural qualities of the river bed and minerals. Natural springs – upon which many villages depend for water – have been adversely affected, and some have dried up completely. Large-scale felling of trees and construction of "approach roads" on the steep hillsides associated with these projects have resulted in landslides. The formation of artificial reservoirs, containing standing water, is also increasing mos-

quito populations, previously unheard of in these hilly areas.

"The diversion of the river into tunnels directly denies the rights of millions of Indians to worship along her banks and bathe in her waters", says Hemant Dhyani (convener, Ganga Ahvaan). "Most of the cultural and religious events take place along the river. When the river is not going to flow, where will people perform their rituals?"

Experts have advised scrapping the Loharinag Pala project and declaring this part of the river an eco-sensitive zone. "This could mean decommissioning fully operational power stations", warns Ravi Chopra, a member of the National Ganga River Basin Authority. Another argument against the project is the low power levels being generated from existing projects. The Maneri Bhali Phase I power project – built with a promise of 90-megawatt capacity – is functioning at a mere 40% capacity because of heavy siltation during the monsoon season and reduced water supply in winter months due to receding glaciers, notes Dhyani. ■

Adirondack lakes making a comeback?

Johanna F Polsenberg

Although they were once among the most obvious victims of acidic precipitation, montane freshwater lakes situated downwind from coal-burning power plants in the north-eastern US may now be showing signs of recovery. Twenty years after the 1990 amendments to the US Clean Air Act created a cap-and-trade program to control the acid rain caused largely by sulfur dioxide (SO₂) emissions, research in New York's Adirondack Mountains demonstrates that waters in studied lakes have become less acidic.

"Acidification of this region's lakes was first documented in the mid-1980s by the Adirondack Lake Survey, which looked at

about 1500 lakes", explains Dr. Nierzwicki-Bauer (Rensselaer Polytechnic Institute, Troy, NY), lead author of the study. "Fifty-five percent of lakes that lie >600 m [above sea level] had pH values below 5.5, and 25% of those were fishless. Historical data showed that some lakes did originally contain fish but became fishless [over time]."

Earlier this month, Nierzwicki-Bauer and her colleagues published the first of a series of papers on their 13-year analysis of 30 lakes (*Environ Sci Technol* 2010; 44: 5721–27). "While there have been lots of articles on individual characteristics of recovery in lakes, no previous Adirondack study has looked at the biota – from the microbes on up to the fish – concurrently with water chemistry", she continues.

One lake in particular, Brooktrout Lake, may be the "poster child" for hope. "Although no lakes have 'recovered' fully, Brooktrout's [water quality] has improved to the point that we and the New York State Department of Environmental Conservation decided about 4 years ago to reintroduce fish". The fish have survived, and data on whether they have reproduced successfully are being analyzed.

With regard to related air quality, "This is very much in keeping with what we have been seeing", says Stuart C Ross, Communications Director for the Clean Air Task Force (Boston, MA). "In the past 5 years alone, SO₂ emissions have fallen by nearly half, from 10.3 million tons in 2004 to 5.75 million tons in 2009. That's nearly a third of what they were in 1990." ■