Many of our current environmental problems could have been avoided with a little forethought. Releasing alien species into new environments, introducing new chemicals without proper testing – the list goes on. And too often, we get to grips with problems only after they've become serious. Bill Sutherland plans to change this. He tells Tom Marshall how.

Scanning the horizon

When conservation scientists meet, they tend to focus on practical problems in the environment right now, and what we could do about them. But when a group of experts from conservation organisations, universities and governments all over the world and from a range of disciplines met in Cambridge late last year, they weren't talking about anything so concrete.

Instead, they were trying to imagine what the next big problems and opportunities might be. By the end of the meeting they had settled on 15 issues that they think we should keep an eye on. They range from the possible side-effects of releasing particles into the upper atmosphere to combat climate change to what effect tiny particles of germ-killing silver could have when they get into the sewage system.

The idea isn't to predict the future, but to highlight areas that may become important in the coming years. Not all of them will. But if even a few do, Bill Sutherland, who organised the event, hopes thinking about them ahead of time will mean we're better prepared to deal with them before they get out of hand.

A professor of conservation biology at Cambridge University, Sutherland's previous projects include collaborating with UK and global policy-makers to identify the key research questions that need answers, and developing evidence-based conservation (see *Planet Earth* Autumn 2008, pp28-9). But identifying the big risks at the moment is a long way from envisaging what things could be like in a decade's time.

Sutherland thinks the scientific community needs to spend more time thinking about a wide range of future issues in order to be sensibly prepared. 'It has struck me for some time that we're not looking forward sufficiently,' he says. 'This means we get taken by surprise by problems we really should have foreseen. An example is biofuels, which were enthusiastically adopted without carefully considering the consequences.'

The idea behind biofuels involves growing plants like oil palms as an energy source. It was championed around the middle of the last decade as a way to reduce our dependency

on fossil fuels. But Sutherland says the conservation and ecological communities weren't properly prepared to predict their effects.

Aggressive targets for increasing biofuel use have meant large swathes of already-vulnerable ecosystems like tropical rainforests have been destroyed to make way for energy crop plantations. This ecological havoc may outweigh any benefit from burning fewer fossil fuels. This consequence was unintended, but hardly unforeseeable. 'We failed to anticipate the social, economic, climate change and ecological consequences of actively promoting biofuels,' Sutherland explains.

'We often only start thinking seriously about environmental consequences when there's already a problem, and by then it's much harder to do something about it,' he adds. 'As it is, we've adopted biofuels widely and now we're trying to catch up on the basic research. This is the wrong way round!'

As well as choosing the issues to focus on, the group also discussed how policy-makers and conservationists could respond. In some cases action may be needed right now; in others, all that's called for at the moment is research to establish whether the risks are real, how serious they are and how we could deal with them. In yet other situations it may be sensible just to wait and see how they develop.

Sutherland and the other participants in the exercise presented their results to Secretary of State for Environment, Food and Rural Affairs Hilary Benn just hours after the end of the workshop – policy-maker engagement in action!

'Some of the issues he was already familiar with, but many he'd never heard of,' Sutherland says. 'This was exactly what we'd been aiming for – a list of issues that are not generally known to most academics and policy-makers. We'll certainly have missed some things, but we hope this kind of exercise will help alert policy-makers and conservation practitioners to issues they might otherwise miss, and we plan to repeat this exercise annually.'

MORE INFORMATION

Bill Sutherland is Miriam Rothschild Professor of Conservation Biology in the Department of Zoology at the University of Cambridge.

FURTHER READING

Sutherland et al, A horizon scan of global conservation issues in 2010, *Trends in Ecology & Evolution*.
www.download.cell.com/images/Edimages/Trends/EcologyEvolution/PIIS0169534709003206.pdf

Just one word: microplastics

Over the past four decades, global production of plastics has increased twenty-five-fold, and only about 5 per cent of this material has been recycled. Much of the rest has been released into the great outdoors. And as most plastics take a long time to decay, a lot of it's still there, making up between 60 and 80 per cent of all litter.

Eventually it tends to get washed out to sea, where it is now accumulating in vast stretches of water like the so-called Great Pacific Garbage Patch. Wind and waves gradually break plastic objects down into tiny granules, and these particles of 'microplastic' find their way into sand and mud all over the world.

We still don't know what this build-up of plastic particles will do to wildlife, but there's a serious risk it will prove toxic. Even if plastic granules themselves aren't harmful to living things near them, we know they can absorb other pollutants from sea water and pass them on to organisms like sea anemones which live by filtering edible particles out of the water, as well as to fish, birds and other large marine animals that mistake plastic fragments for morsels of food. There's no sign of the rate of plastic pollution dropping, and scientists don't know how it could eventually affect the wider environment.

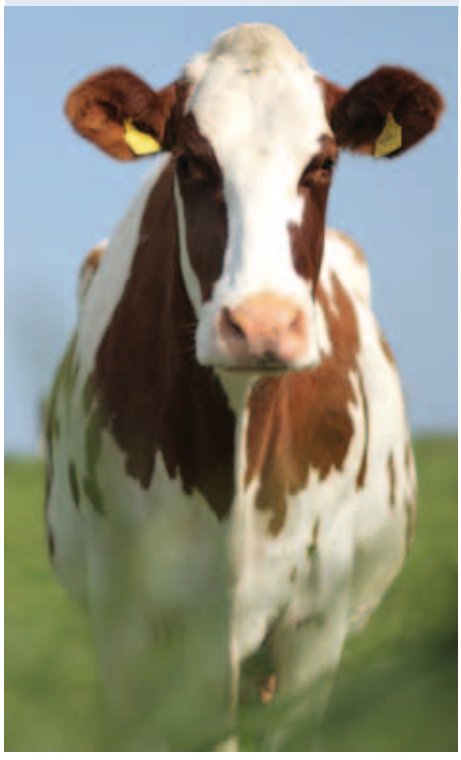
Ashley Cooper/SpecialistStock

Growing our own meat

Meat may be tasty, but farming animals to produce it causes all kinds of environmental trouble – and that's even before you get into ethical considerations and questions of how it affects people's health. In response, several groups are trying to grow synthetic meat in vats in the lab.

The idea is to take muscle cells from an animal and grow them on a frame that regularly stretches and manipulates them to 'exercise' the cells. Eventually we could be tucking into tasty sirloin steaks that have never been near a cow.

A Dutch sausage maker has developed a way to turn pig stem cells into muscle fibres in a fortnight, though so far the meat produced would cost tens of thousands of dollars per kilo. Progress is accelerating, and there's a $1m reward for the first to sell tasty synthetic chicken meat to the public by mid-2012. If the technology becomes widespread, it could greatly reduce greenhouse gas emissions from livestock and ease pressure on farmland and fish stocks. But if the number of animals grown for meat dropped quickly, how might other parts of the ecosystem respond? And what are the medical and ethical implications?



Michael Staudt / VISUM/Still Pictures

Artificial life

Breakthroughs in molecular biology and genetics over the last few years have transformed our understanding of how living things work. In the lab, scientists can now take genetic material from bacteria and combine it with yeast cells to create a new life form that can then live and reproduce on its own.

The ability to create bespoke genetic blueprints for new living things isn't far off. Craig Venter (below), a pioneer in genomics and artificial life (see *Planet Earth* Autumn 2009, pp18-19), envisages an explosion of brand new living things designed to meet our needs, whether cleaning up pollution or producing chemicals on demand. He recently hit the headlines by announcing the creation of what he describes as the first synthetic life form – a bacterial cell controlled by DNA that was built in the lab.

Thousands of people breed plants or animals at the moment – what might happen when they gain the ability to design genomes to make their own bespoke organisms? How could these new creatures affect natural ecosystems? And how can we stop this miraculous technology being put to malicious uses?

The fifteen issues

Microplastic pollution: what could tiny plastic particles do to the environment?

Stratospheric aerosols: some scientists want to shoot fine particles into the upper atmosphere to scatter sunlight and slow global warming. But there could be unexpected consequences.

Artificial life: designing our own microbes could let us make chemical compounds on demand, or engineer our own life forms for any number of other purposes. But the new era of bespoke life will also carry profound risks.

Nanosilver in waste water: tiny silver particles designed to kill bacteria are one of nanotechnology's first mass-market applications. But could they harm natural microbial communities?

Biochar: turning woody biomass into charcoal could let us harvest its energy while keeping its carbon content in solid form, to be returned to the soil and stored there for long periods. But more work is needed on what effects it could have once it's there.

Mobile-sensing technologies: will mobile sensors and apps become a vital tool for monitoring environmental change?

Deoxygenation of the oceans: global warming tampers with ocean chemistry, and the amount of dissolved oxygen is falling. How could this affect marine ecosystems that are already under pressure from overfishing, ocean acidification and changing temperatures?

Changes in denitrifying bacteria: is global warming affecting the behaviour of bacteria specialised in dealing with nitrogen?

High-latitude volcanism: ice sheets cover many volcanoes near the poles. As they retreat, will the volcanoes get more active? And could this itself accelerate climate change?

Synthetic meat: growing meat in a petri-dish could solve many problems – but what are the economic, ethical and environmental implications?

Invasive Indo-Pacific lionfish are causing havoc in the Caribbean, but could exploiting them for food ultimately benefit endangered edible fish species?

Trans-Arctic dispersal and colonisation: Arctic ice separates the Atlantic from the Pacific – what if it melts?

Large-scale international land acquisitions: countries are buying farmland abroad to secure their food supplies in future. What will the cost be for local environments and economies?

Assisted colonisation: could moving plants and animals to new, more suitable habitats help them cope with climate change? Or is this tantamount to 'ecological roulette'?

Impact of REDD: The UN's Reducing Emissions from Deforestation and Forest Degradation in Developing Countries programme (REDD) aims to cut carbon emissions from deforestation. But some fear it could protect forests at the expense of other habitats like savannahs and wetlands.