The path of the dodo

a changing climate for conservation

Hermann Brehm / Naturepl.com

When Sir David Attenborough admits to being worried, we should all sit up and take notice. Has the human race set in motion a chain of events that will culminate in the destruction of life on Earth as we know it? During the past half century Sir David's brilliant documentaries have showcased this planet's breathtaking biodiversity. How much of it will disappear during the next 50 years?

By Rosalind Aveling and Abigail Entwistle

Why bother?

Now that global warming is a mass media hot potato, we are bombarded with a surfeit of information on climate change. As we grapple with complex climate models and start to grasp their implications for the planet and biodiversity, how many of us have asked: 'Do we have a chance here?' Can we really make a difference?

With climate change acknowledged as an inconvenient truth, the central debate has shifted to how we can mitigate its effects, and how long we have. Societies and the politicians that represent them are facing stark choices; in many cases, the very means of reducing the rate of climate change (e.g. tidal energy and biofuels) may themselves have an adverse impact on biodiversity and the environment.

More inconvenient truths

The Intergovernmental Panel on Climate Change (IPCC working group 2 summary report) concluded that if temperature increases exceed 1.5-2.0 degrees Celsius, 20-30 % of plant and animal species assessed would be at risk of extinction, and that:

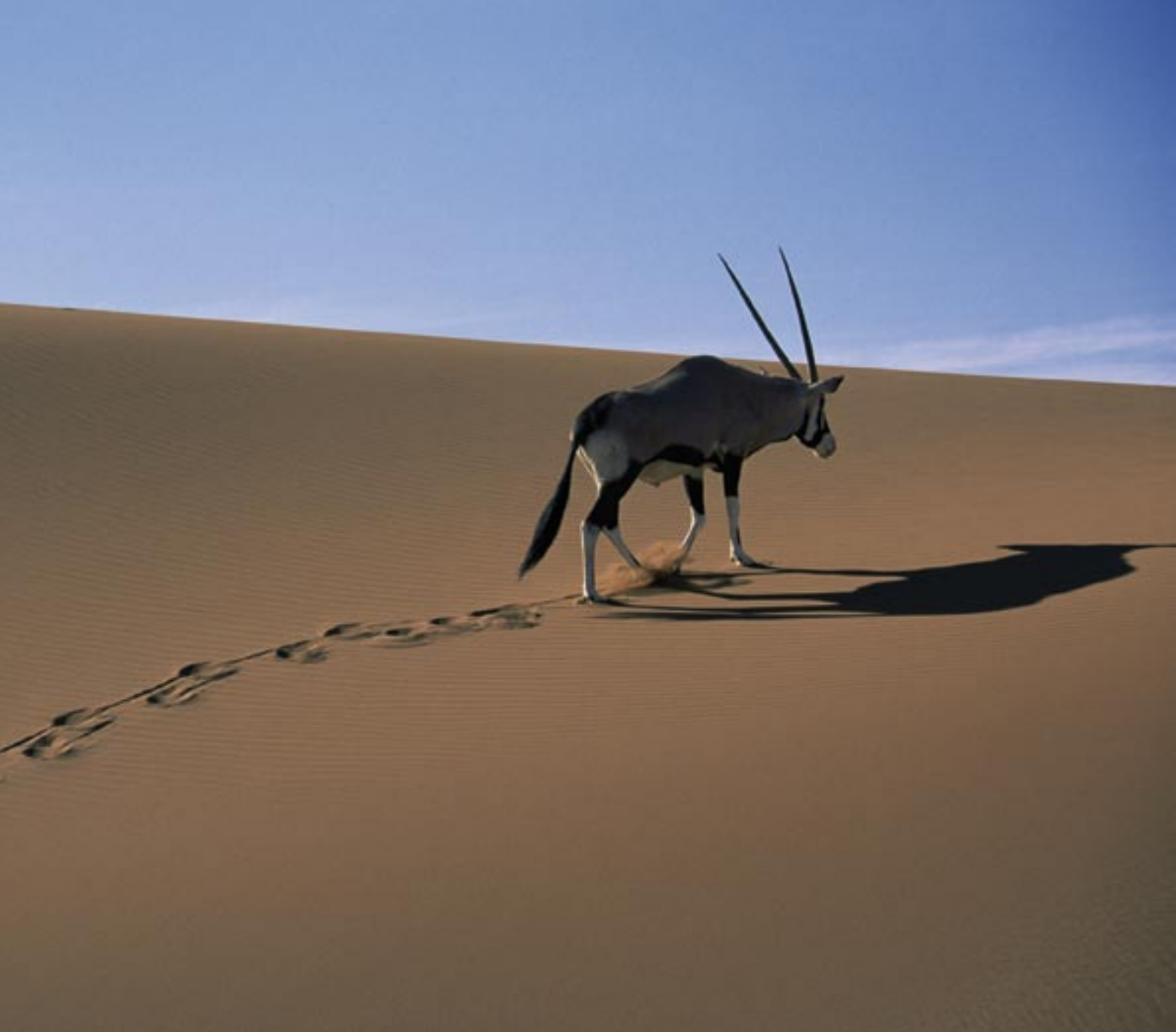
"The continuing, accelerating loss of biodiversity will compromise the long-term ability of ecosystems to regulate the climate, may accelerate or amplify climate warming and could lead to additional, unforeseen and potentially irreversible shifts in the earth system. Urgent action now to halt further loss or degradation of biodiversity will help to maintain future options for reducing the extent of climate change and managing its impacts."

Tough choices

Given the speed of climate change, combined with human population growth and unsustainable patterns of consumption across the globe, can we realistically save representative examples of known and as yet undiscovered biodiversity? What level of extinction can we expect and accept? Assuming that we have a choice, how do we, as conservationists, choose which species and which habitats to save? How can we adapt and change our conservation strategies, so that the greatest range of species can adapt and survive?

Resilience and rapid change

Managing change is not a new challenge for conservationists; it is what we do. Habitats change with time; most of the places where we work are subject to some kind of human influence, and habitats are modified as a consequence. In addressing threats to natural habitats and species, we are trying to retain the integrity of ecosystems and the services they provide. Thus, at site level, climate change



ABOVE: A changing climate is predicted to increase desertification.

"We know enough now to be clear about the magnitude of the risks, the timescale for action and how to act effectively. That's why I'm optimistic - having done this review - that we have the time and knowledge to act. But only if we act internationally, strongly and urgently"

Nicholas Stern, Economist, October 2006

is just another threat to incorporate into conservation strategies. We do recognize, however, that the speed of change may limit our options, as both primary impacts (changing climatic zones) and secondary impacts (through the adaptation strategies of human societies) start to be felt.

Many societies have 'final straw' proverbs about resilience and breaking points. Historically, extinctions have resulted not from a single cause, but from a combination of factors exerting cumulative pressure until the inevitable tipping point is reached. Clearly, species that are already threatened and have reduced populations as a result of habitat loss, disease or over-exploitation will be less able to bounce back if the impacts of climate change further reduce their resilience.

No one is sure how quickly the climate will change. If change happens rapidly - within only a few generations – the chances of adapting in time are severely reduced. In such circumstances it will be the pioneer and opportunist species that survive – those already programmed for rapid adaptation to new conditions. Specialists that have adapted to exploit a specific niche or developed a symbiotic relationship with other species will be the least resilient to change. Often these are already the most endangered.

There are already signs of imbalance caused by rapid shifts in local climate conditions. In some areas plants are flowering earlier, migration seasons are changing, species' ranges are shifting, pollinators no longer occur alongside the plant species that rely on their services, and

ABOVE AND OPPOSITE: Climate change will affect the viability of some areas of land currently used for food production, placing additional pressure on wild habitats.

Our own species – vulnerability, mitigation and adaptation

What can we expect? Changing bands of temperature and rainfall playing havoc with established land use practices around the globe. More crop failure and less reliable, regulated water supplies will have a greater impact on people and natural environments within the developing world. Unpredictability and more extreme events will reduce resilience for societies already living on small margins.

In Spring 2007 the Intergovernmental Panel on Climate Change published two key reports based on the collective contributions of some of the world's finest scientific minds: in April, our latest knowledge of potential **'Impact, Adaptation and Vulnerability'** for human societies under different scenarios of climate change; in May, an outline of **mitigation measures** that would slow down the rate of change and allow more time for human societies to adapt. These reports were made available to policymakers to inform those making critical decisions now. Human societies ***can*** make those decisions – for better or worse – and different nations are already planning adaptation strategies – faced with changing options for land use, water availability and survival under extreme conditions. Unless we intervene on their behalf, the other species with which we share this planet must simply adapt or perish.

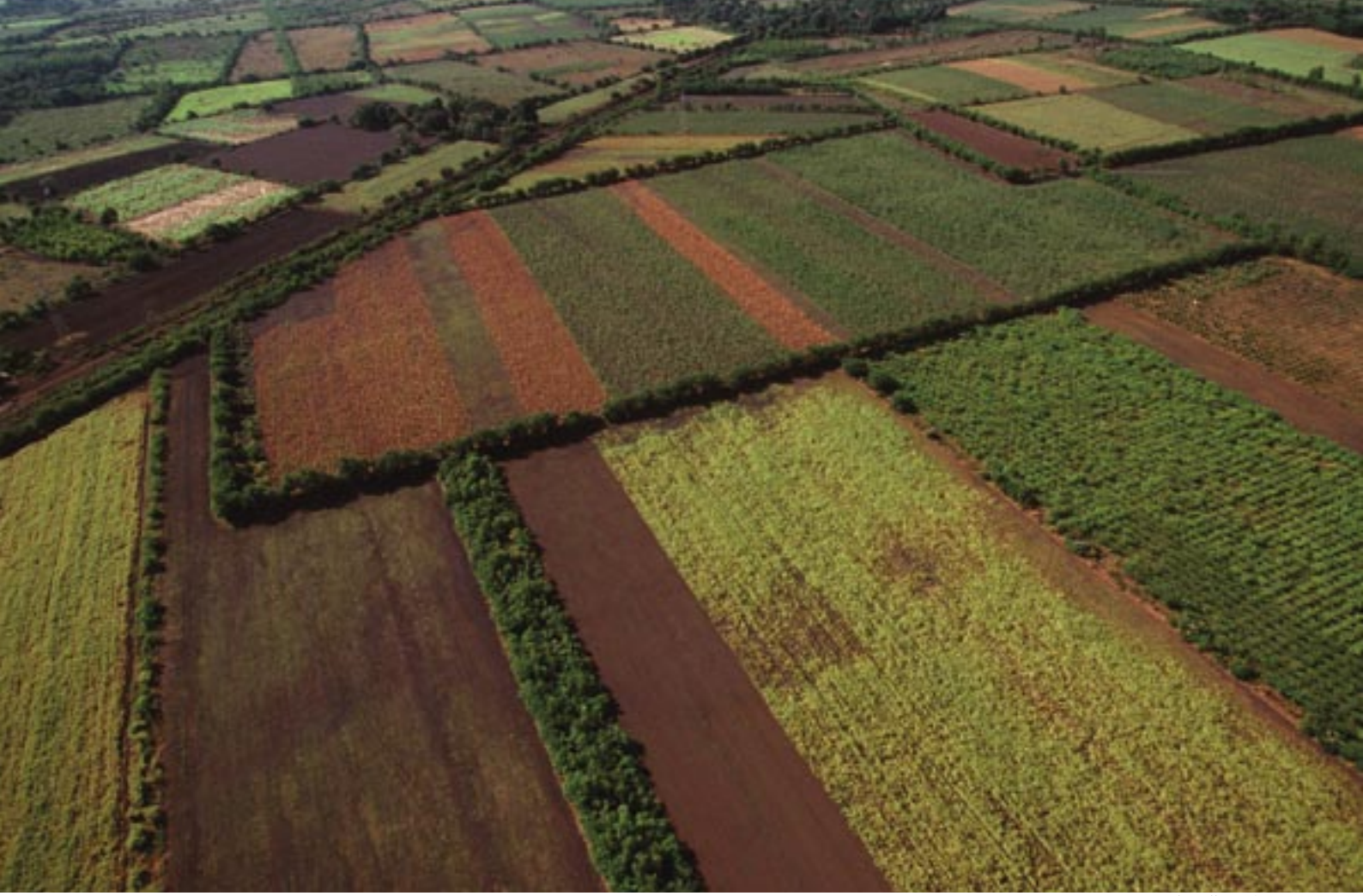
the timing of food availability and reproduction no longer coincide. Society can respond in two ways. At one extreme, we could view this dispassionately as merely evolution in action; whatever the source of the evolutionary pressure, if species cannot adapt in time we let them go. At the other extreme, self interest might persuade us to intervene, in the absence of artificial replacements, in order to maintain essential interactions and processes that underlie our ecosystems. We could choose to help maintain biological relationships or to 'match make' new relationships. If a key pollinator moves northwards, can other organisms play the same role? If a prey species disappears, will another take its place in the web?

Accepting change – shifting species

'Where has that moth (or monkey, or monotreme) gone?' As climate change rewrites the rules, we can no longer be sure of finding a species where we left it. Species able to do so will relocate, gradually or suddenly, following patterns of temperature and rainfall, or other species on which they rely.

Over time, valuable natural areas, either local or global, have been delineated for a range of biological, social and political reasons. Flagship species for those areas, also appreciated locally or globally for both cultural and economic reasons, have proved an invaluable focus for habitat protection efforts. As habitats change with shifting bands of temperature and weather conditions, some of these flagship species and other species central to reserve establishment will inevitably desert our reserves. We can help them to relocate and to survive elsewhere, but we should not abandon those protected areas that have harboured them.

As natural habitats dwindle in extent, those that survive are likely to have a greater value in future, whatever species assemblages they



Both: Juan Pablo Moreiras / FFI

"If we are not prepared to take bold steps to fight climate change then biodiversity is in a sense going to be a secondary matter"

Peter Hain, Secretary of State for Northern Ireland, May 2007

contain. We would be foolish to abandon natural forests anywhere around the world, even if their charismatic megafauna disappeared. We are likely to see further dramatic change if keystone species are removed, or climatic shifts are severe, but remaining forest habitats may still harbour a wealth of organisms of value to us and the planet and are worth protecting.

In the face of increased pressures from the secondary effects of global warming – such as greater need for new farmland as crops fail or displacement of people by drought and floods – we cannot afford to be too pedantic about the exact composition of our natural habitats, but should accept that they will fulfill an important planetary role if we can just keep them vegetated and relatively natural. In some cases, such as extreme desertification, this may not be feasible, but as a general rule, we have to be pragmatic about our investment in natural habitats.

Facilitating movement – biodiversity on the march

For many years conservationists have worried about habitat fragmentation and the isolation of populations that are unable to cross inhospitable areas between fragments. Climate change has brought this issue into critical focus. We are faced with a future where biodiversity will be 'on the march'. Many species can only survive within a specific climate band. Only the most flexible and adaptable will be capable of evolving quickly enough to avoid the need to move.

For some, relocation is relatively easy; many birds already show dramatic distribution shifts as they follow food supplies and changing seasons. For sedentary or long-lived species the shifts will be more gradual. A tree cannot uproot itself, but seed dispersal can help new saplings to establish in more favourable areas. However, for most species to reach their ideal climatic locality they must have an uninterrupted pathway. Unfavourable habitats in which the species cannot take root will stop them in their tracks. We can help them by concentrating on the

Impacts of climate change on biodiversity

Plant and animal ranges have already started to shift pole-wards and, in some cases, to higher altitudes. Natural or man-made barriers prevent range expansion. Natural rates of spread of sedentary species are being overtaken by the speed of change. Changes in species' morphology, physiology and behaviour are happening before our eyes, but are we witnessing effective evolution in the face of change, or the death throes of doomed species? Invasive species, frequently opportunistic and predicted to expand in range as well as abundance, are hastening the decline of established native species assemblages, reducing the healthy diversity of options within the global genetic pool.

Juan Pablo Moreiras / FFI

Earth engineers?

Scientists such as Princeton's Robert Socolow and his colleagues have simplified the planning task of stabilizing the rate of climate change into a series of seven 'wedges' of action that, if achieved over the next 50 years, would justify optimism. These mostly concern the scope and scale of technology, its application and uptake, but one wedge emphasizes the need to amplify the vital role of intact forest and soils in reducing emissions of greenhouse gases. Vegetated natural areas that store carbon and methane, and mitigate climate change, include not only forests, but also peatlands and extensive natural grasslands.

However, it would be short-sighted to focus on capturing carbon without recognizing (and reinforcing) the value of the diversity that natural systems contain. Climate could be controlled, but ecosystem functions lost. The spectre of 'empty forests' is raised, where loss of pollinators leads to loss of the pollinated, where water management and pollution control functions are disturbed and degraded, where food chains are disrupted – including, eventually, our own.

Protecting vegetated natural systems in the face of rampant land conversion is vital, but 'earth engineers' need to be aware that blind pursuit of Socolow's six other recommended carbon control mechanisms, such as clean energy generation and biofuel expansion, may actually contribute directly to accelerated biodiversity loss.

connectivity of landscapes. This means both protecting the integrity of tracts of natural habitat within which species can move and adapt, and also ensuring that the gaps between isolated fragments are traversible, with natural 'stepping stones' laid out to help them reach suitable new habitat.

In some situations species will need more of a helping hand. Gaps may not be easily bridged, and we may decide to transport them to more suitable environments. We have some experience of such interventions, for example moving elephants from flashpoints of human/wildlife conflict, or transferring rhinos between game farms in southern Africa. That experience will have to be drawn on in the face of climate conflict. For some species there is nowhere to go. If you already live on the top of a mountain and are becoming uncomfortably warm, there is no 'stairway to heaven'. In such cases we need to decide if it is appropriate to move species to entirely new homes elsewhere, or take them into human custody.

Keeping the golden goose – retaining natural habitats

Avoiding greenhouse emissions in the first place is obviously a better strategy than coping with their consequences. Avoided deforestation – or, more broadly, avoided destruction of all the habitats that store carbon - is gaining prominence globally and sparking local interest among nations with such natural riches. Voluntary and regulated markets are currently being developed to harness the potential of this concept, which could provide far greater incentives, financially speaking, to protect remaining natural areas. In order to make it workable, the mechanisms for securing finance globally, and robust environmental governance locally, need to be explored and piloted now (see the 'avoided destruction' section later in this article, and the article on pages 18-19).

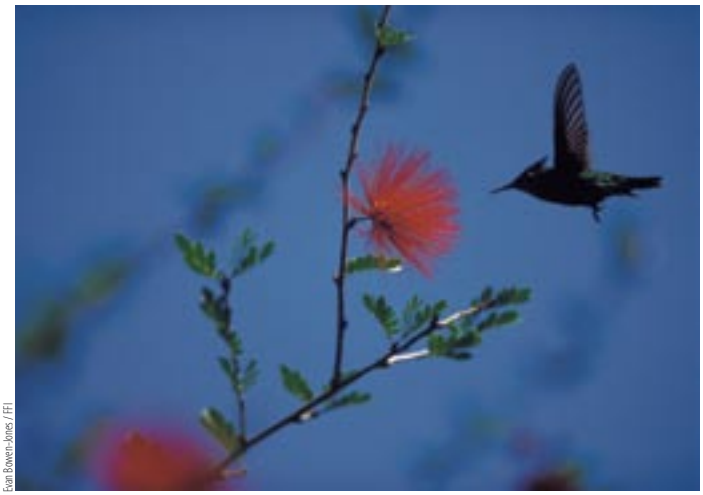
Shifting values – where to prioritise?

Traditionally, protected areas have been designed around their most valuable inhabitants, but what happens when these move away? Environmental managers have already started to take a wider ranging approach to protected area selection. Landscapes – and seascapes – may have more importance than specific fragments of habitat, so conservation efforts need to be viewed with a larger lens. New protected habitats can be strategically located in areas where they facilitate adaptation to a changed climate – by allowing species movement and retention of ecosystem services. In this context, management techniques such as restoration of degraded habitat are likely to assume increasing importance. It is important not to abandon existing protected areas as we seek ways of linking them to a larger landscape. Even as the species composition changes, their inherent value as natural habitats remains.

Room in the ark?

For some species, climate change may be the final blow. The future for polar bears in the wild looks bleak, and we may be the last generation to see the awe-inspiring wide-ranging behaviour of this species in its natural habitat. When the moment comes, should we 'rescue' the last survivors? Is it morally justifiable to keep them in captivity for future generations to observe, when there may be no suitable habitat to which polar bears could ever be returned?

We also have to recognize that we cannot create projects to protect all the species that are likely to be threatened by climate change. Our primary concern should be at the level of habitats, which act as reservoirs for biodiversity, protect ecosystem services and ensure that as much natural carbon as possible remains locked up in vegetation rather than being released into the atmosphere to compound climate change. For both marine (see box opposite) and terrestrial environments, we also need to anticipate the impact



Evan Bowen-Jones / FFI

ABOVE AND OPPOSITE: Species are shifting their range in response to climate change. The movement of pollinators such as birds and butterflies will affect ecosystems and human agriculture alike.

of future climate scenarios on areas of natural habitat, and on species distributions and responses. Improving the accuracy of our monitoring and models will help us identify areas that could become invaluable corridors or reservoirs in the changing landscape.

Policy and practice?

Who exactly should set global priorities? Within the UK, dialogue between government bodies with responsibility for policy, management and research on the environment has started to raise the profile of biodiversity within the climate change debate. Decision makers are being encouraged to view biodiversity, climate change and human livelihoods holistically when developing strategies for sustainable development, protection of biodiversity and reduction of climate change and its impacts.

In an initial report in June 2007 a group of agencies highlighted the discernible impacts of climate change on biodiversity. Up to 50% of the species studied worldwide were observed to be affected. Finally, after being sidelined for so long in the development arena, environmental managers and those concerned with retaining biodiversity are starting – just starting – to be recognized as centre stage actors against the backdrop of a warming world.

Snatching victory from the jaws of defeatism

Conservationists have offered mutually beneficial solutions to society and business by protecting ecosystem services. Tackling climate change, biodiversity loss and sustainable development as one issue similarly opens up the possibility of 'win-win-win' scenarios. Reducing land use change and conserving natural systems produces a threefold benefit for global society: emissions are reduced, biodiversity loss is reduced, and ecosystem services are maintained, thus increasing the potential for sustainable livelihood benefits.

Controlling climate change requires concerted global action. Those of us who care about preserving species diversity on this planet must first resolve how to save energy ourselves. Secondly, we have to influence choices being made by others, be they individuals, communities, businesses or political economies. Meanwhile, we have an obligation to pitch in on behalf of natural habitats, while the world is waking up to the importance of making that choice.

A 2007 report on the greening of philanthropy by New Philanthropy Capital argues that, despite the scale of the threat, investing time, effort and funds in retaining a biodiverse environment is not wasted: ***'It is quite simply the most critical investment we might ever make.'***

Out of sight, out of mind?

Climate change and the marine environment

Climate change impacts on the marine environment are coming increasingly into focus – rising sea levels, altered ocean currents, local temperature changes, acidification. All these can have a dramatic impact on an environment already stressed and degraded by pollution and overexploitation of marine resources.

The means to counteract such pressures are clear:

- **Creating space for recovery.** There is a need to bring a greater area under protection (marine protection lags far behind progress on land), and to design complex networks of protected areas that allow species to move between patches, regardless of changes in current direction. Scientists and conservationists have proposed a comprehensive network of potential **Marine Protected Areas (MPAs)** that would maintain diversity and allow stocks to recover, increasing resilience in the marine system. The potential MPA network is based on strategic values of the areas proposed, with change and resilience in mind, rather than an attempt to maintain current assemblages only. Avoiding a deeper crisis for marine stocks and diversity requires immediate action from all nations, supported by the international community.

- **Reducing downward pressures on marine populations.** Overfishing is depressing populations of many species to a level where the additional stress of climate change could lead to extinction within only a few generations. This danger is particularly acute where larger and older individuals are fished out, reducing the prospects of recovery.

- **Added value** for people and the marine diversity on which many depend can be gained by active management of coastal systems, which not only retains the areas of shallow water important for many species, but can also minimize the impact of large-scale inundations due to rising sea levels. Increasing the health of coral reefs, by reducing pressure from coastal pollution and practices such as fishing with explosives and poisons, may increase resilience to rising water temperatures and reduce bleaching.

Melting mountains: The habitats, people and wildlife that depend upon fresh water supplies from glaciers will be seriously affected by their disappearance

Juan Pablo Moreiras / FFI

Focus on: climate change

Climate change – an African tragedy?

In 2005 Tony Blair noted Africa's particular vulnerability to climate change, given predicted temperature rises towards the centre of the continent, and associated significant changes in rainfall patterns. He echoed the findings of an Oxfam report published in the same year, which demonstrated the potential human misery that would be caused by changing climate in this region. The report concluded that "a new model of development is called for, one in which strategies to increase human resilience in the face of climate change and the stability of ecosystems are central".

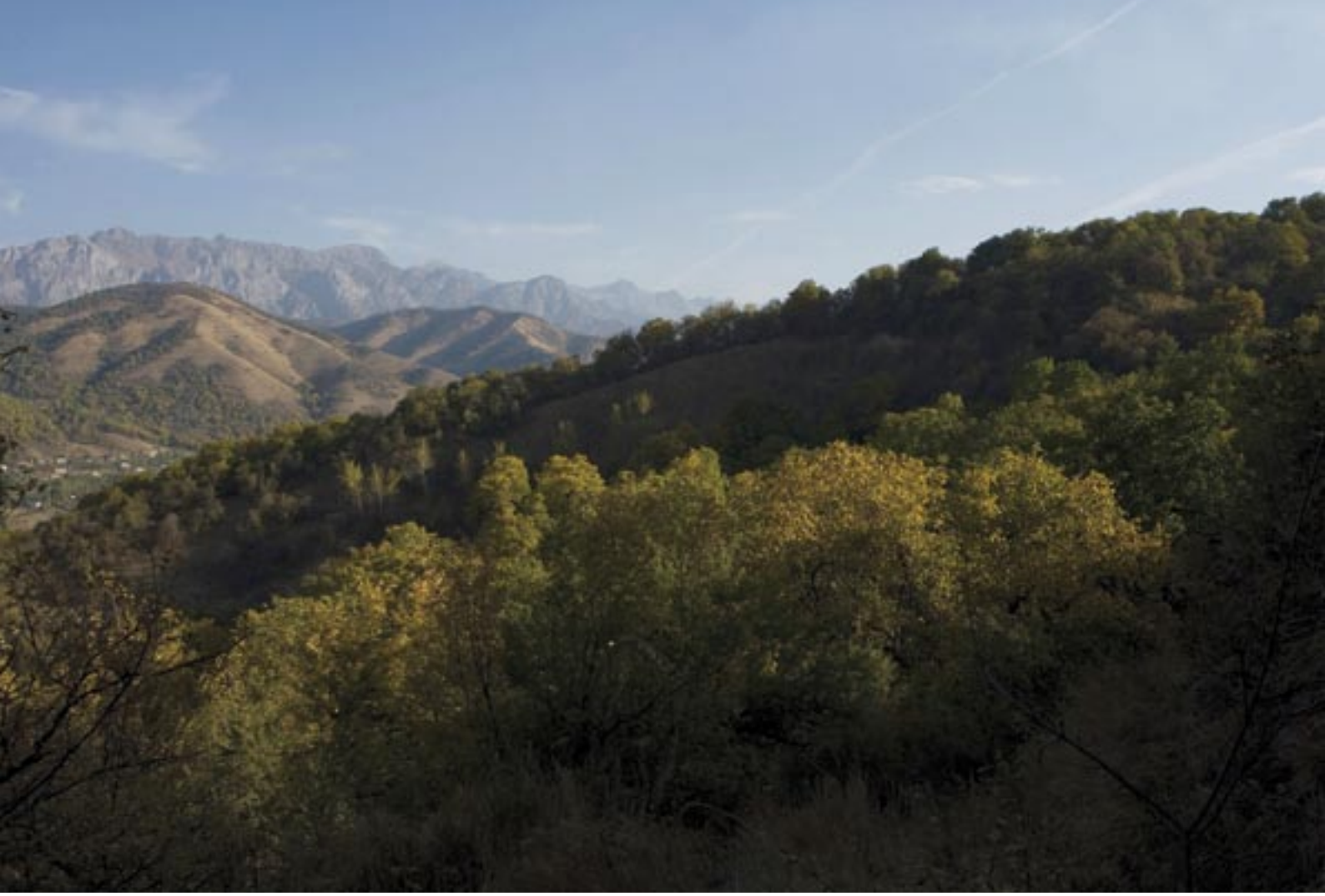
Many of the African ecosystems in which we currently work are likely to alter significantly as a result of climate change. For instance, the southern tip of Africa will probably be significantly affected by increased temperatures and decreased rainfall, and the floristically diverse fynbos habitat is likely to contract to a fraction of its current extent. It is predicted that fynbos will shrink to a distribution focused on the Agulhas Plain, making our current conservation holdings there even more significant than they already are.

However, the complex impacts of climate change on ecosystems and the human societies they support can perhaps be illustrated by changes already reported from dry savannahs of northern Kenya. These areas have always been arid and relatively inhospitable, but still provide important grazing and migration routes for significant numbers of large ungulates and elephants, which rely on natural springs during their annual migrations. Recent changes in weather patterns, including more severe droughts, cannot be directly attributed to climate change, but are entirely consistent with the predicted changes anticipated under climate models.

These droughts have a significant human cost – with reports of crop failure and in some cases starvation. Furthermore, grassland areas are decreasing as desert landscapes expand. There has been a subsequent increase in local conflicts over scarce resources (both land and water supplies), which in turn places added stresses on the environment. However, people are not the only ones competing for limited water supplies, as these are also vital to the survival of local wildlife populations. In some cases the migration routes of these species are already changing. Without the vital natural springs these areas would already be completely inhospitable to such species, forcing them to move south – into cultivated lands – and thus into further conflict with the people who farm them.

BELOW: A Cape sugarbird* (Promerops caffer) *on a limestone sugarbush* (Protea obtusifolia) *in South Africa's fynbos. Rising temperatures are predicted to reduce the area of this unique and diverse habitat.

Jason B Smith



Juan Pablo Moreras / FFI

ABOVE: Climate change will place further stress on Central Asia's walnut-fruit forests, which have already declined by 90% in the last 50 years.

Temperate Asia – disappearing forests and melting mountains

Climate change predictions suggest temperature rises of 1 – 3.5°C by 2100 across the temperate biomes of Asia, with rainfall patterns showing more localized changes. This in itself may trigger further releases of greenhouse gases, as the extent of boreal forest is predicted to contract by 50% and the combination of warmer and wetter conditions would speed the release of CO_2 and methane from the peaty soils under the northern tundra.

In addition, there is evidence that the great glaciers of Central Asia are already melting; between 1959 and 1988, 1,081 glaciers in the Pamir-Altai region disappeared. This has been attributed to climate change, but may also be compounded by saline deposits blown from the Aral Sea. These mountains – and their glacial systems – provide a key catchment and watershed for the region, providing water for five countries. It is predicted that overall water supply will be decreased under models of global warming, and one consequence of the eventual reduction in summer run-off from these glaciers will be increased aridification and desertification in parts of the Central Asian lowland plains. This is a region where tensions over access to water resources by downstream states already run high. Changes in glaciers and snowfall patterns high in the Central Asian mountains could have a fundamental effect on water regulation for millions of people, and for the wildlife of the whole region.

These great mountain systems of Central Asia – the Pamirs, the Altai and the Tien Shan are home to some of the world's most fascinating, and poorly studied, ecosystems. The warming of mountain systems has direct impacts on their wildlife – as glacial snowfields are lost and the annual snowline moves to higher altitudes, the amount of available habitat for montane species (such as snow leopards) becomes restricted, and individual mountain tops become effectively isolated from surrounding mountain systems. Changes are also anticipated in the distribution of Central Asian mountain forest systems, including the rare walnut and fruit forests of the region, which have already declined by 90% in the last 50 years. Forest loss and climate change will together exacerbate threats of erosion, landslides and loss of stability within these systems.

The impact on humans of climate change across this varied system is hard to predict, but it seems likely that some lowland areas may become less hospitable (particularly if subject to increasing desertification), some mountain areas may become less stable and less able to support low-level agriculture, some traditional ways of life will be substantially disrupted, and changes in water availability may bring increased stresses to many populations.

Focus on: climate change

Both: Juan Pablo Moreras / FFI

South America – is the future of the Amazon at risk?

The Amazon is considered by many to be the world's greatest rainforest. As such it plays a vital role in controlling climate across the region, and has a role in global atmospheric patterns affecting rainfall as far away as Europe and Central Asia. The Amazon also holds vast carbon stores in its trees and soils, and acts as a gigantic 'lung' that daily absorbs significant amounts of CO_2 as trees grow.

Surely such a vast, and moist, expanse of habitat would be well buffered from climate change? Recent reports suggest otherwise. A report from WWF indicates that rainfall could reduce dramatically, which, coupled with the ongoing threat of deforestation, would result in an Amazonian savannah rather than a rainforest across up to 60% of its current range. Indications of what may be in store for the Amazon are already apparent. 2005 saw one of the worst droughts in the region, and reductions in rainfall reduce tree growth (and thus their ability to absorb CO_2) and also increase the risk of forest fires.

This degradation would of course be disastrous for biodiversity; the Amazon is estimated to hold around 30% of the world's species. Furthermore, at least 180 indigenous groups traditionally rely upon the forest of this region. In addition, on a global scale the knock-on effects would be the loss of the role of this forest in mitigating climate, and the potential release of thousands of tonnes of CO_2 into the atmosphere – resulting in a much more serious scenario of climate change. Protection of remaining forest in this region is vital to minimize the risk of an environmental disaster that would be felt across the world.

'Avoided destruction'

Over recent years there has been increasing international political attention given to the role of 'avoided deforestation' (also called 'avoided destruction', to incorporate other carbon-rich habitats) in mitigating climate change. When we talk about the causes of climate change, most of us consider the emissions from fossil fuels as being the main culprit. This is certainly the case, but many of us are unaware that over 20% of CO_2 emissions each year come from the destruction of natural habitats, a figure which in comparison dwarfs those from air travel (standing at 3-5%). The importance of this issue has been recognised by both the Stern Report and the Intergovernmental Panel on Climate Change.

In 2005 a number of countries joined forces to lobby for forest protection projects to be recognised as valid means to reduce emissions under the Kyoto Protocol. This would allow the carbon value of natural habitats to be recognised – and potentially traded – on the world market. It might seem straightforward that the international Kyoto Protocol process should back projects which prevent the destruction of natural habitats. However, there would be a need for such projects to demonstrate that net carbon release had indeed been prevented (not just been displaced to another area), to quantify the emissions that would otherwise have occurred, and to demonstrate that this carbon is indeed stored for the long term. This is undoubtedly a challenge, but the potential gains make it an opportunity we must explore.

Trialling 'avoided destruction' in South-east Asia

In South-east Asia, forest loss continues to pose an immediate threat to the region's biodiversity - for which the dwindling population of

orang-utans provides an emotive flagship. What is also becoming clear is the extent to which clearance of forests (especially peatland forest) in this region is fuelling carbon emissions. According to research undertaken by Wetlands International, Indonesia is the world's third largest producer of greenhouse gases, directly as a result of carbon released from forest destruction and fires. The region's forests urgently need protection, and the challenge is to reconcile this particular need with the those of the local population for sustainable livelihoods and access to forest resources.

The Indonesian regions of Papua and Papua Barat support 24% of the country's remaining forest cover, an area which also supports over half of Indonesia's recorded biodiversity. But these forests are under growing threat from logging and conversion to plantations (primarily oil palm). The global importance of these forests cannot be overstated, and the threats they face are becoming critical. FFI has recently started working with the Provincial Governments of Papua and Papua Barat and the Papuan Civil Society Support Foundation to explore opportunities to promote effective forest conservation through piloting a model of avoided destruction and, if established, harnessing carbon-related finance to sustain this initiative in the longer term. Central to this model will not only be demonstrating effective protection of the forest (and its associated biodiversity and carbon-stocks), but also the development of effective local governance systems. The challenge will be to ensure these are underpinned by a system that allows for equity and sharing of income from carbon finance among local communities, while enabling the practical costs of forest protection and monitoring to be met. If successful, it has been estimated that protection of a significant portion of these forest stocks (proposed to cover over a million hectares) could lock up millions of tonnes of CO_2 that would otherwise be released into the atmosphere.

Proposed initiatives such as this (and a similar project under development in Aceh Province) are essential to demonstrate how avoided destruction projects might operate on the ground, and to help national and local governments develop the necessary technical and governance structures to verify that the carbon in such areas would otherwise have been released, but has now been permanently 'locked away' as a result of such projects.

many of us are unaware that **over 20% of CO_2 emissions each year come from the destruction of natural habitats**

OPPOSITE AND BELOW: Tropical forests and other habitats play an important role in climate regulation, as well as storing vast quantities of carbon.