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Recreation and the environmental sciences

The term 'recreation' may carry with it a sense of frivolity. Yet by digging a little deeper we see that recreation is an essential element of human biology and psychology. This may include unwinding from the stresses of daily demands, socialising with others, reinforcing a sense of identity, or reconnecting with the natural world.

So what has all this to do with environmental science? Actually, quite a lot.

The benefits that flow to people from the natural world include a wide array of cultural ecosystem services, nourishing beneficiaries in a variety of ways, from the financial to the aesthetic, spiritual and social. An appreciation and recognition of the plurality of these ecosystem services is fundamental to the wise use and management of the ecosystems that sustain them.

Of course, all uses of ecosystems, recreational or other, impose their own pressures. So learning how to minimise these pressures – for example through temporal and/or spatial closed seasons related to the breeding and nesting needs of fish and birds, limiting footfall on vulnerable sites, or banning artificial street lighting where dark skies fulfil the needs of nocturnal animals – requires scientific knowledge as a key input to wise policy and practice.

And judicious use of environmental science can also help us go far beyond mere damage limitation to repairing the environment. Recreational benefits, along with a range of linked favourable outcomes can be enhanced where, as an example, fisheries management makes a transition from merely restocking fish in degraded

environments to enhancement of aquatic habitats damaged by agriculture, river engineering and other forms of development. Ecosystem-based fishery enhancement measures (such as restoring riverine and linked wetland habitats, cleaning spawning gravels, creating passes in impoundments), amongst a range of progressive, nature-based practices, can result in a river that promotes self-sustaining fish stocks and is a better habitat for all wildlife, improved hydrological buffering, natural purification and landscape aesthetics.

We desperately need to slow and halt our pressures on the biodiversity and ecosystem processes that underpin our security and wellbeing. As urgently, we need to go beyond this and rebuild our substantially degraded inheritance of ecosystems, as an essential foundation for continuing resilience and opportunity. Our recreational interactions with nature – through walking, swimming, angling, surfing, painting, photography and so many others activities – can not only reconnect us with our natural environmental wealth, but also provide economic, political and other motivations to bring sustainable environmental stewardship into the core of societal concerns.

The environmental sciences have much to offer in support of this greater mission.



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It's in our nature

Paddy Fowler reviews the relationship between recreation and the environment.

On a blustery morning of the 24th April 1932, in the shadows beneath Kinder Scout in the Peak District, some 400 radical, working-class ramblers from Manchester and Sheffield waited nervously to begin their morning hike. This was a hike like no other, a hike that would establish the right to roam and change the course of UK environmentalism. Departing from Hayfield in the West and Edale in the East, the two groups determinedly set their sights on summiting the peak. Kinder Scout was on private moorland, so this was an act of civil disobedience, a mass trespass.

Before long, a scuffle broke out with a group of local gamekeepers (some reports called them hired thugs posing as gamekeepers) enlisted to defend the land, but this blockade was surpassed and both groups converged on the plateau, exchanged congratulations, and began to descend.

The story made headlines around the country as a small number of the trespassers were arrested for their involvement in fighting with gamekeepers. This attracted increasing numbers of ramblers to attend

successive events, precipitating a wave of support which increased public demand for the right to access private land. The mass trespasses, and resulting media campaigns, led to the development of bills of access to mountains, reports into national parks and, eventually, the introduction of the Countryside and Rights of Way (CROW) Act 2000, implementing the right to roam in certain areas of England and Wales. Roy Hattersley called it “the most successful act of direct action in British history”.¹ The right of the public to enjoy the countryside for recreation had triumphed over the rights of landowners to prevent access to their property.

“This was a hike like no other, a hike that would establish the right to roam and change the course of UK environmentalism.”



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Opening up huge swathes of countryside to the general public helped to establish recreational pursuits as a major British pastime. In 2013, outdoor recreation was claimed to be the UK's favourite pastime with 75 per cent of adults taking part at least once a month and 51 per cent doing so weekly.² This flood of new recreational activities in our environment has brought a bewildering array of new conflicts over rights: the mountain biker versus the rambler, the climber versus the right of birds to nest undisturbed. This edition of the environmental SCIENTIST highlights that even 87 years after the Kinder Scout Trespass, there is still much to be fought over.

IMMERSED IN NATURE

The mass trespass of Kinder Scout paved the way for entire landscapes to be opened up for all classes. Where previously there were the barriers of wealth and status, soon there would be a right to roam, and access to lands owned by others were anyone's to explore. In 1951, the Peak District, perhaps by no coincidence, was made the first National Park in the UK. Today, the UK boasts 15 national parks covering almost 10 per cent of the UK's land area, encompassing mountain ranges, chalk streams, wetlands and coastlines for anyone who seeks to explore Britain's natural landscape. With access to land came natural pursuits; more people took up rambling in their free time and the working class could enjoy the benefits that acres of open and wild pastures could offer without any requirement for ownership.

As more land was opened up to public access over time, a myriad of recreational pursuits flourished within their boundaries. Today our parks are filled with cyclists, rock climbers, hikers, surfers, skiers, and fisherman, as well as providing an excellent location for a host of constantly evolving new activities such as ziplines and potholing. The scale of human activity in these areas brings into question to what extent those landscapes remain 'natural' beneath our tyre tracks. National Parks have a duty to conserve and enhance their natural and cultural assets, but this can clash with their other purpose of promoting the enjoyment of the parks and raises further questions about who's enjoyment and how you balance conflicting demands.

Across the UK, millions of people take to riverbanks, lake shorelines and canal towpaths to participate in one of the UK's most popular recreational pastimes, angling. For a long time after the industrial revolution, the UK treated its waterways with little care, dumping huge volumes of waste into the waterways, leading to disastrous pollution and the numbers of fish dwindling on the edge of the abyss. In my local area, The Wandle Trust in South London, have brought the River Wandle - a favourite haunt of Sir Izaak Walton for the "Trout with marbled spots like a Tortoise" - back to a condition where it is now teeming with marble spotted fish once



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more.^{3,4} Catching one of these trout from a pristine pool, a glimpse of a goshawk weaving through the woodland, or seeing sperm whales breaching in the North Sea are coveted sights in the UK but they may not be true representations of nature. We have shaped our natural environment to such an extent that it begs the question, have we abused the rights of our ecosystems and natural processes to become human landscapes directed and controlled by a human idea of a right to nature?

“Like so many issues in the environment, recreation is a multi-stakeholder, wicked problem.”

THE AIR WE BREATHE

Whereas the right to access nature is virtually uncontested, the fight for clean air has only recently registered broad public concern. In this edition, Laurence Caird investigates the role air quality has to play on athletic performance and in breaking the

2-hour marathon mark. This isn't just an issue for elite athletes - we often unwittingly increase exposure to harmful particulates whenever we run, cycle or walk. A study published in the journal *Preventive Medicine* found that after a certain cut-off point, time spent exercising in most urban areas, even gently, can begin to have negative impacts on human health due to exposure to poor air quality⁵. Cycling for over 1½ hours daily in urban areas where PM_{2.5} levels exceed 100 µg/m³ - the cut-off point on an average day for the benefits of cycling to be negated by the impacts on health - may be doing their health more harm than good in their choice of recreation. The right to breathe clean air may be agreed in principle, but we are a long way from enjoying it in practice.

FINDING THE BALANCE

All recreational activities involve some interaction with the environment: the intake of air during exercise, the water in which we swim, or the land on which we walk, climb or run. The environment impacts our activities and our activities impact the environment. In our acts of enjoying recreation in the environment - through the noise we make to the visual impact of the infrastructure that recreation



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requires - we can diminish the enjoyment of others seeking escape or recreational pursuits in nature.

Like so many issues in the environment, recreation is a multi-stakeholder, wicked problem. I hope this journal helps readers think about ways in which we can explore, exercise and play in nature, whilst striking a balance between competing human desires and the rights of the natural world to not be exploited. **ES**

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Access rights?

Pippa Langford asks whether we benefit the environment by encouraging more people to go outdoors.

People enjoy using natural sites for a range of activities, including playing with their children, meeting their friends, walking, cycling, horse riding. They have a range of motivations, often several for a single visit: they need some fresh air; they want to be fit, they need to walk their dog, they may use a green route for their commute because it makes them feel happier; some people visit the outdoors specifically to see wildlife, others the wider landscape, the changing seasons, the power of the sea, somewhere new, somewhere they visited as a child and felt happy, or because it is their nearest natural place and it is convenient for their lunch break.

But with an increasing population, demand for new housing and a recognition that we need to do more

for nature, what role does outdoor recreation play in the conservation of the environment? Would an increasing number of people enjoying natural places damage the environment, or contribute to its protection?

USERS AS PROTECTORS

There is a long history of people who enjoy using sites for recreation acting to preserve them from housing, industry or intensification. Early campaigners acted from a range of motivations, often a sense of justice and wanting a better environment for the urban poor, as well as to preserve the places they knew and loved which they felt were increasingly under threat. For example, the Open Spaces Society was founded in 1865 to prevent the inclosure of common land (this was land with *de*

facto access rights and with specific ‘taking’ rights for particular local properties – for example, the tenant of a specific farmhouse having rights to graze 35 sheep on a particular common even though the soil was owned by someone else). The Open Spaces Society can claim credit for saving many of the 120 commons in London and others, such as Ashdown Forest, the Malvern Hills, Berkhamsted Common and Epping Forest,¹ many of which are also important for nature. But the Society had a greater impact by campaigning to change the law to make it impossible to do works that prevented or impeded access. This had the consequence of making it difficult to change the use of commons in a damaging way: 55 per cent of common land in England is now a site of special scientific interest (SSSI), compared to a national average of 8 per cent, and almost all commons now have public access rights. Without common land being protected from inclosure all those years ago, it is probable that a significant proportion would have been physically enclosed, used more intensively or built on, and therefore no longer as valuable for nature or people.

Thinking strategically, members of the Open Spaces Society also recognised that there was a need for an organisation that could own land for the purposes of protecting it for the public to enjoy. So they supported the formation of the National Trust, which now owns many thousands of hectares of land that is important both for nature conservation and public enjoyment. The Open Spaces Society and the National Trust were not alone: many other bodies, such as local authorities, also recognised the importance of having greenspace for public recreation. They own sites for this purpose that are also beneficial for their environmental qualities. For example, the City of London actively intervened to protect Epping Forest from development and acquired many other sites around London for recreation. Many of these, such as Burnham Beeches, attract millions of visitors every year, but are also designated and managed for their nature conservation importance. Another example is Southampton Common, in the middle of the city of Southampton, protected from being built on for the purpose of public recreation in 1844; much of it was designated a SSSI in 1987.

The engagement of the public in protecting their local sites continues today: there are protests to stop development on local nature reserves, prevent the closure of areas of commons for commercial events and stop the transfer of Forestry Commission land into private ownership. It is important to recognise that whilst protestors may be largely provoked into action by a loss of access rights rather than wider environmental impacts, they act from a combination of values: an affinity for a place, their love of nature, or a sense of social, economic and environmental justice. Without the public’s interest in protecting sites for outdoor recreation and their other related values in the past, it is likely that there would be far fewer sites of importance for nature conservation in the present.

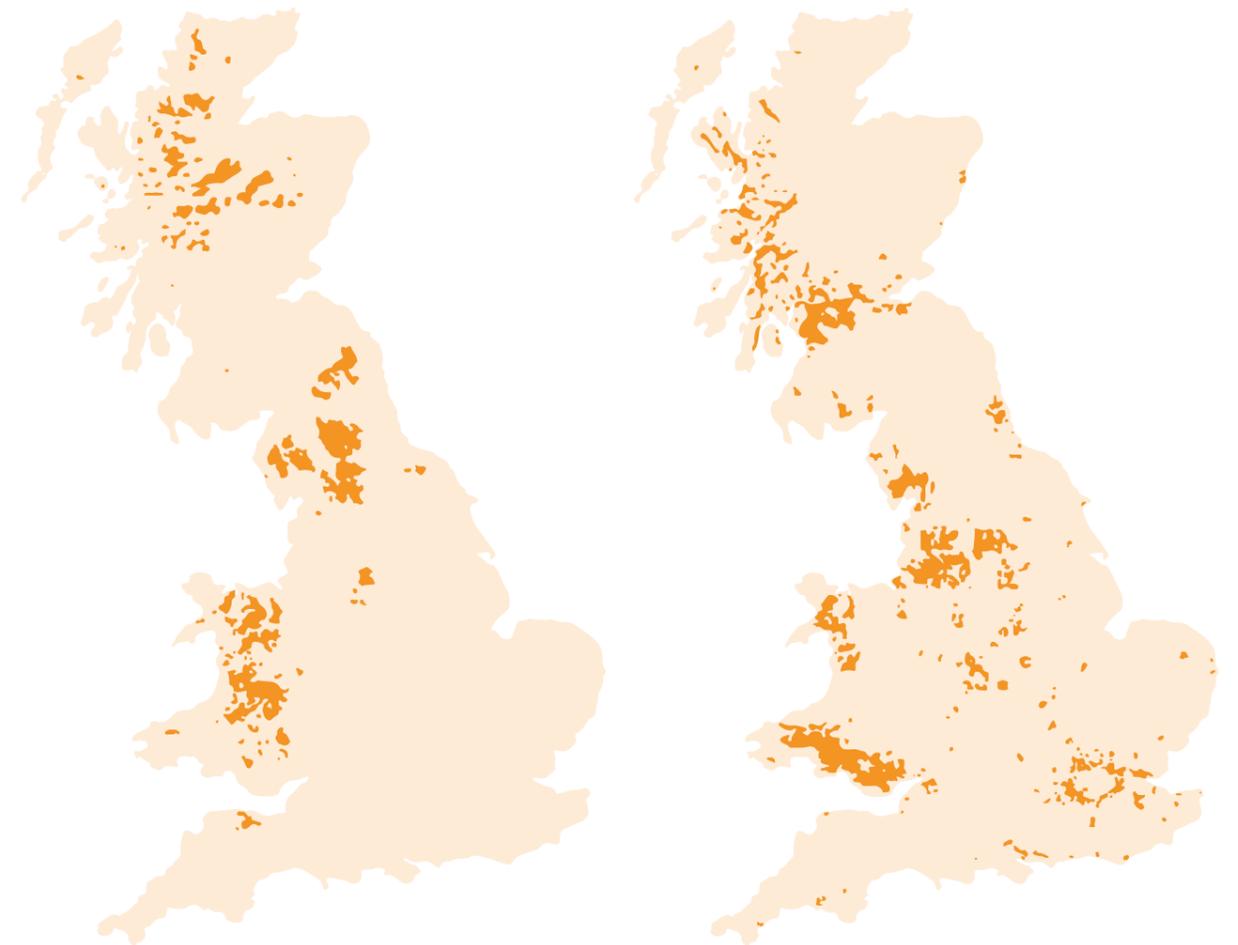
DAMAGING ACTIVITIES

In a densely populated country such as England, there is a potential tension between protecting nature and visiting it. The damaging effects of many types of recreation on habitats and species are reasonably well documented and understood, although they can depend greatly on time of day, intensity, season and location. Natural England has addressed these in a recent review of how to improve England’s most important sites for conservation² and has identified those features that are most vulnerable to disturbance by public access. These can include direct physical damage to habitats by erosion due to high levels of walking, off-road driving and other activities. Walking with dogs off a lead in particular can directly change the behaviour of animals, for example by keeping birds away from their nests or feeding sites. Recreational disturbance can have indirect effects too: dogs worrying livestock can lead to graziers withdrawing livestock from sites that are best managed by grazing to maintain the vegetation in a favourable condition. Public access can also have other deleterious effects, such as trampling, littering and nutrient pollution from dog faeces.

Such analyses of recreational impacts are commonly framed by the question of whether biodiversity or another environmental feature is impacted (usually negatively) by recreation. The wider social, economic and political impacts of recreation are usually not included. However, recognising that it is people who have acted in the past to preserve sites for recreation – and whose support as voters and taxpayers is crucial to securing the regulatory and fiscal measures needed for positive conservation of the natural environment – leads us to enquire about the impact of recreation on biodiversity at a larger scale. There is no national database of all sites that have public access, but it is interesting to note that 56 per cent of country park land, 15 per cent of local nature reserve land and 10 per cent of access land (all classes of land that have full public access) are also designated as SSSI compared to the average of 8 per cent of land in England. The evidence therefore suggests that nature and recreation can co-exist positively, that land managed for public recreation can also be managed to protect nature and that recreation has often been more benign to nature than other land uses in the past.

MORE PEOPLE VISITING THE OUTDOORS?

Whilst it is possible to look at the historical situation and conclude that people visiting and then defending the natural environment has led to positive environmental outcomes, questions are often raised about whether it is sustainable to encourage more people to visit more often, now and in the future, especially as the population in the UK has increased. Even without interventions to reach those who currently do not benefit from visits to the natural environment, the rise in the England’s population is very likely to increase



Planting locations determined by considering only market priced goods

Planting locations determined by market priced goods plus the value of recreation and greenhouse gases

▲ **Figure 1: The maps illustrate the change in location and total social value of the planting of new woodland where different benefits are considered.⁷ The map on the left would produce a net loss of £66 million per annum whereas the map on the right would produce a gain of £546 million per annum.**

the number of visits and, in some places, the building of new houses will have a significant impact on the number of visitors to local sites. This is where a consideration of sustainable development, particularly concerning the social context of participation in outdoor recreation, is critical.

Many people, especially from social classes D and E, those who have a black or ethnic-minority background, and those with a disability or health issue visit the environment much less often than those who are white and from social classes A and B.³ Especially concerning is the growing disconnect of children from nature as they are likely to spend less time outdoors than previous generations. It is important therefore to

consider interventions that meet the needs of all people, particularly those who do not currently benefit from enjoying the outdoors, and measures that would achieve this without impacting negatively on the environment.

ECOSYSTEMS THINKING

Using the ecosystem approach to policy-making, the increased demand for outdoor recreation can be used to justify interventions that increase the area of land that is managed both for recreation and nature. The benefits of going outdoors have been calculated: people who live within 500 m of accessible greenspace are 24 per cent more likely to meet recommended levels of physical activity.⁴ Reducing the sedentary population by just 1 per cent



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could reduce UK morbidity and mortality rates in ways valued at £1.44 billion.⁵ The provision of more accessible greenspace, wherever it is lacking or is forecast to be needed, would deliver public health benefits, but it can also deliver other benefits, such as space for nature, cleaner air and mitigation of the effects of climate change (see example in **Figure 1**).⁶ A proactive landscape-scale approach would assess what provision of natural routes and spaces would provide great outdoor experiences that would be accessible to everyone, supporting both their recreational and active travel needs. Providing these places would not only make places much better environments for people to live and work in, but could also be designed to deliver more space for nature, both in greenspaces and corridors, and reduce recreational impacts on sensitive sites.

ENVIRONMENTAL IDENTITY

Finally, it is important to consider the impacts of outdoor recreation on individuals, how they relate to the natural world through their lifetime and how this influences the next generation. Environmental identity (a stable sense

of oneself as interdependent with the natural world) develops primarily, if at all, during childhood.⁸ If children do not have the opportunity to spend time in nature, the result may be a weaker sense of interdependence with the environment in adulthood. For adults, environmental identity is positively associated with frequency of visits to natural places⁹ and the frequency of visits is related to experiences in childhood. People who have visited a variety of sites as children are more likely to visit a variety of sites as adults. In the future, if the benefits of visits to the natural environment are to be experienced by the whole of the population, interventions should be designed to meet the needs of families in particular, so that parents who grew up with little contact with nature can acquire the necessary knowledge, skills and motivations to help their children have a positive experience of spending time in nature. It is suggested that this would lead to future generations having more of a sense of interdependence with nature. Fortunately we know what features attract people to natural sites and routes: a dense network of well-signed paths; woodland, particularly deciduous woodland; freshwater; the coast; colourful, species-rich grassland; birdsong;

and being able to see the sky and trees. We also know how to make places accessible for the disabled, children and the elderly. All of these are compatible with other environmental outcomes.

To conclude, recreational greenspaces and green routes are good for both people and biodiversity, and it is possible to balance the two to get positive outcomes for both. There will be some limited areas where either recreation or biodiversity must take priority, but in most places careful management will allow both to thrive side by side. The answer to the initial question about whether we benefit the environment by encouraging more people to go outside is that some wildlife at a small scale tends to do better without public access, but the need for more places and routes provides the positive pressure for publicly accessible natural greenspace, which is good for biodiversity at a larger scale. We also know that places that are treasured by people for recreation are protected by them from more intensive land uses, so in planning for new places for nature, meeting people's recreational needs should be a critical selection criterion, as it is likely that people using these sites for recreation will be natural allies for their long-term protection. **ES**

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Running out of fresh air?

Laurence Caird highlights the relationship between poor air quality and exercise benefits.

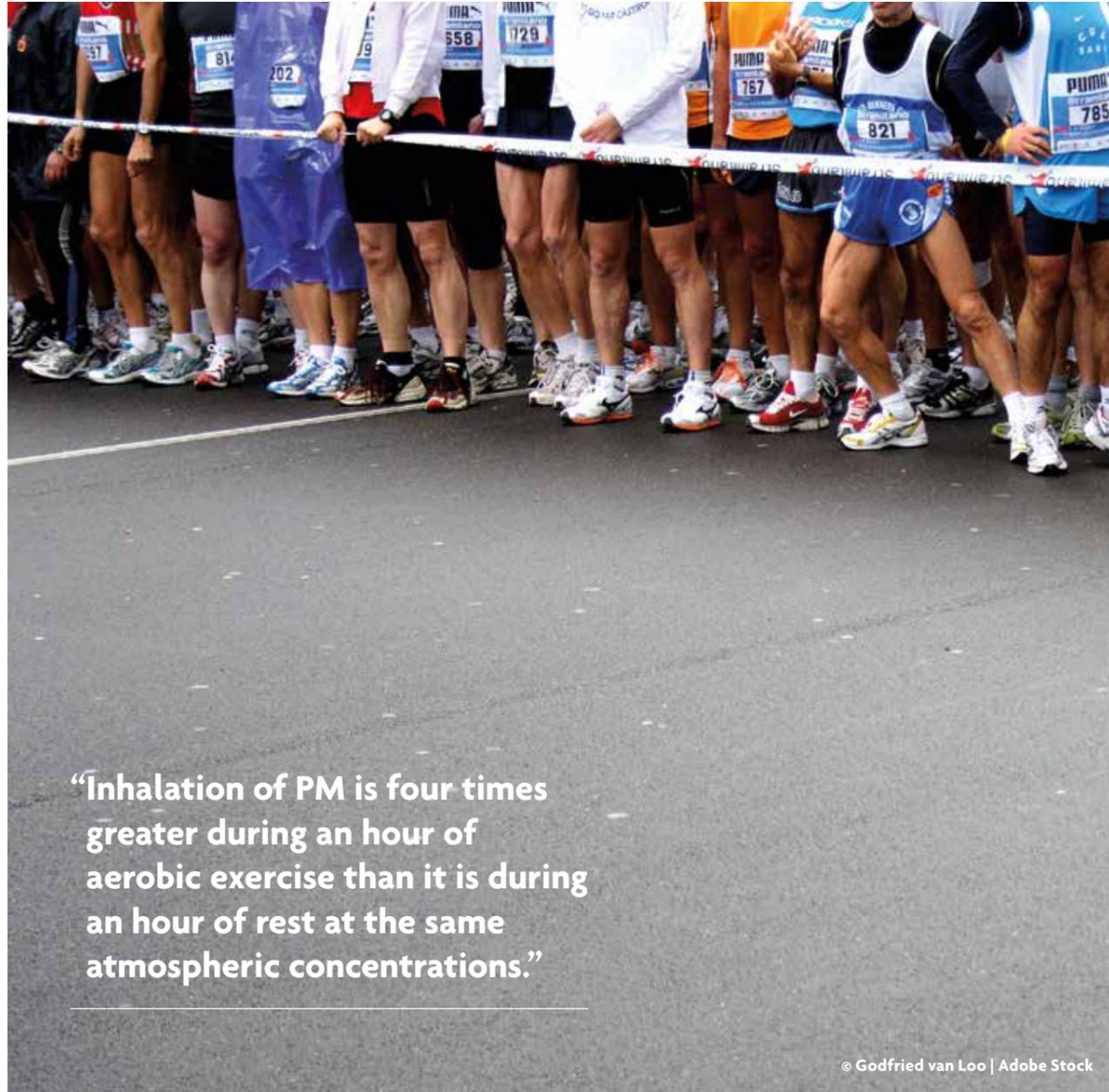
On 6th May 2017, a three-year research and development programme culminated with Kenyan athlete Eliud Kipchoge, the world record holder for the men's marathon, attempting to become the first human to run a marathon in less than 2 hours. He narrowly missed the target time, completing the course in 2 hours and 25 seconds. The attempt is the subject of a documentary, *Breaking2*¹, which explains the extent of the research and development programme and the many marginal advantages that were studied in great depth to ensure the best chances of success: the course (the flat, smooth racing circuit at Monza in Italy), weather conditions, pacing strategy, running shoes and clothing technology, nutrition and hydration. But one thing was apparently not

considered by the team: the air quality. Is it possible that this could have made the difference between failure and success for Eliud?

Air pollution is increasingly well documented and better understood as a health risk, and it has been demonstrated that long-term exposure to poor air quality is linked to a range of health effects. Most of the research in the field is focused on chronic long-term exposure effects in the general population, but there is some interesting data on the effects of air pollution on athletic performance.

EFFECT ON THE GENERAL POPULATION

Much of the research in this field has studied air pollution in terms of a combination of pollutants, typically those



“Inhalation of PM is four times greater during an hour of aerobic exercise than it is during an hour of rest at the same atmospheric concentrations.”

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associated with combustion (carbon monoxide – CO, nitrogen dioxide – NO₂ and particulate matter – PM) as these are the most abundant in the towns and cities in which most people now live. These pollutants are created by a range of sources, but in the urban environment the key sources are road traffic and heating plant.

Inhalation of PM is four times greater during an hour of aerobic exercise than it is during an hour of rest at the same atmospheric concentrations.² This is caused by the greatly elevated breathing rate required during exercise, coupled with a predominance of oral breathing over nasal breathing. Nasal breathing is an effective filter for PM,³ whereas oral breathing is not. Although

other urban pollutants such as CO and NO₂ may not be as effectively filtered by the human nose, it is reasonable to assume that inhalation of these pollutants is higher during exercise than rest due to the elevated breathing rate alone.

When it is considered that many people may, for example, live in a suburban home with low or moderate pollution, but might exercise by cycling along or running next to busy roads where pollutant concentrations are much higher due to emissions from traffic, then it is probable that an hour of exercise for some individuals may represent a significant proportion of their entire daily exposure to these air pollutants.

▼ Table 1: Records broken at the last five summer Olympic Games. (Data for Olympic Games before 2000 is not readily available.)

Year	Host city	Number of records broken		
		World records	Olympic records	Olympic records in running events
2016	Rio de Janeiro	27	91	5
2012	London	32	66	6
2008	Beijing	37	125	11
2004	Athens	31	47	1
2000	Sydney	34	77	6

Studies have shown that urban air pollution can have a negative effect on both the physical and cognitive benefits of regular exercise. A study in Belgium⁴ put two groups of untrained individuals through a 12-week structured aerobic training plan; one group trained in central Brussels (the urban/high pollution group) and the other group trained on the outskirts of the small town of Mol (the rural/low pollution group). Air quality measurements were taken during each of the training sessions; the results showed that the urban group was exposed to significantly higher concentrations of PM during the training sessions than the rural group. A series of physical and cognitive tests were undertaken on each of the individuals before and after the training programme and the study reported that although both groups saw a similar increase in aerobic fitness levels, indicating the air quality had little impact on fitness and performance improvements, the urban group showed an increase in inflammatory blood markers (indicating stress on the respiratory and immune systems) and no improvement in cognitive function, whereas the rural group showed no increase in inflammatory blood markers and significant improvements in cognitive test results.

The findings of the Belgian study are supported by other research, which has found that there are negative effects of aerobic exercise in poor air quality, including reduced lung and vascular function² and impaired improvements in exercise-induced cognitive function.⁵

ELITE ATHLETES

Ahead of the Olympic Games in Beijing in 2008, there was a great deal of concern in the sporting community

regarding the reported poor air quality in Beijing and its effect on athletes.⁶ Although there were concerns amongst some coaches and nations' sporting bodies that the poor air pollution could be a real health risk to the athletes, the general concern was about poor performance, with Olympic officials conceding ahead of the Beijing Games that the poor air quality would potentially reduce the number of Olympic and world records broken at the Games.⁷ In reality, Beijing proved to be a very successful Games: the number of world records, Olympic records and (with particular relevance to this article) Olympic records in running events broken were higher than any of the last five Olympic Games (see Table 1).

It would be rational to conclude from the performance analysis in Table 1 that poor air quality may not affect the peak performance of elite athletes, at least on race day. However, other evidence in the field would not support this conclusion. Studies on trained athletes have demonstrated significant decreases in performance in poor air quality compared to environments with cleaner air. The observed effects include decreases in event performance,⁸ decreases in maximum oxygen uptake (known as the 'VO₂ max') and increases in inflammatory blood markers,⁹ consistent with those effects measured in untrained individuals.

In relation to the observed number of records broken by athletes at the Beijing Games, it is perhaps important to acknowledge that the other recent Olympic host cities (Athens, London, Rio de Janeiro and Sydney) are all large cities with poor air quality as well; and scrutiny around the air quality in Beijing catalysed the Chinese



authorities to make significant efforts to improve the air quality ahead of the 2008 Games, an action that is not known to have been taken by any of these other host cities. It could therefore be that the focus on poor air quality in Beijing and the measures taken to improve it ahead of and during the Games was in part responsible for the high performance of the athletes in Beijing.

MARATHON RUNNERS

The effects of poor air quality on elite athlete performance are likely to be greatest in those athletic disciplines that

require the greatest endurance, such as marathon races, where athletes spend prolonged periods performing at high aerobic rates. A study undertaken in the USA in 2010 examined the performance of athletes at seven major US marathons over several years; it looked for correlations between race-day performance and the concentrations of a range of urban air pollutants during each marathon.¹⁰ The study concluded that there was a correlation between concentrations of PM₁₀ (particulate matter smaller than 10 microns in diameter) and marathon performance, such that marathon times decreased as PM₁₀ concentrations

increased. The correlation was statistically significant only in female athletes, but evidence of the correlation was also visible in the data for male athletes.

Returning to the opening hypothesis about the performance of Eliud Kipchoge in his attempt to run a sub-2-hour marathon: evidence suggests that the air quality conditions, both in the locations in which he trained and the location in which the run took place, could have contributed to his performance. For all the other marginal gains that were considered by the team

in Eliud's attempt on this record, perhaps if air quality had been considered then just maybe *Broken2* would have been *Broken2*.

RECOMMENDATIONS FOR EVERYONE

There is significant room for further research in the field of air pollution and athletic performance, but there are a number of conclusions that can be drawn from the evidence currently available. There is no doubt that chronic exposure to high concentrations of urban air pollutants can negatively impact health, and that aerobic exercise increases exposure to urban air pollutants through elevated breathing rates and oral breathing. Athletic training regimes for elite athletes and the general population alike should consider the air quality conditions in training locations and avoid the most polluted areas, such as busy roads or urban centres, where urban pollutant concentrations are highest. The results are likely to mean better performance and better health benefits. **ES**

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Hikers, vipers and bikers: Conflict in the UK's National Parks

Carolyn Roberts outlines the unequal struggle between economic demands, people's enjoyment and the needs of the environment.

The UK's National Parks include some much-loved landscapes. Around 10 per cent of England, Scotland and Wales is currently designated as National Park, broadly for its scenic value – a heady mix of geology, climate, ecology, water and land use that makes for a memorable view. The designation is intended to protect land from the pressures of modern life, preserving it for future generations in the face of inappropriate commercial activity. But unlike many of the 113,000 National Parks elsewhere in the world, the UK's National Parks are neither owned by the nation, nor are they environmentally 'intact' – each one has been dramatically affected by centuries of human habitation. In addition, over 90 million tourists tread the ground every year, particularly at well-known honeypots such as Hadrian's Wall and Derwent Water. The UK's National Parks are hence always caught up in controversy over how to conserve the best of the country's scenery, ecology and rarer wildlife, whilst simultaneously allowing local people to earn a living, and visitors to enjoy the spectacle.

However, our perception of what is appropriate to conserve may fly in the face of science. Environmentalist George Monbiot, for example, characterises some of the best-loved UK National Parks as 'wet deserts' because of their diminished biodiversity and wholly artificial ecosystems, and suggests that preservation in this state is undesirable. UK National Parks do contain above-average proportions of the most wildlife-rich habitats such as heaths, fens and ancient woodlands. It is also true that up to 80 per cent of some specific habitats that are priority targets for conservation are within the National Parks and that they are homes to endangered species such as the fen raft spider, currently the subject of a reintroduction programme. But large areas of National Parks are not particularly valuable ecologically, having already been damaged by intensive cultivation, sheep grazing and afforestation with non-native trees. The main difficulty in reintroducing the fen raft spider and other endangered species is the loss of much of the relevant habitat, which is part of a wider problem associated with human pressures. This has left protected fragments that are too small to be viable, where reintroduction of threatened species is likely to fail.

CONFLICTS BETWEEN USERS

Our National Parks are the focus of controversies between local residents, Park users, Park managers, local government and others. At Tyndrum, in the Loch Lomond and Trossachs National Park, disagreements between residents, an Australian-registered gold mining company and the Park Authorities prevented the processing of gold ore. However, following the reversal of this decision in February 2018, the expectation is that 23,000 ounces of metal can be produced without significant environmental damage. Local residents are largely in favour, as the production of unique Scottish gold wedding rings could create well-paid jobs and bring income into an impoverished region. However, the Park Authorities and other residents are concerned about mine tailings killing moorland vegetation, pressure from noise and traffic, and potential water pollution from acid drainage. The tailings might be sculpted into an artificial glacial 'moraine' which could have unforeseen implications for the educational experiences of future students of geomorphology.

“Most of the land cover of UK National Parks is not natural in any meaningful sense.”

At Honister Pass in the Lake District National Park, a proposal for a recreational zip line created controversy in 2012, and was twice refused. The Friends of the Lake District, the Cumbria branch of the Campaign for the Protection of Rural England, Cumbria Wildlife Trust, the Wainwright and Open Spaces Societies all objected strongly on the grounds of impact on landscape character and loss of tranquillity. It was alleged that a zip line would create parking problems, and would intrude on the views of 'wilderness', or at least of relatively wild environments. Environmentalists suggested that the charms of the area would be destroyed for fell walkers and hikers by the shrieks of the riders. Conversely, the aspirant entrepreneur suggested that the zip line would have minimal impact, would be used for transporting slate as well as riders, and would bring new money into an area that had non-native tree planting and was already heavily mined. In November 2018, permission was granted, aligning the Lakes with Snowdonia and the Peak District where thousands of visitors already enjoy recreational zip lines, treetop trails and other commercial forest-based experiences, apparently without much opposition.

Elsewhere in the Peak District National Park, clashes between hikers and off-road motor and trail bikers have prompted serious animosity, with police involvement and threats of legal action between different users of green lanes (unpaved roads with historic rights of way

for motorised vehicles, horses and pedestrians). The differing priorities generated apoplectic exchanges on social media as well as on the trail. Some messages asserted that trail bikers had a legal right to use these public rights of way, that bikes were less dangerous than horses or dog fouling, and that motorbikers' access to these exciting routes was already constrained. This contrasted with messages suggesting that the hikers were elderly, bigoted, hypocritical, 'grumpy old gits', whose opinions were unimportant, and worse. Whilst readers may grimace at the Anglo-Saxon epithets, it remains unclear whose views should have priority. One suggested solution is to pave the roads, removing the attraction for off-road bikers, but presumably no one would prefer that option to the *status quo*. In practice, most cases have been resolved in favour of environmental protection but there are grains of truth in the bikers' assertions.

LEGISLATION FOR NATIONAL PARKS

As some of the pro-biker messages highlighted, rights to enjoyment of National Parks were hard won. Following a mass trespass on Kinder Scout ridge in the heart of the Peak District in the mid-20th century, members of workers' rights groups from Manchester were involved in violent conflict with the Duke of Derbyshire's gamekeepers and the police. Their claim for the right to roam conflicted with the grouse-shooting rights of the landowners, but captured public attention and political support. Legislation followed in 1949, quickly succeeded by designations of specific areas until the South Downs acquired its status as the fifteenth National Park in 2010. There is a current campaign to designate London as a 'National Park City', which would raise further challenges to the UK concept of a National Park. The early Parks were characteristically marginal agricultural land, but the later ones clearly are not, which is where many of the current controversies arise. The law was adjusted in 2005 to emphasise and clarify the two statutory purposes of the Parks:

- Conserve and enhance the natural beauty, wildlife and cultural heritage; and
- Promote opportunities for the understanding and enjoyment of the special qualities of National Parks by the public.

When National Parks carry out these purposes they also have the duty to:

- Seek to foster the economic and social well-being of local communities within the National Parks.¹

For simplicity these imperatives can be represented in a Venn diagram, where different interests may be weighted more or less heavily, dependent upon the prevailing political climate. In the case of the green lanes, where local people have objected to bikers



enjoying some of the special qualities of the area (for example the gradients, and the challenge of sport in a legal off-road location) and green lanes are gradually being removed from bikers' use, then it is useful to emphasise the changes in balance amongst the three sets. There may be some damage from motorised vehicles on local ecology and conservation, but they are probably quite slight overall. However, the weight of local opinion from resident walkers and horse riders, with their own impacts on footpath erosion, car parking and litter, is also observable.

A principle known as the Sandford Principle is intended to be used in the case of conflicts. The official view of Park authorities is that "most of the time it is possible to achieve both the original two purposes of the National Parks by good management. Occasionally a situation arises where access for the public is in direct conflict with conservation. Following the ethos of the Sandford principle, the Environment Act 1995 sets down how a priority may be established between conservation and recreational use". The Sandford Principle is then summarised: "where those two purposes cannot be reconciled by skilful management, conservation should come first".²

There is a raft of other legislation too, protecting specific habitats, species and activities. Of course,

in the case of opening a gold mine, where it would be necessary to cover part of the ground with mine tailings, or construct a pseudo-glacial moraine, then the National Parks conservation priority could not hold. Similarly, if it could be demonstrated in the zip line case that 'enjoyment' and 'access' were very important, then conservation would not come first.

However, unpicking what is intended by the statutory purposes is even more complex. Statements about natural beauty quickly run into difficulty. Most of the land cover of UK National Parks is not natural in any meaningful sense. In terms of vegetation, natural scenery would principally comprise the ancient beech and oak woodlands of postglacial England or Atlantic hazel woods in the Scottish uplands, which were largely removed by human activity in the Bronze Age. Re-establishing these woodland ecosystems would block the views of many of the features that visitors now enjoy. Nor would many farmers and walkers want the reintroduction of wolves, bears and lynxes, even though these too are natural inhabitants.

Visitors also enjoy the constructed 'chocolate box' agricultural scenery. The landscape of the Norfolk and Suffolk Broads, for example, is almost entirely a human artefact of pumped drainage, river straightening and fuel extraction carried out from the 17th century onwards.

These peaty areas are no longer drowned under the postglacial sea, or 'rushy, plashy fen',³ but are now often dried out, shrunken and oxidised organic soils resulting from water extraction within and beyond the Park boundaries, and are intensively cultivated. Whereas some concept of 'restore' to an arbitrary point might be achievable, 'rewilding' National Parks to some notion of a romantic, pristine past with ancestral ecosystems and roaming predators is probably undesirable and almost certainly impossible.

INTERNAL CONTRADICTIONS

The contradictions within the statutory purposes are too many to describe. Water in National Parks, for instance, is very popular as an element of beautiful scenery, but reservoirs are not in any sense natural. Water is sucked away from several of our National Parks to supply cities. Buttermere may be a more-or-less natural lake (though its ecology is not), but Thirlmere is managed as a water supply reservoir, its levels rising and falling in response to the demands of Manchester. For many years, people were excluded from close access to the

water, too. Contradictions arise in relation to water and wildlife as well. Conservation is suggested as an imperative, but angling is permitted in many National Parks, which may not be consistent with preservation of wildlife, or at least of individual fish.

“UK society judges it appropriate to pay only about £1 per person per year for the privilege of maintaining National Parks.”

Beyond that, although there are some heroic attempts to reintroduce specific endangered species of animals and plants, UK society judges it appropriate to pay only about £1 per person per year for the privilege of maintaining National Parks. In fact, biodiversity is greatly threatened across the UK, and it is difficult to see

whether National Park designation has produced much benefit. Red-List species exist, but wildlife conservation locally and internationally remains problematic. The World Wildlife Fund found in 2014 that from 1970 to 2010, the average numbers of 3,000 species of mammal, bird, reptile, amphibian and fish had declined by over 50 per cent because of unsustainable human consumption.⁴ With or without its National Parks, the UK is participating in this sixth great extinction. Over the last 40 years, for instance, two-thirds of the UK's common larger moths have declined, according to Rothamsted's 2013 national insect survey,⁵ despite the protection nominally afforded by National Parks. Moths are a good indicator of wider problems with habitat protection. There is some evidence that moth declines are greater in the south where National Parks and habitat protection are thinner on the ground than in the north of Britain, but the evidence for effective protection is not compelling. The UK's residents tend to want their landscapes and habitats, even in conserved areas nominally of 'natural beauty', to be rather sanitised, and are prepared to see wild areas and biodiversity eroded despite the warm words about wildlife 'protection'.

And what of intensive sheep farming, wind farms and second homes? In the face of these internal contradictions, who are National Parks actually for? The National Parks' statutory purposes make specific reference to the economic and social wellbeing of local communities. Local occupancy clauses have been used to try to mitigate some of the worst of the exclusions for local residents of National Parks, but desirable places with attractive landscapes experience economic pressures of two sorts. For some local people, second homes will drive up prices and reduce their chances of staying within the National Park. Conversely, motorboat owners, zipliners, climbers and mountain bikers bring money into the cafés, restaurants and shops in the Parks, and so there is a strong pressure to accommodate commercial interests, even at the expense of the wildlife. The third imperative of National Parks relating to the social and economic interests of local communities (and what is 'a community'? Can a collection of second homes, a few people working in a gold mine or a group of hikers walking a green lane, be a community?) may not be achievable in conjunction with the first and second. Consequently, tourism is accommodated, facilities constructed, and nature driven back.

UNPROTECTED BOUNDARIES

National Park boundaries are not always impermeable. UK Government Minister Amber Rudd said early in 2015, 'we have agreed an outright ban on fracking in National Parks',⁶ but opinions on the environmental risk and appropriateness of shale gas extraction vary over time. The UK Government's current view of appropriate preservation of scenic and valuable habitats allows drilling next to National Parks, if not directly in them, even when corrosive fracking fluids can be injected 1.2 km below ground inside the Park boundary. The net addition to atmospheric carbon from burning this fossil fuel, and the impact on future climate change, will also be significant. Clearly, a bounded National Park area does not automatically protect the environment overall. Boundaries can introduce other challenges too, displacing and concentrating damaging activities to just beyond the protected area, or encouraging particular agricultural practices to operate more intensively in one area than another and inflicting greater overall damage as a result.

Another example of modern priorities, such as roads, potentially breaching the boundaries of a Natural Park came about in the area around Arundel in Sussex when it became the subject of major debate only a few years after the creation of the South Downs National Park in 2010. Proposed bypass routes intruded into the Park or bisected important habitats, severing wildlife corridors. The route finally selected will inevitably introduce noise, traffic and light pollution into a protected area that was formerly rather peaceful, even if not 'natural'. Whether the road reduces or merely displaces Arundel's congestion remains to be seen.



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WITHOUT NATIONAL PARKS

The loss of upland soils in the face of intensive sheep farming, the smaller role of uplands in reducing damaging flood runoff, and the loss of native forests, all suggest that National Parks are not fulfilling their missions, at least in some areas of the UK. However it is impossible to be certain because, from an experimental perspective, what might have happened in the absence of National Parks can only be the subject of speculation. There could have been even more inappropriate development (although the UK has other legislation to help prevent that) and wildlife might have been driven away to an even greater extent than has occurred already. **ES**

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Angling for sustainable fishing

Mark Everard and **Adrian C. Pinder** report on how recreational angling is increasingly taking into consideration the needs of fish populations in its approach to management and policy influence.

Anglers need fish. Fish need water. In the freshwater realm, rivers and lakes (and estuaries for migratory species) need to contain enough water of adequate quality, with food to support mixed fish species, and a diversity of habitat for fish breeding, feeding and refuge needs throughout their various life stages. Understanding the diverse needs of mixed fish populations throughout the changing seasons and throughout their lives is essential for sustainable management. That understanding is also vital for influencing the wider environment of policy and practice to address the many pressures on aquatic environments.

A CHANGING PARADIGM

The caricature of the shotgun-wielding river fishery manager with a slash-and-burn approach to riparian habitat, restocking fish and culling predators to maintain a standing crop of accessible fish, was perhaps well-earned in the period after the Second World War. But this paradigm has, with some exceptions, been substantially shifted, at least across Europe in recent decades.

Today, progressive management of river fisheries seeks to identify and protect, and to restore where degraded, habitat that is important for the life cycles of fish. Many ecosystem-based fishery management measures (see **Box 1**) are now commonly implemented to support natural regenerative processes, with a primary emphasis on the promotion of self-sustaining mixed species fisheries resilient to environmental extremes of drought and flood as well as predation. As promoted in the excellent booklet *Wild Trout Survival Guide*,¹ similar measures are encouraged in game fishing waters (those that contain salmonids: salmon, trout, etc). Pertinent to guidance underpinning all of these measures is that they are founded on knowledge about the disparate needs of fish species throughout their various life stages, working with or emulating natural processes. Nature-based approaches yield far wider benefits, not only for all aquatic life but also for multiple ecosystem services such as flood buffering, catchment water storage and physico-chemical purification, landscape aesthetics, erosion regulation, nutrient cycling and carbon sequestration.

BOX 1. PROGRESSIVE, ECOSYSTEM-BASED MEASURES TO PROMOTE SELF-SUSTAINING, MIXED SPECIES FISHERIES

The book *River Habitats for Coarse Fish: How Fish Use Rivers and How We Can Help Them*² documents how river habitats serve the breeding, feeding and refuge needs of populations of coarse fish (freshwater fish other than salmonids; see **Figure 1**). It also outlines measures that can be implemented to improve habitats to foster sustainable fish populations. Some examples of these measures include:

- Creating buffer zones by installing fencing to exclude stock from the water's edge, enabling the natural regeneration of riparian vegetation as a source of food and also breeding, nursery and refuge habitat;
- Encouraging untilled buffer zones between arable land and the water's edge to reduce soil loss from fields and the consequent influx of sediment and its associated load of nutrients and other agrochemicals into water bodies;
- Jetting spawning gravels to remove excessive silt resulting from poor agricultural practices;
- Retaining or installing large woody matter into streams to host food, and to diversify flow regimes and physical habitat; and
- Opening up 'fry bays' in habitat-poor river margins where shallow water can warm in the summer months, providing refuge, fine food items and optimal growth conditions for juvenile fish.

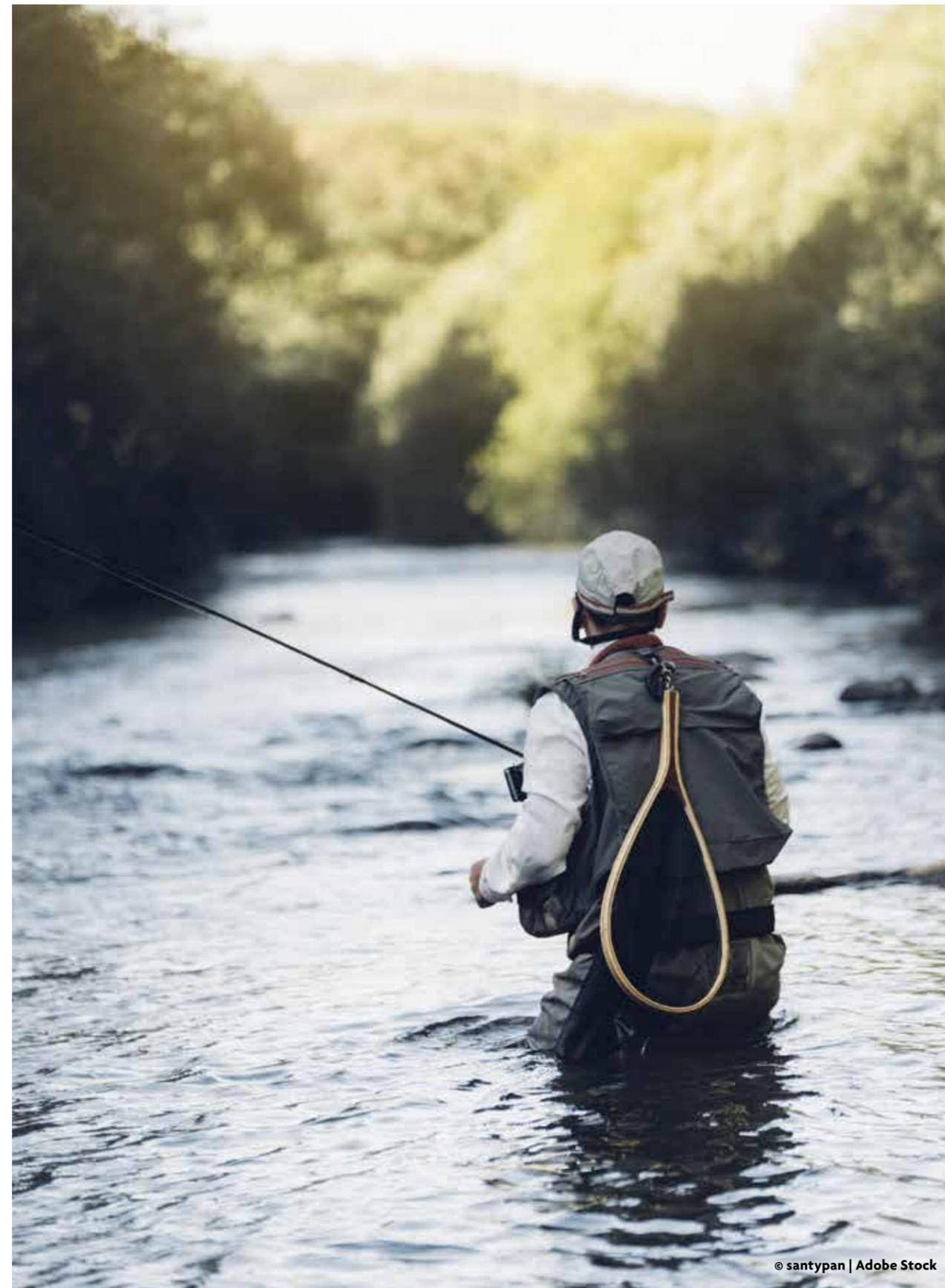
SURVEILLANCE OF FISHERY ECOSYSTEMS

A claim with considerable substance is that anglers are the 'eyes and ears on the bank', attuned to their target fish and also aware of the wider waterside environments that not only sustain fish populations but also contribute substantially to the enjoyment of angling. With 1.4 million anglers licensed to fish in fresh waters and regular weekly participation by in excess of 100,000 anglers over the age of 16,³ there are many such 'eyes and ears' routinely on the bank. Anglers are responsible for a significant proportion of calls to the Environment Agency's Incident Hotline (0800 80 70 60) reporting problems such as fish in distress or pollution.

Catch data recorded by anglers can be analysed to provide a solid evidence base of trends in fish populations. This has become increasingly important as statutory monitoring budgets are cut back or where such routine statistical monitoring does not occur. This can not only inform issues of emerging concern to environmental regulators and fishery managers, but may also constitute a basis for legal cases such as those pursued in the UK by the NGO Fish Legal (see **Box 2**).

BOX 2. NGOS IN THE UK PREDOMINANTLY OR SIGNIFICANTLY DRIVEN BY RECREATIONAL ANGLING INTERESTS

- The UK's extensive network of catchment-based Rivers Trusts, coordinated under the national umbrella body, The Rivers Trust (www.riverstrust.org), has wide-ranging interests in river management.
- Salmon and Trout Conservation UK (www.salmon-trout.org) was founded over a century ago to champion the conservation of Britain's salmonid fish, and has significant policy influence.
- The Wild Trout Trust (www.wildtrout.org) was established to promote habitat restoration favourable to the survival and recovery of trout populations in British rivers.
- The Avon Roach Project (ARP, www.avonroachproject.co.uk) was initiated by private individuals responding to a 2005 Environment Agency report that roach were in precipitous decline, potentially below sustainable stock levels, in the middle Hampshire Avon, a river once famed for its roach stocks. ARP activities include collection of roach spawn for captive rearing, habitat enhancement and collation of efforts by a range of statutory and non-statutory bodies.
- The Angling Trust (www.anglingtrust.net) is a governing body representing game, coarse and sea anglers and angling in England and Wales, with diverse activities including policy influence, promotion of angling participation and habitat advice.
- The Angling Trust subsumes Fish Legal (www.fishlegal.net), a non-profit organisation set up to use common law to fight pollution and other damage to the water environment (both freshwater and marine) and to protect the rights of anglers and angling.





▲ Figure 1. A roach (*Rutilus rutilus*), a cyprinid fish that is one of Britain's most ubiquitous and desirable freshwater angling species. (© Mark Everard).

In England and Wales, anglers buying licences to fish for migratory Atlantic salmon and sea trout are required to submit annual catch returns, including numbers of fish taken and returned. The compiled dataset is used by the Environment Agency and others to assess stocks, and to direct management and regulatory actions as necessary.

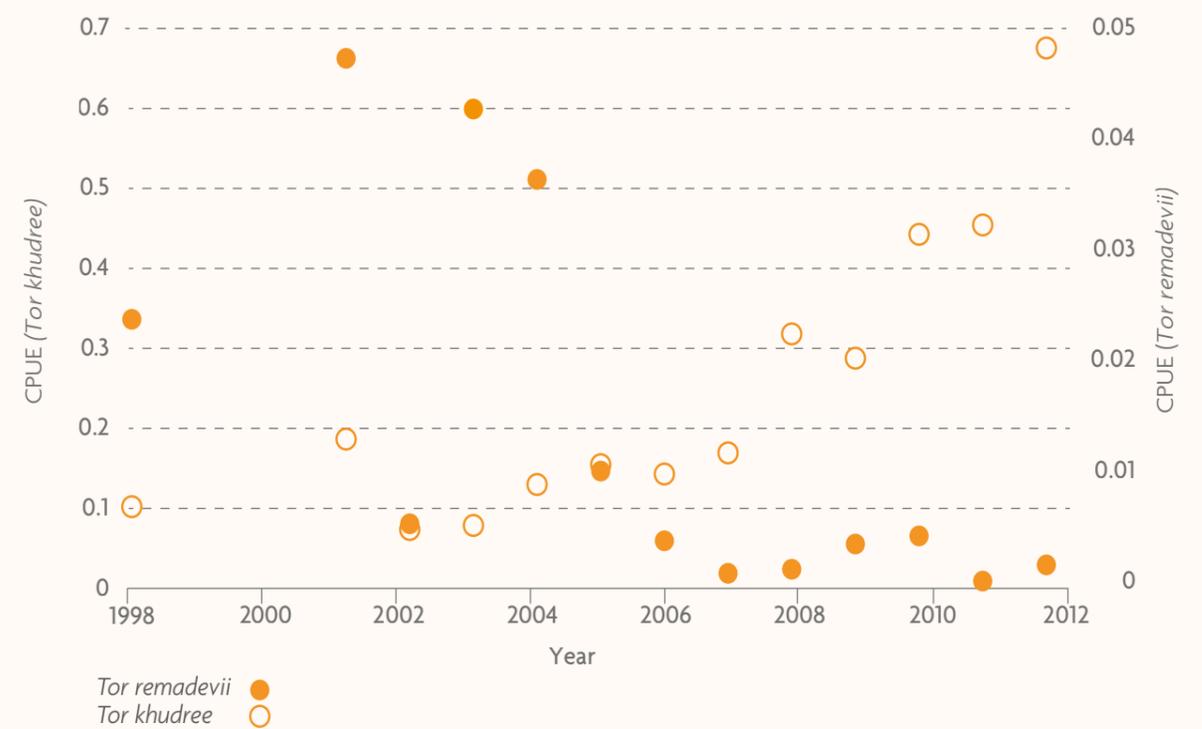
Long-running documented angling returns can also be plotted to show significant changes in species dominance or abundance, as in the case of the invasion of South India's Cauvery (Kaveri) River by a stocked non-native blue-finned species of mahseer. (This blue-finned species is currently referred to as *Tor khudree*, but is subject to some taxonomic doubt attributed to extensive experimentation with hybridisation at the originating hatchery.) This has led to a precipitous collapse of the endemic hump-backed mahseer (*Tor remadevii*),⁴ the largest mahseer species, which is now considered to be on the brink of extinction and the only one of 16 mahseer to have been assessed as Critically Endangered on the IUCN Red List of Threatened Species.⁵ A plot of changing species dominance over time is shown in Figure 2.

POWERS FOR GOOD

Angling not only serves as a valuable way of connecting people to the natural environment, but also encourages socialisation across cultural, age, socio-economic and other barriers. It is also an economic powerhouse, with angling-related activities (such as licences, tackle and clothing, travel, accommodation) conservatively worth over £3 billion to the economy of and creating 27,000 full-time equivalent jobs in England and Wales alone in 2015.⁶ In the UK, over 1.4 million anglers are licensed to fish in fresh waters, with many more fishing the sea without need of a licence.

With this high degree of participation and investment comes democratic power, and a force for the protection and conservation of valued fisheries. For many decades now, the needs of different types of fish populations have underpinned water quality standards as a framework for regulation, subsumed today into the EU Water Framework Directive. The needs of fish and the wider water environment, through the voices, investments and votes of an angling public, have power over decisions pertaining to their protection.

Angler-catch-derived temporal population trends in catch per unit effort (CPUE)
Showing data from 1997 - 2013⁴



▲ Figure 2. Angler-catch-derived temporal population trends in catch per unit effort (CPUE) of two mahseer species: the endemic hump-backed mahseer *Tor remadevii* and the invasive blue-finned mahseer, *Tor khudree*.

Angling interests have also become organised into wider networks of non-governmental organisations (NGOs) seeking to increase understanding across the angling community and wider population, as well as to influence policy and practice better to safeguard aquatic environments. A small subset of these civil society initiatives in the UK with predominant or significant angling interests is outlined in Box 2. The same is true across many other developed world nations. Akin to the activities of progressive fishery managers, policy influence and practical initiatives instigated by these NGOs achieve wider benefits for aquatic life and multiple ecosystem services.

For some migratory fish species that span geographical zones, as well as for groups of species that occur across a number of countries, international NGOs and intergovernmental NGOs (INGOs) have been established to promote their protection across broad but essentially interlinked habitats. Examples of such bodies are listed in Box 3. In developing countries, the economic value of recreational angling activities can be an influential force for conservation of river

ecosystems. Revenues from visiting recreational anglers, including payment for guiding and catering services recirculated amongst the local rural communities, can constitute a powerful conservation lever for those communities to hold back from destructive fishing practices (dynamiting, pesticides, non-selective gill nets) and instead to self-police rivers where live fish have a greater value than dead fish⁷ (see Figure 3).

HOW ENVIRONMENTAL SCIENCE CAN HELP

The trajectory of human development, certainly post-industrialisation, has been one of narrow and short-term benefit realisation, with scant or no consideration for the wider ramifications of resource use. Arguably, the former paradigm of fishery management might have fitted that mould. However, society changes not by top-down diktats, but through the revision of practices in all layers of society, and this even includes recreational angling interests and practices.

The conservation benefits of catch-and-release angling fundamentally depend on a high proportion of fish surviving when released after capture. This topic has



▲ **Figure 3.** The economic value of live fish, achieved through a share of angling tourism revenues, as in the case of the golden mahseer (*Tor putitora*) in the Indian Himalayas, can create a powerful incentive for local rural communities to withhold destructive fishing methods. (© Mark Everard).

received considerable research attention, informing fishery management decisions. This is part of a progressive evolution in fishery management and angling practices, many of which environmental science has helped address. Science, for example, informed the 1986 ban on lead fishing weights in sizes that can be ingested by swans and other waterfowl and provided an evidence base behind the banning of knotted fishing nets as a contribution to improving fish safety. Further scientific research is also ongoing to assess and improve upon the already very high survival rate of fish released after capture and to better inform fishery conservation plans. Bankside damage and poaching can be problematic locally, but science-based advice is helping inform the former and scientific detection methods can help pursue the latter. In terms of the decreasing and low levels today of recreational anglers taking fish home ‘for the pot’, this need not present a problem if within sustainable yield limits which, again, can be informed by the environmental sciences.

Today, fishery ecosystems face additional, mounting pressures from population growth and urbanisation, food security challenges intensifying land use, increasing abstraction of water to meet these burgeoning

BOX 3. INTERNATIONAL AND INTERGOVERNMENTAL NGOS ESTABLISHED TO SAFEGUARD FISH OF RECREATIONAL ANGLING INTEREST

- The Atlantic Salmon Trust (www.atlanticsalmontrust.org) was founded in 1967 in response to growing concerns about the over-exploitation of wild salmon in the Faroes and Greenland Coastal waters, affecting salmon stocks returning to natal rivers, including British waters, where the Trust is also an influential advocate for salmon conservation.
- The North Atlantic Salmon Conservation Organization (NASCO, www.nasco.int) was created in 1983 as an intergovernmental organisation to enact the Convention for the Conservation of Salmon in the North Atlantic Ocean, with the objectives of conserving, restoring, enhancing and rationally managing wild Atlantic salmon across their broad geographical range.
- The Mahseer Trust (www.mahseertrust.org) is a charity established to conserve mahseer (*Tor* spp.) as flagship species, creating greater awareness and promoting environmental stewardship of rivers throughout the mahseer range countries in south and south-east Asia.

needs, and external factors such as climate change. All of these influences intensify stresses on fish stocks, and therefore angling. Angling literature, events and international networks with fishing interests can be a useful mechanism for transferring knowledge about the ecological needs and optimal conservation and management of recreational fish stocks.

Lessons from practice can form an empirical evidence base underpinning robust scientific advice and influence, shaping policy development. These lessons can also inform practical actions by angling-related interests to mitigate some of these wider environmental pressures. Progressive, ecosystem-centred fishery management can go a significant way towards adaptation to environmental changes by protecting or enhancing not only fish stocks but also broader water-dependent wildlife and linked ecosystem services of substantial cumulative public benefit. Ecosystem-based management of recreational fisheries is one element addressing the greater challenge faced by global humanity of not merely slowing and halting the pressures on biodiversity and ecosystem processes, but of rebuilding our substantially degraded inheritance of ecosystems as a vital resource for continuing security and wellbeing. Knowledge from the environmental sciences has, and will continue to have, much to offer in support of this greater mission. ES

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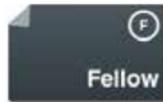
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Nature reserves: Just how natural are they?

Robert Ashcroft explains why the concept of 'natural' may not be the most useful approach in the context of nature reserves.

The nature reserve I know best is a small wetland site in East Anglia, the RSPB's Strumpshaw Fen, which is a short drive from the city of Norwich. Over numerous weekend visits I've learned my way around the paths, ponds, reedbeds, meadows and woodlands of this reserve. I've found it a refuge from the noise and business of city life, and I've seen wonderful wildlife: marsh harriers, relatively rare birds in the UK, thrive here, and can reliably be seen gliding low over the reeds searching for prey, or performing elaborate courting rituals and food passes high above in the spring. I've seen starling murmurations, barn owls circling silently over the meadows at dusk, and even bitterns on a few very lucky occasions. The site is host to a number of rare plant and insect species too, with hundreds of wildlife enthusiasts and photographers flocking there each summer to see its swallowtail butterflies. Even on the evening visits when there's been little to see, the

whispering fizzer of tall reeds in the wind makes it easy to feel a long way from the city and the railway that brings trains rushing past the reserve.

Lowland fen is identified as a priority habitat in the UK Biodiversity Action Plan,¹ and with studies suggesting the UK has lost up to 90 per cent of its wetland habitats since the industrial revolution,² largely due to drainage, this is clearly a threatened habitat. Considering the range of important ecosystem services provided by wetlands and the number of threatened species they support, the conservation of such sites is generally considered to be essential. But just how 'natural' is my wetland haven?

UNTOUCHED RESERVES?

The UK's first nature reserve, at Wicken Fen in Cambridgeshire, was established in 1899 by the



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National Trust.³ The site is another small lowland wetland reserve, and similar in many ways to Strumpshaw Fen. Wicken Fen was established as part of a movement that really took off in the post-war period, a reaction against Victorian industrialisation and loss of countryside.

This wave of environmentalism was based on a divided view of nature separate from humanity – a static, stable nature under threat from human actions. As such, these reserves were largely considered to be “places for nature”,⁴ which needed to be largely left alone other than for scientific research. In the early life of the reserve this approach was not particularly successful, however, with the open, grassy habitats favoured by the site’s birds being lost due to succession. It was soon decided that some management would be required, and a cutting regime was established. Later, experiments by Sir Harry Godwin at Wicken Fen would reveal the significance of this type of management for maintaining certain habitat types (see **Box 1**). Now, intervention at Wicken Fen is specifically targeted at the conservation of the site’s areas of threatened fenland habitat. Originally intentions were less specific, with a broad aim of returning the site to its original state, but with a lack of clarity about what this state actually was.

In reality, the lowland fen habitat so valued at both Wicken and Strumpshaw Fens is closely tied to the actions of people: historically these were important sites for the harvesting of rushes for flooring and reeds for thatch. People also dug peat to burn. As building materials and heating methods developed, these traditional management practices declined. Left alone, succession would take its course on these sites, with many of them developing into scrubland and eventually a woodland climax community. To conserve these habitats today, management interventions are necessary to prevent succession taking place. This, however, requires a very clear vision of the state that is being aimed for.

So, is this really ‘natural’, or is it wildlife gardening on a grand scale? Indeed, Dr Steve Trudgill, the academic who introduced me to these ideas, argues that “Nature conservation should perhaps be renamed ... as it does not seem to be much about conserving nature, that is, leaving nature to get on with itself”.⁵

WHOSE NATURE?

The example of Wicken Fen, or indeed Strumpshaw Fen, demonstrates that quite intensive management may be required to maintain some nature reserves in a form consistent with a dominant view of what is



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BOX 1: THE GODWIN PLOTS

In 1927 Sir Harry Godwin, a botanist and ecologist at the University of Cambridge, was investigating the effects of cutting vegetation on plant communities. As part of this study he set up an experiment at Wicken Fen, which continues to this day. Godwin split his sites into five plots, each with a different cutting frequency: the first was cut annually, the second every two years, and so on, with the fifth plot never cut.

The results of this study showed that management had a significant impact on the composition of plant communities. In the more regularly cut areas, sedge species such as the great fen-sedge *Cladium mariscus* declined, while other plants such as purple moor grass (*Molina caerulea*) and yellow loosestrife (*Lysimachia vulgaris*) increased in abundance.⁶ These findings supported the emerging theory of succession (the process by which the structure and composition of ecological communities change over time), and although widely accepted today, was considered remarkable at the time. They demonstrated that left unmanaged, scrubland and woodland species could eventually become established on these fenland sites, changing the nature of the habitat altogether.

Although Godwin finished his experiments in 1940, they were restarted in 1955 for Cambridge University students to study, and are maintained to Godwin’s methodology to this day.

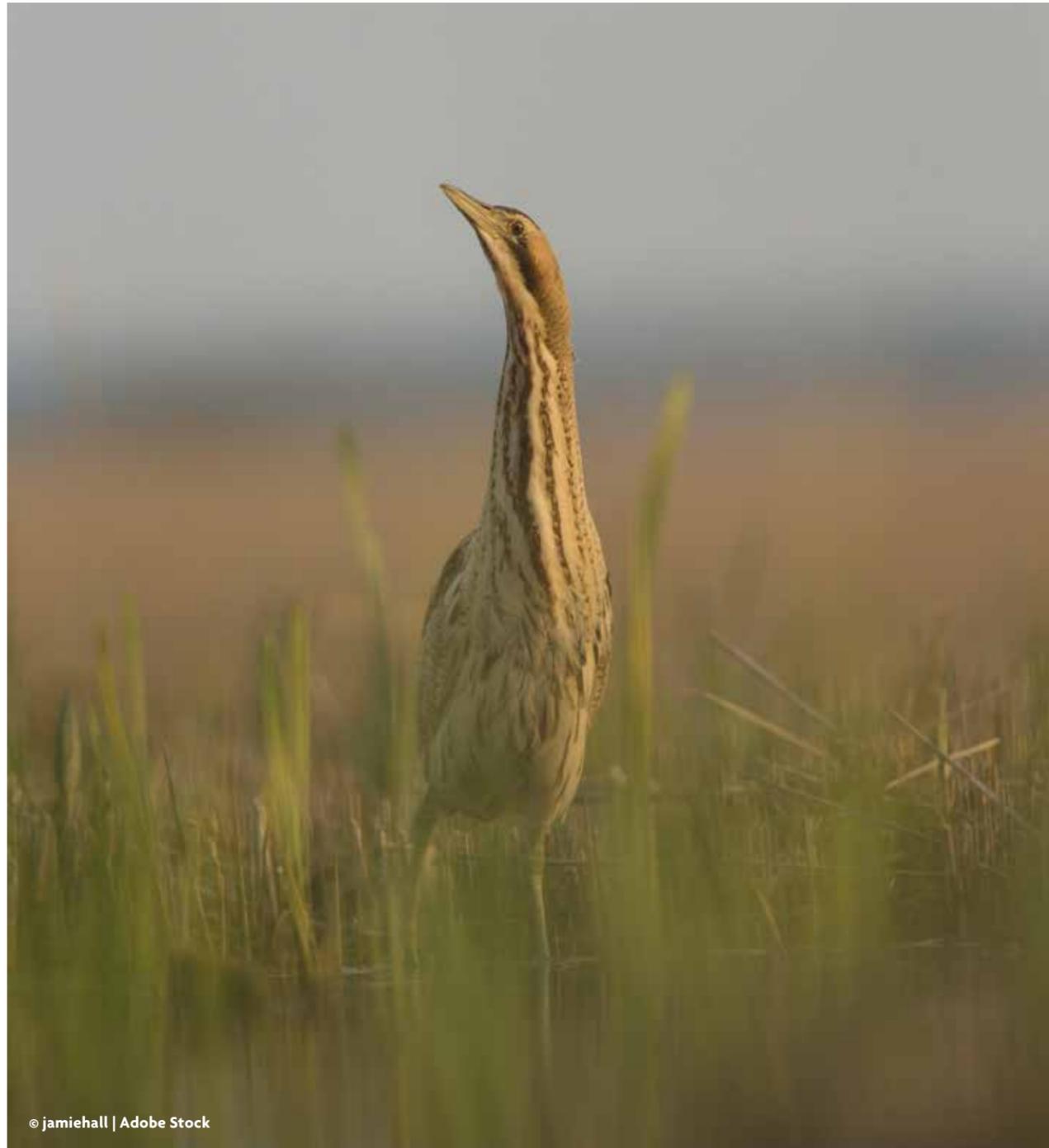
natural. To the analytically aware environmentalist, this clearly challenges assumptions about nature as an entity separate from humanity. We must accept, therefore, that plural conceptions of what is natural exist. These are culturally and socially constructed, but unique to the individual. Once this is recognised, a fundamental question emerges for conservationists, nicely articulated by the scholar James Proctor in 1995: “Whose nature are we conserving?” Or perhaps more importantly, “Whose nature ought we to conserve?”⁶

Trudgill argues that “conserving nature involves management through a plan which expresses preferences, rather than letting nature take its course”. These preferences are rooted in our values, and where individuals, communities or other stakeholders in a place value its nature in different ways, this can lead to conflict, which can take different forms. In the Pacific Northwest, Proctor writes about remnants of ancient forest that are home to populations of the endangered northern spotted owl (*Strix occidentalis caurina*) but are also valuable to the logging industry and therefore important to the livelihoods of many people. In debates about the forest’s conservation status, Proctor observed that disputes often emerge from “divergent ideas about what nature is and should be, what our

role in nature is and should be".⁶ Although politically attractive, it is almost impossible to protect or restore everyone's nature. This means we must negotiate management plans and interventions, seeking cooperation and compromise. To do so, understanding the different ways in which nature can be valued is extremely important.

This is a particularly important factor for scientists to consider in their work. Science gives valuable insights

into system functioning and dynamics. We can model the likely impacts of different interventions and monitor their success with sophisticated techniques and technologies. Science can suggest the most effective and efficient methods to achieve particular conservation goals, and as our understanding of the diverse and fundamental services we derive from natural capital grows, science has an increasingly important role in helping us to establish what these goals should be on regional, national and international



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scales. However, at the local level of individual sites, science alone cannot make conservation a success. When it comes to establishing the preferred state that conservation management is seeking to preserve or recreate, science is only one of multiple narratives that must be considered.

RECREATION AND CONSERVATION

Nature reserves emerged in the UK as part of a movement reacting against urbanisation and limited access to the countryside. Even though early reserves were often managed to exclude people, recreation and protected area conservation are now clearly linked in the UK. This can obviously be a profitable partnership for conservationists, as demonstrated by the huge membership of the UK's environmental non-governmental organisations (NGOs) and the large number of visitors to their reserve estates. The gaze of the recreational birdwatcher or rambler on a nature reserve is also helpful in demonstrating the role of value judgements in conservation management.

Currently, a new and exciting school of nature conservation is emerging, aligned with elements of the rewilding agenda, which focuses on allowing natural processes to reassert themselves (for example at Knepp Castle Estate in West Sussex and Ennerdale Valley in Cumbria). However, such projects are challenging to establish and maintain due to the scale of site required, and so are still small in number. Even in these cases, however, a judgement must be made in order to reach the conclusion that it is this type of nature that stakeholders are seeking to conserve or restore.

Holland and Rawles argue very neatly in a 1993 paper that conservation is about "negotiating the transition from past to future in such a way as to secure the transfer of maximum significance".⁷ The gaze of the recreational environmentalist is perhaps also valuable here in opening our eyes to the depth and diversity of significance that we should be seeking to conserve. To return to my fenland reserve examples, Wicken Fen was originally established to protect a cultural landscape that was rapidly disappearing - this heritage is significant. A threatened habitat, this site and others are home to numerous rare and threatened species of plant and animal, and contribute to a regional network of sites supporting their continued presence and recovery in the UK - these species are significant. Science shows us that these sites provide valuable ecosystem services, from carbon sequestration to flood management and water filtration - these services are certainly significant, if not fundamental to our continued existence! And of course, these sites also provide cultural services, through the recreational opportunities and benefits they provide. As evidence increasingly shows us the importance of access to

the natural environment on our physical and mental health and wellbeing, that is also significant.

To ensure we can achieve the conservation of all of these benefits and services, we must be aware of and alive to alternative understandings of nature and ways of valuing it, to ensure that through our actions, however well intentioned, we do not inadvertently impose our values on the landscape without first properly recognising and considering the values of others. **ES**

Robert Ashcroft is an environmentalist with an interest in conservation, writing and environmental policy. Now in a policy role at Defra, Robert previously spent four years working on policy and publications at the IES and is an Associate Member of the Institution. He is writing in an independent capacity and all views are his own.

 @AshcroftRob

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Andrew Mackintosh describes the benefits and impacts of climbing.

The sport of rock-climbing takes place in very particular places: rocky cliff faces at various angles, boulders, ice-falls and gullies. Like other outdoor sports, it generates environmental impacts, but also brings personal and societal benefits that are in part due to the sport's close connection with the outdoors.

Rock climbing has a long history, with some cliffs in the English Peak and Lake Districts, North Wales and Scotland having been climbed for well over 100 years. Over this time, climbing has developed into a number of strands, including:

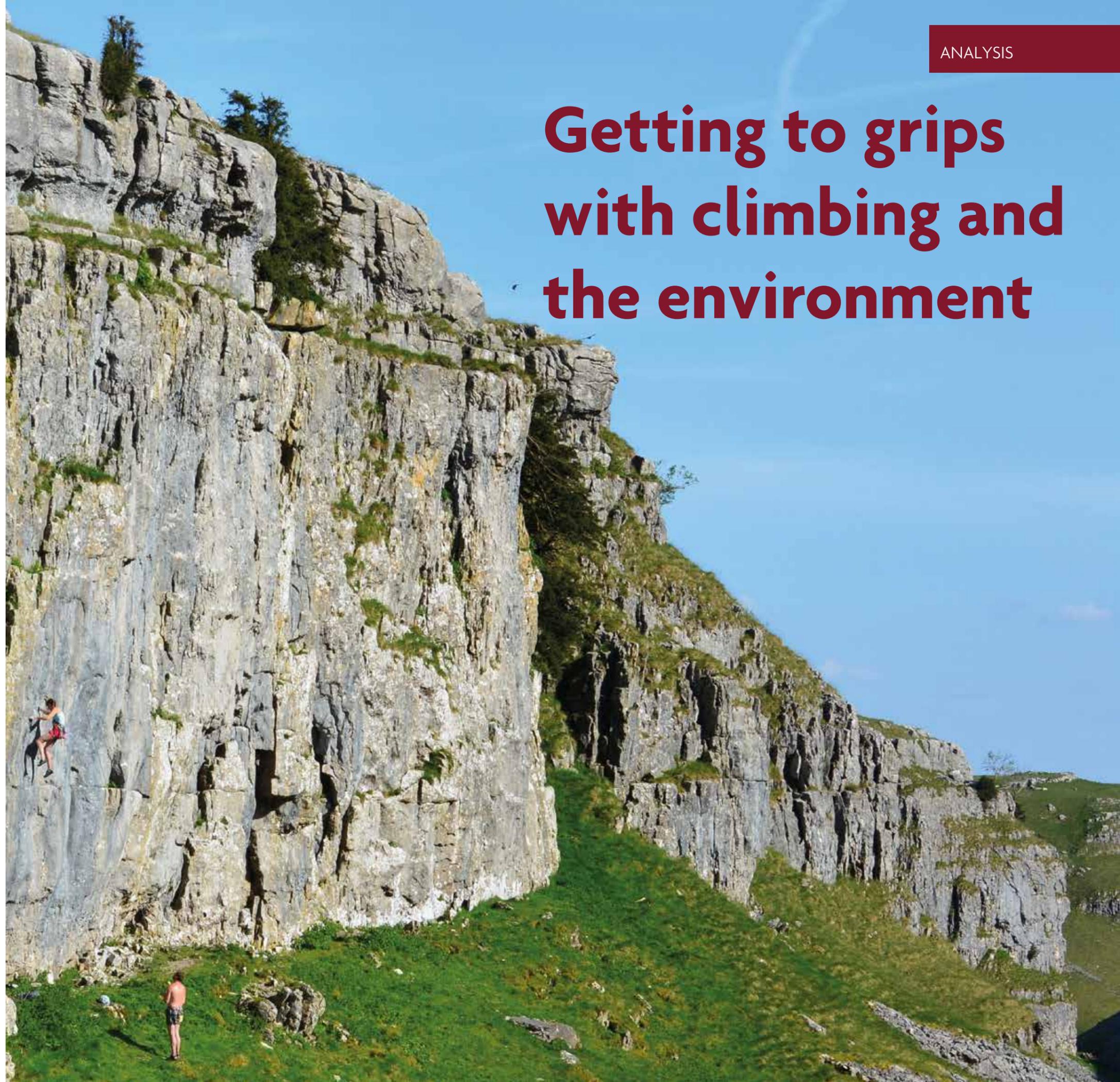
- 'Traditional' rock-climbing: on small or large cliffs, generally using ropes and protection that can be removed during the climb;
- Sport climbing: using fixed gear (bolts) that are preplaced in the rock;
- Bouldering: un-roped climbing on smaller cliffs and boulders; and
- Scrambling: easier climbing that grades into hill walking.

Sport England¹ figures indicate that over 100,000 people go mountaineering every week, with the British Mountaineering Council (BMC) finding that 74 per cent of their 55,000 membership go climbing outdoors.² (Mountaineering is a cover-all term that is generally applied to larger-scale climbing activity within mountainous places but includes elements of rock climbing.)

ENVIRONMENTAL IMPACTS OF CLIMBING

In common with other recreational activities in the outdoors, climbing has a range of impacts on species, habitats and other physical features. Whether these impacts are significant in conservation terms will depend on a range of factors, including the magnitude and frequency of the activity, the sensitivity of the particular cliff environment or species, the type of climbing and the history of the cliffs' usage.

- **Figure 1. Sport climbing on High Stony Bank in North Yorkshire within the Malham-Arncliffe Site of Special Scientific Interest. There is a voluntary restriction in place for avoiding the raven's breeding season. (© A Mackintosh)**



Getting to grips with climbing and the environment



▲ Figure 2. Moughton Nab North Yorkshire. (© A Mackintosh)



▲ Figure 3. Traditional rock-climbing on a mountain crag in North Wales. (© A. Mackintosh)

Potential impacts are most likely to affect:

- Plant species and communities;
- Cliff-dwelling animal species – particularly nesting birds; and
- Geology/geomorphology: erosion of cliff faces, soils etc.

IMPACTS ON VEGETATION

There have been a limited number of climbing-specific studies, mostly in Europe and North America, looking at the impacts of climbing on cliff vegetation communities.

Lowen *et al*³ noted that previous research^{4,5,6} indicated that climbing had negative impacts on plant communities on rock faces and at the base of cliffs: species density, cover and abundance were reduced. Access management, including exclusion areas, might occasionally be required to protect vulnerable species and habitats. However, they also drew attention to findings by Kuntz and Larson⁷ that microsite differences were an important factor, and the selection by sport climbers of less-featured rock faces (i.e. without macro-features such as large ledges, etc) that

supported less vegetation was significant, rather than the lack of cover being mainly attributable to climbing use. In a review of research on climbing impacts, Holzschuh⁸ concluded that abiotic differences between control sites and a low volume of studies made it difficult to draw absolute conclusions about the impacts of climbing on biodiversity. She therefore advised that further research was needed to address these issues and look into the effects of climbing intensity. Another study by Lorite *et al*⁹ concluded that climbing adversely affected species richness, cover and composition, with greater impacts at more-intensely used sites.

IMPACTS ON WILDLIFE

Climbing on cliffs will in places invariably lead to interaction between climbers and species – most commonly birds that use those cliffs for roosting, breeding and nesting. In the UK, climbing outdoors tends to start increasing in spring and can thus coincide with breeding and nesting. Lowen *et al*³ note that the presence of climbers on cliffs with raptors or seabirds in particular is a potential concern for site managers.

In a study in the Alps, Brambilla *et al*¹⁰ found that in comparison to undisturbed sites, the breeding success of peregrines (*Falco peregrinus*) was lower where they co-existed with either ravens (*Corvus corax*) or climbers, but particularly low where both were present.

Ruddock and Whitfield¹¹ studied golden eagles (*Aquila chrysaetos*) in Scotland and noted that whilst climbing activity could potentially reduce site occupancy and thus breeding success, appropriate management of access to reduce disturbance should provide the necessary protection to ensure long-term success.

Holzschuh⁸ noted that further research is needed to understand the variables affecting biodiversity on recreational cliffs and suggested that temporary climbing bans were an easy solution to protecting cliff-breeding birds – this is usually the approach taken by the BMC and relevant conservation bodies. Loeb and Jodice¹² observed that some bat species will make use of cliffs for roosting and foraging, but found no negative impacts associated with climbing where this took place on bat-roosting sites in the eastern USA. Nevertheless, they did recommend more research in this area.

EROSION

Clearing rock faces of vegetation for climbing obviously equates to accelerated erosion of a cliff environment as opposed to the more-or-less gradual erosion by the climbing activity itself, or in the absence of activity. Erosion takes place around the bases of cliffs and on the approach and descent paths, with potentially vulnerable surfaces including screes and fragile soils on ledges, cliff tops and gullies. Bringing a cliff, or section of an existing cliff into use for sport or traditional climbing sometimes entails clearing loose rock and vegetation to make climbing possible. The significance of the impact will depend on the amount of clearance and the status and characteristics of the species themselves.

Whilst it is clear that rock climbing can potentially have a negative impact in terms of erosion, it seems important to take into account whether the cliff is either newly in use or has been climbed on for a long time. On well-established cliffs, where climbing may have taken place for many decades, the impact of current climbing activity may have reached a steady state.

THE BENEFITS OF CLIMBING

Outdoor climbing entails being active in the natural environment and for many, if not most, climbing in the outdoors – for the views, situations and natural beauty of their surroundings – is a significant part of the sport.

The BMC, as the national body that represents climbing in England and Wales, actively campaigns



▲ Figure 4. Trow Gill North Yorkshire. (© A Mackintosh)

on a range of environmental issues including public access, erosion control and inputs to national policy consultations. It identifies a number of benefits in taking part in climbing, including:¹³

Physical health: climbing is an active sport and being physically fitter generally can reduce the risk of major illnesses, improve immune systems, combat obesity, and increase quality of life and life expectancy.

Mental health: outdoor activity can help to reduce stress and anxiety, and improve mental agility, self-esteem and overall wellbeing.

Engagement with the natural environment: current government policy in England seeks to encourage people to connect with nature for the health, wellbeing and social benefits this can bring.

Climbers certainly do actively engage with their sport's environment and volunteer to monitor bat populations and bird species, including peregrines in South West England, and regularly help in conservation management work on or around the cliffs they climb. There is also a keen awareness of wider landscape and environmental issues and involvement in environmental campaigns.

Many upland areas – often contiguous with National Parks – rely on the visitor economy, and the outdoor sports/recreation industry is of particular significance in these areas. Sport England¹⁴ estimated that the value of the climbing, mountaineering and walking sector in 2015 was £3.2 billion per year.

MANAGEMENT AND GOOD PRACTICE

Throughout England and Wales, the management of cliffs to minimise the impact of climbing usually takes the form of BMC-initiated voluntary access agreements, mainly for bird species, where the BMC advises its membership to adhere to temporal and area restrictions in agreement with the relevant conservation body.

Examples of restrictions include avoiding the nesting sites for peregrines on a range of lowland and upland sites, ring ouzels (*Turdus torquatus*) on Stanage Edge in Derbyshire (see **Box 1**) and various seabirds on cliffs around the English and Welsh coastlines. The approach is less frequently used to protect vegetation, but agreements are in place that define and/or limit where climbers can start using new sections of cliff on protected sites.

Typically, an agreement will define an agreed time period of weeks or months to enable site selection and nesting to take place and will define the area affected; i.e. the whole of parts of a cliff or buttress.



BOX 1: EXAMPLES OF MANAGEMENT & GOOD PRACTICE

Ring ouzels, Stanage Edge: Stanage Edge in the Derbyshire Peak District is probably the single most popular cliff in the country and has been climbed for over 100 years. It has thousands of visitors each weekend throughout the year, including walkers and bike riders.

The cliff is within the Eastern Peak District Moor SSSI and a breeding site for the ring ouzel, a Red List bird, whose numbers have been in steep decline. A migratory African bird, it favours moorland vegetation (heather [*Erica* spp., *Calluna* spp.], bracken [*Pteridium aquilinum*], bilberry [*Vaccinium myrtillus*]) for nesting but can be easily disturbed by nearby climbers and walkers.

The BMC, in partnership with the Peak District National Park,¹⁷ the Eastern Moors partnership and volunteers, helps to run and advertise an access-restriction regime during the breeding season.

Mend our Mountains campaign: mountainous areas used by climbers, mountaineers, riders and walkers are increasingly popular places to visit. This pressure, combined with fragile soils and habitats, often-extreme weather conditions – at risk of intensification by current climatic trends – results in high levels of path erosion, soil loss and visual scarring of valued landscapes.

Recent major storm events, particularly those affecting the Lake District in 2015, have exacerbated this problem, with extensive damage to path networks eroding surfaces and destroying associated structures. Government funding has been available for local authorities but budget cuts and scarce resources generally mean that the issue remains a major problem.

Mend Our Mountains is a BMC-led collaborative crowd-funding project aimed at repairing and enhancing eroded public paths and associated structures within National Parks. It raised over £100,000 in 2016 and a second campaign is aiming to raise £1 million, to be targeted on erosion-control works.¹⁸

Once the breeding period is over, the restriction may be lifted in agreement with the management body, such as Natural England.

The restriction is communicated via the BMC Regional Access Database (RAD) website¹⁵ and via a mobile phone app, and information about long-standing restrictions will also appear in climbing guide books in their access and conservation sections.

This approach relies on good working relationships and a bit of give-and-take on both sides, and generally works well throughout the country, with few reported problems. The conservation bodies such as Natural England have to be mindful of their statutory duties in protecting habitats and species, and the BMC seeks to carry their membership with them by demonstrating that restrictions are fair and evidence-based, whilst adhering to the principle of *least restrictive access* – an approach also adopted by Natural England with its statutory commitment to promoting public access to the countryside.

Voluntary restrictions are a key part of the BMC *Environmental Policy and Action Plan*¹⁶ which, as well as general policies on sustainability, energy and transport, has specific conservation policies on reducing climber impacts and supporting the protection of protected species. In addition to this, the organisation publishes area Green Guides, which provide details of nature conservation interest and good practice when climbing in the areas covered.

The BMC is also a land-owner and owns two cliffs on a site of special scientific interest (SSSI). It is thus required to manage them in accordance with their statutory designation and agreed management regime.

CONCLUSION

Rock climbing in all its outdoor forms is clearly an activity that entails a relationship between those doing it and the outdoor environment, and like other similar activities, participation engenders impacts and benefits.

There appears to be little available research in England and Wales on the nature of the impacts and the specific benefits of climbing, but reported problems are few and existing management agreements and processes, by and large, seem to work well. It is also clear that climbing has benefits for the individual, local economies and in terms of promoting environmental behaviours and engagement.

Maintaining and continuing to develop an evidenced-based, balanced approach to managing climbing, whilst retaining the principle of least restrictive access, should enable people to continue to enjoy the sport whilst continuing to protect vulnerable environmental features characteristic of cliff environments. **ES**

Andrew Mackintosh is a Senior Specialist for Public Access and Recreation at Natural England, advising mainly on the interaction of public access, biodiversity and landscape issues. He has previously worked as a public footpath officer and a nature reserve warden, and has been an active climber for over 35 years.

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Riding the sustainability wave: Surfing and environmentalism

Gregory Borne shows that engagement with nature can lead to pro-environmental behaviours.

There is a myriad of reasons why the relationship between surfing and sustainability is an attractive focus for academic study. The relationship between cultural and subcultural dynamics, the transition of the multibillion-pound surfing industry to sustainable business models, or the technological developments that create artificial wave environments that challenge our very perception of what is natural are just a few deep academic topics to dive in to.

THE SURFER-ENVIRONMENT PARADOX

The sheer raw beauty of the act of surfing engages millions of people all over the world. The direct contact with a wave and the hours spent immersed in nature surely means that surfers are more environmentally aware than the general population? Could surfers act as environmental stewards and leaders? Do they act as the 'canaries in the coal mine', highlighting oceanic pollution and the impacts of climate change?

Anecdotally, this proposition is supported by groups such as Surfers Against Sewage, who have successfully changed legislation, lobbied government and mobilised thousands of people across the country to engage in environmental actions such as beach cleans.

Unfortunately, there is little empirical evidence to support this proposition. Indeed, it has been observed that there is a tension within surfing between individualism and broader engagement, which makes it important to understand competing values and motivations. The surfing industry relies on the production, packaging and distribution of consumer products, it relies on the production of surfboards and wetsuits that contain toxic and polluting materials. The following discussion explores the research that has sought to address this paradox and tensions within the surfing community.

THE VALUE-ACTION GAP

It is worth briefly outlining some of the broader debates that relate to environmental knowledge and action. The question of whether direct engagement with nature, not only promotes environmental awareness but also engenders individuals to undertake pro-environmental behaviours has received increased academic attention. The research suggests that raised awareness of the environment and environmental issues does not necessarily translate into environmental action on a personal or societal level; this is termed the 'value-action gap'.

A review of the academic literature points to a complex process that engages socio-psychological insights that change according to the geographical location, cultural context, age range and gender category. Nevertheless, there is an emerging consistency in the data that points

to the important influence of direct engagement with nature on pro-environmental behaviours. Whether on land or in the ocean, there is increasing evidence that outdoor pursuits have a significant impact on an individual's relationship with the environment and their action towards it. However, the question of what creates pro-environmental behaviour is so complex that no single model can appropriately express the multitude of variables involved.

Work relating to environmental attitudes and behaviours frequently follows Schwartz's norm-activation theory¹ and the application of the altruistic behaviour concept.² Norm-activation theory highlights the importance of such factors as values, perceived consequences of behaviour, ascription of responsibility or control attribution. The altruistic behaviour concept focuses on personal norms, feelings of moral obligation and altruism. Schwartz went on to argue that values in society are ordered along two pivotal dimensions. The first extends from the self-enhancement pole (which relates to self-interest) to the self-transcendence pole (which relates to altruism).³ The second dimension contrasts analysis associated with openness to change with conservative values.

These insights combine with an acknowledgement that perceptions of nature alter significantly and are highly contextual.^{4,5} With these observations in mind, research indicates that engagement with nature can enhance pro-environmental behaviours. The underlying premise is that engagement and identification with nature promote not only an awareness of environmental issues but also a personal sense of stewardship and protection that translates into pro-environmental behaviour. For example, Larson *et al.* (2010), looking at outdoor recreation in state parks, concluded that outdoor recreation does impact environmental behaviours.⁶

Situational variables are also important in exploring environmental behaviours. Proshansky *et al.* (1983) claimed that humans, through their interactions with the physical environment, develop a cognitive structure representing memories, ideas, feelings, attitudes, values, preferences, meanings and conceptions of behaviour and experience related to the physical environment.⁷ Proshansky's place-identity concept relates to a system of references to the environment that are constructed by the individual over time. Another term in the literature that has been used to describe bonding to an environmental setting is 'place attachment'.⁸ Together these terms enable the construction of environmental identity and attachment, not just at the local level but also through an expanded global awareness.

ENGAGING THE SURFING COMMUNITY

Our research⁹ took the form of a broad-based survey conducted in partnership with a not-for-profit organisation based in the USA, Sustainable Surf.



This organisation has had a significant impact over the past six years in moving the surfing industry towards a more sustainable operating model. The survey was open on the Sustainable Surf website from June 2017 until January 2018. Participation were encouraged through a prize of a surfboard. There were 575 responses from people in 35 countries. The vast majority surfed and felt that being in nature was the most significant motivating factor. This was ranked higher than friendship, exercise or having fun, though these also scored highly.

“Whether on land or in the ocean, there is increasing evidence that outdoor pursuits have a significant impact on an individual's relationship with the environment and their action towards it.”

The majority of participants indicated that they engaged with surf culture such as surf media, films and clothing. Overwhelmingly, they pursued other outdoor activities. All respondents considered themselves to be environmentally aware, and over 80 per cent indicated that they felt that it was the act of surfing that made them more environmentally aware. Equally significant was that respondents felt they behaved in an environmentally-friendly manner. When asked what respondents felt were the main barriers to doing so, infrastructure was the most significant, followed by money and information. Initial insights indicated that, as a subgroup of recreational ocean users, surfers were not only engaged with nature, aware of environmental issues, but also translated these into action.

Evoking environmental concern through risk association is identified as a prominent factor in activating behaviour and engaging the general public¹⁰. The research presented surfers with several sustainability risks, including climate change, ozone depletion, biodiversity loss, carbon footprint, ocean acidification, marine plastics and sea-level rise. There was a high level of awareness of these risks, again pointing to an engaged population with a propensity to act in a positive way in order to mitigate against or adapt to these risks.

COMMUNITY AND PLACE ATTACHMENT

Community and place attachment have been identified as significant variables in connection with environmental behaviours. This is particularly pertinent in light of the processes associated with



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globalisation and the exponential growth of interactive web technologies, mediums and platforms. Focusing on community as a variable of analysis within the research therefore allowed insights into how surfers understand their position within global networks. Overwhelmingly, the research indicated that surfers felt that they were part of more than one community. These communities included family and friends, hobbies, work and more, and were not seen as being geographically fixed, but combining local and global elements. The global connection resonated strongly with their perception of the environment: participants indicated that they were most concerned with the environment, followed by health and education; the economy and crime were of lower priority. The majority also said the environment was important in their everyday lives.

OCEAN CONNECTION

A significant component of the research sought to establish the impact of the ocean on environmental awareness and action. Most of the surfers in the research displayed very high concern for the health of the oceans, and the act of surfing increased their interest in protecting it. Direct connections were also made with their wellbeing – a reduction in the quality of the ocean environment directly impacted their own wellbeing. This connection to the self is important, as it addresses the tension between individualism and broader action.

RESPONSIBILITY

It has been argued that feelings of responsibility are intimately tied to an individual's ability to act in a pro-environmental manner. The research therefore sought to establish who participants felt was responsible for environmental problems. The majority placed responsibility on everyone, followed by several closely related issues (corporations, government, the economic system then the general public) indicating a diverse assignment of blame for current environmental issues. Over a third of participants said that they themselves were responsible. This result presented a certain level of contradiction within the data: this self-responsibility versus a transfer of responsibility from the individual to a more generalised understanding of responsibility ('everybody').

CONCLUSION

Overall the results suggest a highly environmentally engaged and motivated group. There was consistency in relation to being engaged with nature through surfing and a resultant raising of awareness and environmental action. Participants identified strongly with nature in their everyday lives and overwhelmingly indicated that the act of surfing contributed towards this engagement. There was also a strong engagement with multiple communities, both locally and globally. Respondents also identified strongly with the ocean at a personal level.

The results present just a glimpse of one outdoor recreational groups' engagement with the environment. This snapshot – part of a broader research project conducted over six years on three continents¹⁰ – contributes to an emerging body of evidence of the ability of environmental recreation within natural environments to foster the right conditions to engage and motivate people to think more meaningfully about their everyday actions and the impact these have. **ES**

Gregory Borne is a Senior Lecturer at Plymouth Marjon University and the Director of the Plymouth Sustainability and Surfing Research Group. His research focuses on multiple dimensions of sustainable development at both the global and local levels. Gregory is the author of four books, the most recent of which explores the relationship between surfing and sustainability. His next book is examining the relevance of the Sustainable Development Goals to local communities with an emphasis on parish councils.

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Shooting to protect

Paddy Fowler talks to **Tim Flach** about the process of taking photographs for his most recent book and exhibition, *Endangered*.

Tim Flach is a photographer based in London. He describes himself as an animal photographer rather than a wildlife photographer because he is most interested in how we, as humans, engage with animal imagery and how that engagement can be used in visual storytelling, particularly in relation to conservation.

We spoke to Tim about his latest project and the role photographers play in protecting the environment they catalogue.

Your latest photographic book project, *Endangered*, shows us animals on the edge of extinction. While in other projects you often captured your animal subjects in a studio setting, in *Endangered* you physically had to go out to meet the animals in their natural habitat. Why did you choose that approach for this project?

For the most part, I had no option but to photograph the animals in their habitat, as they could not be found in zoos or could not be brought into the studio. When I started looking into producing a book on endangered animals, I was most interested in how to tell stories strongly and how to connect with people to create the desired change. I started by looking at research conducted by people such as Professor Linda Kalof,¹ who has investigated the effect of pictures of animals against plain backgrounds as opposed to in their natural settings. From meaning maps (pre- and post-exhibition evaluation tools used to analyse emotions), it was found that people were more likely to find a sense of kinship when the animals were represented in a style that is culturally associated with human portraiture. Has the environmental movement unwittingly separated us from the connection to wildlife by removing the emotional connection to other living things, by often creating a distant non-human world?

This influenced my approach for my book: I could create images that created character, personality and engagement with empathy as a priority. This is contrary to traditional wildlife programming, which seeks to make manufactured situations look real – I do the opposite and make it look as if the photographs are taken in a studio when they are actually taken in the natural environment.

The anthropomorphisation of animals has often been shunned by the scientific community – romanticised depictions of animals in beautiful picturesque habitats. Why have you chosen to include emotive images in this series?

We often view words such as ‘anthropomorphism’ in a derogatory way. The word originally came from giving human attributes to the gods and it was later used to interpret human characteristics in animals. In practice, it isn’t often us seeing the human manifest in an animal, but seeing our world in theirs, our communication and social structure. This is more linked to anthropocentrism, the way we look outwards from a human perspective and apply this to the outside world. So, we see something, for example, in a photograph of an albatross by Chris Jordan² in which he shows the plastics within the carcass to show the result of their presence inside the animal. What brings it home is not only the carcass of the dead animal, but that you can identify all the bottle tops that we see in our fridge. The great challenge, I believe, isn’t humanising animals but bringing the sense of otherness to a sense of sameness, showing their world colliding with ours – this is the distinction I want to bring forward.

I think the word ‘kinship’ is interesting because it suggests that we are part of an extended family and that we have that sense of shared commonality. Obviously, we already live in a world that is so separate from the one that our ancestors inhabited, our digital world is vastly different from theirs and we are moving further and further away from the more natural world in which they lived. I think of the Cambridge study³ in which children of 4–12 years old were asked to identify British wildlife from images. Perhaps unsurprisingly, they could identify more Pokémon characters than British wildlife. I think it is quite clear that unless we culturally redefine our relationship with nature, humanity doesn’t have a future.

For us to really be touched by the stories and to engage with what is often difficult scientific information, we need emotion. It was George Schaller who said, “you can do the best science in the world, but unless emotion is engaged it is not very relevant”.⁴ I take this on board. I really think that as artists we should work more collaboratively with scientists to connect the subconscious and the conscious, to take these things that really touch people and create the desired change.

The photography of endangered animals shares a number of traits with hunting, including terminology and techniques (shoot, tracking shot, stalking, camera traps etc.). As the hobby of hunting, especially of rare and endangered species, continues to decline in popularity, is the photography of rare animals taking its place, with the perfect photographic ‘shot’ replacing the perfect ‘shot’ to mount on the wall?

We also see many projects in conservation where there is a change in how a community interacts with nature, often where outsiders have brought wealth into a local community. I remember one project where raptors following certain flight paths through a community were being decimated by hunting groups that were bringing money into the community, but it was clearly unsustainable. Now they have a much more sustainable revenue, as ecotourists are encouraged to take photos of the birds on their migratory journey. This change happened in a matter of years, so the local hotels filled up quickly and money poured into this particular village. There was a clear changeover from killing to photography, which offered a different type of tourism without impacting the revenue of the local community.

Clearly, we are in a time when we take pictures to prove that we were in front of a rare animal. It is certainly not a new subject area. Susan Sontag wrote about the topic in the 1970s in the book *On Photography*⁵. She mused on using long lenses to shoot animals on safari versus the traditions of shooting the animals. Even I say I go out to shoot animals when I am on a photography trip – in fact, I am often questioned about whether I am actually shooting animals when travelling. I think that it almost





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goes back to our primordial sense of the adventure in finding the animal, tracking, stalking etc.

A number of the species you have photographed in *Endangered* are in their situation because of climate change and other human-linked destruction of habitats. What impact do you think an increase in tourism for photography to these areas will have on their recovery, in terms of the impact of travel and the presence of more humans in their habitat?

I think that one of the greatest challenges we have is land-use change. Here we are in the sixth extinction, so how do we go forward and make better decisions? Having spent quite a lot of my time in other parts of the world, where half the people live on less than the equivalent of £1.50 a day, it is naïve to think that with good governance they won't just use the land for livestock, leaving that land with no ecological system in place. So I would say that I'm not suggesting the trade-off is the right one, but the trade-off where we have pristine forests with ecotourism instead of those forests being logged and turned over to livestock is a much better option even if there is an ecotourism impact.

Of all the mammals on Earth, humans contribute 36 per cent to the overall biomass, livestock 60 per cent and wild animals make up only 4 per cent.⁶ That puts things into perspective. It is undeniable that ecotourism can harm the environment, but we are dealing with just trying to save areas from land-use change and turning wild habitats over to pasture. If we don't value the ecosystems and culturally redefine our relationship with them, are we going to be able to make that desired change?

Many governments, on the surface, sound as if they are concerned about protecting ecosystems, but this is often driven by economic interests. We have really got to concentrate on the big picture and avoid a certain degree of sentiment in certain situations and really try to work out how we can move forward in an intelligent way. To really connect with the influences of the planet, whether financial, political, economic or artistic, we must have cohesion; without this, we do not have a future.

Victorian collections of rare and exotic animals were instrumental in scientific advances. Today the focus is less on discovery and more on the recovery of rare and endangered species; what part do you think photography plays in the conservation of endangered species?

We are living in the age of the ascendance of the image – photographs have a more important role to play than they have ever had before. So, interestingly, when you look at the many different image makers out there, there are more exploring the connection between people and the natural world in the last few years than in history. We are seeing a seismic shift, this is happening quickly and must do so to address the challenges we face. Can

we respond fast enough and with enough urgency? Will we know when we reach the tipping point?

In *Endangered*, you have not only focused on the popular endangered species, but also on the less-charismatic faces of the endangered species world. What was the reason for including these less-attractive yet equally endangered species?

When I was looking at the ecological drivers, I didn't take a picture for at least three months, while doing research. All I did was speak to people, not just conservationists but communicators for conservation organisations too. They were, in a sense, relaying to me the disappointments and failures that they had experienced, that certain types of image don't reach certain people and that other images do. I also asked people what must-haves I needed in the book, what stories needed to be told – climate change, land-use change, coral, vultures, pangolins, saigas – all these are stories that you have to tell. I wanted to represent some of the key stories within the 300 pages of the book. It only contains 160 images – clearly we had to pick the candidates carefully. For example, the pied tamarin (which comes from Manos in South America and is largely unknown), actually looks a lot like Yoda, so instead of an animal, you see *Star Wars*.

The insects were included as they are the small majority. Clearly, they are incredibly important but also you have got to look at the cultural relationship of how we transform animals that are very familiar to us. I needed to show the Lord Howe Island stick insect, once thought extinct then rediscovered in a bush on a rocky outcrop not far from the island itself. Conversely, I included pandas in the book to be able to talk about the fact that we give a strong cultural meaning to pandas and their link to conservation. The animals were chosen to represent storytelling around different ecological drivers, rather than simply taking the most exotic and beautiful animals and putting them in a book.

Continuing from that, were there any animals that you personally wanted to include in the project?

Well, I had must-haves rather than would-likes – for a book you need to have the really key stories to build from. People would constantly tell me that I must look at saigas, but the saigas were not easy to get hold of as they are not kept in captivity and their numbers are very low. I had to pursue them as a really key animal to include.

Has producing *Endangered* changed the way you take photographs of other animals?

In terms of how I take pictures and the influences on my work, each project is like a journey. You forget things and learn new things. The key is that when you are introduced to what is happening out there, in nature, you can't ignore it.



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When talking about *Endangered*, I am often asked why I chose to involve science in my practice. When you see the reality of the situation some of these animals are in, there is no option but to pursue that journey. I am a different person for going on the journey and witnessing these animals on the edge of extinction around the world. Meeting the people around the issues and understanding the situations that many of these animals are in, such as where the populations of vultures or pangolins had collapsed, you can't really go back because you're a different person with that knowledge. I am more mindful of where we are going and how we plan to go about it.

Where do you see the future of photography and how we tackle the problems you have mentioned today?

One of the areas where we are seeing massive changes in our understanding is in neuroscience. There are certain traits that we often react to before rational thought. A study undertaken at Oxford University⁷ showed that our reaction to cuteness is faster than we could have imagined. This can give us a better understanding of how we interpret images. Speaking to scientists makes me a more effective communicator as I am able to use their research in the creation of images.



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When you are a visual communicator, in a sense you have got to be thinking about whether you want to reach the unbeliever, or what you may call the egotist, compared to the altruist. The altruist is always easy to bring on board and they will back you up on a campaign: when they see an image of a polar bear foraging, they'll help it to gain traction in the public sphere. It is the egotist that you really want to start to engage with through the storytelling and emotion. So understanding the very mechanisms of visual communication allows us the possibility of engaging them with the visual storytelling before they have a conscious thought and a chance to think otherwise. **ES**

Tim Flach has published five books: *Endangered*, *Evolution*, *More Than Human*, *Dogs Gods and Equus*. He can be found at www.timflach.com and on instagram at @timflachphotography. Tim was interviewed by **Paddy Fowler**, Publications Officer at the Institution of Environmental Sciences.

Page(s)	Species	Conservation status
58–59	Monarch butterfly cluster	G4*
61	Polar bear	VU
62	Crowned sifaka	EN
64 △	Pied tamarin	EN
64 ▽	Lord Howe Island stick insect	CR
65	Saiga antelope	CR
66	Axolotl	CR

*The species is not currently listed on the IUCN Red List, however, their numbers are in significant decline and the clustering phenomenon is becoming rarer every year.

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