

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Protected Landscapes Amidst the Heat of Climate Change Policy

Paul Sinnadurai

Brecon Beacons National Park Authority

Wales

United Kingdom

1. Introduction

The arguments in favour of maintaining, improving and extending the global Protected Area network, which includes Protected Landscapes, statutory nature reserves, biosphere reserves and other designated sites, are rehearsed regularly (Bass et al., 2010; Boitani et al., 2008; Brooks et al., 2010; Dudley et al., 2010; Jackson et al., 2009; Janssen, 2009; Kharouba and Kerr, 2010; and Leroux et al., 2010). Protected Areas are increasingly designated in places that maintain a significant proportion of national biodiversity, protect watersheds, soil carbon stores and indigenous food production. Consequently they maintain livelihoods and communities where resilience is linked to environmental goods and services. Where evidence emerges that biodiversity conservation is a central tenet of efforts to mitigate and adapt to the effects of human-induced climate change (EASAC, 2009, TEEB, 2010), a natural and logical conclusion is that Protected Areas themselves have a significant role to play in national climate change mitigation and adaptation strategies.

The Protected Landscapes in Britain (National Parks and Areas of Outstanding Natural Beauty), have a provenance that is based upon landscape and access to the countryside. The demand for open access to the countryside and protection of it grew during the nineteenth century as the Industrial Revolution produced a rapid urbanisation and industrialisation of the British landscape. Campaigns and demonstrations in favour of access to the countryside, of having access to large open spaces to experience the freedom and exhilaration provided by regions now designated as National Parks, lead to a landmark Act of Parliament¹. During subsequent decades this saw the designation of ten National Parks in England and Wales, an additional Act of Parliament to designate the Norfolk and Suffolk Broads as an equivalent status landscape, the establishment of lobbying bodies and the passing of further legislation² to give National Park Authorities autonomy within local government.

There are now fifteen National Parks in Wales, Scotland and England covering about 10% of the land by area. Being relatively large areas within the context of Britain, and having been designated in order to preserve the majesty and beauty of some of the most rugged landscapes and coastal areas, it is no coincidence that they are dominated by upland and mountainous terrain. They therefore support significant tracts of biodiversity (ENPAA,

¹ 1949 National Parks and Access to the Countryside Act.

² 1995 Environment Act

2010), which are also present in the lowland and coastal National Parks. Their geographical positions mean that they possess examples of most or all of the principal habitats and species of importance for biodiversity conservation in Britain, as well as the highest and lowest areas above sea level, the warmest and coldest, wettest and driest climates. This combination of significant tracts of land rich in biodiversity, exposure to meteorological extremes and additionally the coincidence of the upland National Parks in Britain with the Less Favoured Areas³, mean that they are ecologically and economically at least as vulnerable as other regions in Britain, if not more so, to the adverse effects of climate change. Rural resilience and the ability to respond effectively to the effects of climate change are put under still greater strain by the inherently high ecological footprint⁴ of rural life in National Parks (Dawkins et al., 2008).

Just as it is for Protected Areas elsewhere in the world, it is equally logical that National Parks in Britain have a significant role to play in national climate change mitigation and adaptation strategies. Being less urbanised and maintaining larger tracts of open hill, contiguous agricultural land, forestry, wetlands and undeveloped coastline than elsewhere in Britain, they can serve as 'environmental barometers of change' and test beds for new approaches to mitigating and adapting to climate change. This argument is repeatedly well made by the bodies representing National Park Authorities in Britain, yet it is largely unheeded at a national policy level. This Chapter examines the policy tensions that now impinge upon the National Parks and the Authorities charged with overseeing their management. These tensions stem from the historic purposes of the Parks and the modern purposes to which they can be put and which are being asked of the National Park Authorities but for which they are not yet well-enough equipped or supported to do so. It takes the reader 'under the bonnet' of the struggle to maintain the National Parks whilst at the same time meeting the new challenges whilst encumbered with tools of the trade from a post-war era. The Chapter is written from the viewpoint of a professional ecologist who has observed the conservation agenda evolve rapidly, from within an organisation and institutional framework that changes more slowly.

As a policy issue, climate change has seemingly rushed in on protected landscape management priorities, which gives rise to uncertainties over whether the current issues such as biodiversity conservation are being met satisfactorily (National Assembly for Wales, 2011) whilst new issues threaten to push them aside. National Park Authorities face the same challenge during the coming 50 years as they faced in the past, namely to retain the quality and value of the Park landscapes as their character evolves and new pressures arrive. Additional challenges arise from the emerging evidence of the cross-cutting societal value of biodiversity conservation and the cross-cutting societal risks posed by climate change, requiring a wider and deeper skill set to be deployed in National Park management than has traditionally been required. A question is ever-present, that of whether such skills

³ Less Favoured Areas are mainly upland regions within the European Union that are designated for special economic attention under the Common Agricultural Policy by virtue of their natural characteristics (geology, altitude, climate, etc.), which put farmers at an economic disadvantage.

⁴ Measured as global hectares per capita, the biological ecological footprint (i.e., the amount actually available on the Earth per person) is 1.8 global hectares per capita (Dawkins et al. 2008). The actual figure for the USA is 9.6, for China 1.6, for Brazil 2.1 and the global average is 2.2. For Wales it was 5.16 in 2003 and rose (at a 1.5% annual rate in line with trends elsewhere in Britain) to 5.25 in 2005. Based upon figures listed for the counties in which the National Park sits, it is 5.3 to 5.46 global ha/capita in the Brecon Beacons National Park.

can or must be provided within and by the public sector or whether there is more to be gained by forging new partnerships within the commercial and private sectors and more significantly still, within the communities that live and work within the Parks?

This Chapter does not aim to discuss the technical issues surrounding the physical and biological receptors of climate change such as conserving carbon-rich peat, managing wetland ecosystems, understanding upland carbon budgets and fluxes, adjusting habitat management in response to climate change or the societal benefits from doing so. This is elegantly discussed elsewhere (Clark et al., 2010). The potential value to society from defining a stronger role for National Parks in adapting to the effects of climate change in Britain has been discussed (Sinnadurai, 2008) and is revisited here.

2. Invisible landscape sentinels; Britain's national parks

In accordance with categories established by the International Union for the Conservation of Nature (IUCN), National Parks and Areas of Outstanding Natural Beauty (AONBs) in Britain are Category V Protected Landscapes (Lucas, 1992; Phillips, 2002). As such, they are managed for their contribution to landscape and seascape; conservation and recreation are especially dedicated to the protection and maintenance of both biological diversity and natural and associated cultural resources; and they are managed through legal and other effective means (local action, projects and policy). The aim throughout the world where Category V Landscapes have been designated is to spread the value and achievements of management to areas beyond their boundaries, ensuring that the people who live and work within them are fully involved and benefiting from their management. This aim is underpinned by Category V management principles set down by the IUCN (Phillips, 2002), which in summary are as follows:

- Landscape, biodiversity and cultural values are at the heart of conservation
- Management should occur at the intersection between people and nature
- People are stewards of the landscape
- People should be central to all management
- Management should be co-operative and multi-stakeholder
- Good management requires good political and economic support
- Enhancement is as important as protection
- In cases of irreconcilable conflict, priority should be given to retaining the special qualities of an area
- Economic activities not essential to the area should take place outside it
- Management should be highly professional and business-like
- Management should be flexible and adaptive
- Successful management should be measured in environmental and social terms.

All of these principles lend themselves to developing effective local and regional responses to climate change. They encompass all aspects of landscape management, require local people to be closely involved in and wherever possible leading management, they seek to avoid activities that are inappropriate in nature and scale, they require professional and flexible business management, they require improvements as a consequence of management and they account for social as well as environmental benefits. They are suited to influencing the behaviour of people in a positive and progressive, self-helping way so that rural resilience to the potentially undermining effects of climate change is nurtured and enhanced. As well as the physical raw materials within National Parks, the management

principles provide the building blocks for successful responses to climate change. However, they post-date the statutory purposes for which National Parks were designated:

The first purpose is to conserve and enhance the natural beauty, wildlife and cultural heritage of the National Parks.

The second purpose is to promote opportunities for the understanding and enjoyment of the special qualities (of the Parks) by the public.⁵

In pursuance of these purposes, National Park Authorities have a duty to seek to foster the economic and social well-being of local communities within the National Parks by working closely with the agencies and local authorities responsible for these matters. This duty brings the purposes closer to the management principles but it does not 'drill down' to achieving the self-help and self-determination that is expressed by them. Consequently, conservation work tends to resemble that undertaken by other conservation organisations working to different but overlapping remits centred on biodiversity conservation. Within National Park Authorities, ecologists and biodiversity officers work within the broad family of conservationists that includes statutory agencies, national and regional trusts and non-governmental organisations. This perhaps represents an absence of a distinctive approach within National Parks (where the other organisations are also active) and leaves room for adjustment in closer pursuance of the management principles. Currently, species and habitat conservation projects, farm-based conservation, historic landscape conservation and built environment conservation work are interchangeable with that undertaken by other organisations, with National Park Authorities providing an extra pool of staff to fulfil a common end.

In their responses to the inquiry undertaken by the Sustainability Committee of the National Assembly for Wales in failures to meet the Convention of the Parties 2010 target to halt the losses of biodiversity (National Assembly for Wales, 2011), the Welsh National Park Authorities submitted a list of over 200 biodiversity conservation projects undertaken by them during the past decade. This was in response to criticism of the contribution made by the Welsh National Park Authorities to biodiversity conservation, indicating an apparent lack of awareness at a Government level of the range and depth of such work undertaken by them. Similarly, ENPAA (English National Park Authorities Association) published a report (ENPAA, 2010) summarising the major contribution made to biodiversity conservation within National Parks in England. This helped to raise the profile of the hitherto 'invisible' biodiversity conservation work (Robins, 2008) and indicates the strength of achievement within these small organisations, in addition to the conservation work of other organisations.

The stand-out feature within National Parks about biodiversity conservation work that can be achieved there is one of scale and focus, owing to the range, size and quality of habitats present in these large rural areas, together with the range of conservation organisations at work. The challenge is not only to achieve outcomes at appropriate scales but also to provide national and regional solutions to climate change mitigation and adaptation based upon integrated landscape management within the National Parks.

2.1 Defining a way forward

The vision for the Welsh National Parks has been stated as follows (Welsh Assembly Government, 2007):

⁵ Section 61 of the 1995 Environment Act.

- *The Welsh National Parks are protected landscapes of international importance which capture much of what is distinct and special about rural Wales, environmentally and culturally. Although predominantly rural in nature, the Parks contain a resident population of over 80,000, are close to important urban communities and have significant potential to enrich the lives of the people of, and visitors to, Wales and to contribute positively to public health and well-being and to the Welsh economy. They are living landscapes, moulded by their communities over thousands of years. They are places where sustainable development is promoted for the benefit of the environment, the economy and for Park communities. They are places that experiment with new approaches in sustainable development and environmental conservation, providing exemplars of best practice for wider Wales, and helping to shape and lead future rural policy and practice. They are also places where all who can influence the future of the Parks work together to conserve and enhance their natural beauty, biodiversity and cultural identity, in line with sustainable development principles. Guided by the Park Authorities, these special areas are becoming progressively richer and more diverse in terms of landscape, wildlife and heritage and are enjoyed and cherished by a full cross-section of society.*

This vision has pulled the National Park purposes closer still to the IUCN management principles and invites National Park Authorities to play a lead role in rural resilience. By referring to “sustainable development principles”, which are not included in the Park purposes and duty, it hints at a changing role for National Park Authorities and the National Parks. This is the beginning of the policy and legislative groundwork that may be necessary to redefine the role of National Parks and their Authorities, in Wales at least: towards landscapes that make an explicit contribution to climate change mitigation and adaptation, and biodiversity conservation, as well as the food production, access and recreation that they are already recognised for.

Redefinition is easier said than done. Public consciousness views National Parks in their historic context, providing free access for people to roam through wide open spaces, to adventure and to relax; biodiversity conservation and climate change responses are unlikely to be uppermost in the minds of most visitors, despite the primacy of biodiversity conservation within the Park purposes. During this Internet era when the world is changing rapidly, when ozone depletion, acid rain deposition within the British uplands (Batterbee, 2004), uncertainties about the impacts of genetically modified food crops on the environment and on public health, increasing public discomfort over the market distortions and environmental degradation produced by the Common Agricultural and Fisheries Policies, and the attention that sustainable development and biodiversity conservation have drawn beyond the boundaries of National Parks, it has not been obvious that these relatively large, relatively undeveloped but modified agricultural and afforested landscapes serve a wider role than is reflected in their purposes.

For example, the Brecon Beacons National Park is the source of more than 25 rivers and streams affecting south Wales. It also includes many decaying peat-rich and water storing wetlands, which need to be restored to continue to provide the long term benefits that agriculture and settlements have relied upon for centuries. Drinking water for south Wales, the largest conurbation in the country, is supplied from the reservoirs and catchments in the Brecon Beacons. These resources are likely to come under increasing resource management pressure as a consequence of rising demand and rising consumption on the one hand and uncertain supplies during prolonged dry summers or wet and stormy winters on the other (Environment Agency, 2008). So strategic investment in catchment management in the Park is essential, to provide these ecosystem services and lasting public benefits. Most of the

carbon-rich peat soils and organo-mineral soils are situated in the British uplands (Clark et al., 2010) and most of the British National Parks are upland or montane, co-incident with much of the soil carbon resource. The priority must be to restore and conserve these 'carbon banks' (Welsh Assembly Government, 2010). Water and soil carbon conservation are new tasks that must be achieved within National Parks, thereby modifying their role and increasing their significance to the nation.

2.1.1 Growing consciousness of climate change in national parks

The Intergovernmental Panel on Climate Change (IPCC) published its first assessment report on global climate change in 1990, leading to the publication of the United Nations Framework Convention on Climate Change (UNFCCC). Whilst this produced some ripples at an intergovernmental level, it failed to register as an issue at the local conservation level, where sustainable development and biodiversity conservation had arrived as the take-home messages from the Rio Earth Summit in 1992⁶. During the following decade, the UK conservation organisations invested significant resources in preparing and publishing national biodiversity action plans and steering group reports (DoE, 1994) and tranches of habitat and species action plans, as well as the formation of partnership local biodiversity action plans (LBAPs) at the county level. The National Park Authorities of Wales and England published their respective LBAPs and set about trying to implement them. Throughout this process climate change was not included as a relevant issue; this Chapter hazards a guess that most, if not all biodiversity action plans failed to include the effects of climate change on the conservation targets set for the habitats and species involved. By 2010, the net result was that together with other nations, the UK failed to fulfil its commitment to meet the European Union target for halting the loss of European biodiversity by 2010. The process had been high on published strategies and plans, high on hyperbole, but low on achievement.

This same period between the mid-1990s and 2010 saw the publication of three sets of climate change scenarios by the UK Climate Impacts Programme (Hulme and Jenkins, 1998; Hulme et al., 2002; UKCP, 2009). These led to a number of modelling studies on the effects of climate change on biodiversity (for example Berry et al., 2006; del Barrio et al., 2006; Harrison et al., 2001; Honnay et al., 2002; Hossell et al., 2000, 2003; Hossell, 2000; Hulme et al., 2003; Perry et al., 2003; Thomas et al., 2004). By now, climate change consciousness was growing within the conservation professions and devolved governments (DETR, 2000a, 2000b; Welsh Assembly Government, 2000a, 2000b; 2001) and twenty years after the Rio Earth Summit, climate change began to influence local policy setting.

The National Park Authorities slowly started to pay attention to the impacts of climate change, with the Brecon Beacons National Park Authority undertaking a literature review in order to provide information notes for circulation between the Authorities and preparing the first position statement for the Association of National Park Authorities in 2004. These signalled that climate change was firmly at the heart of European and UK policy and that National Park landscapes were likely to be affected significantly by climate change in the future. There was general acknowledgement of the important role that National Parks can play in helping Wales and the UK to adapt to climate change, for example as vehicles for promoting integrated planning responses to and assessment of climate change, though there

⁶ United Nations Conference on Environment and Development 1992.

were not (and still are not) specific national policy drivers to support this. For example, whilst the Welsh Assembly Government supported the development of regional climate models (Welsh Assembly Government, 2000b), such a model has yet to be provided for Wales 11 years later.

The expectation in disseminating this information was that it would stimulate the National Park Authorities, and their sponsoring bodies, into a flurry of activity to develop a co-ordinated leading role in mitigating and adapting to climate change within the landscape; this did not happen. Local Government Associations in Wales and England published Declarations on Climate Change to which the Welsh and English local authorities, and National Park Authorities, signed up. Whilst actions responding to the effects of climate change are now underway in National Parks (Table 1) this work is supported by position statements issued by the Associations of National Park Authorities (ANPA, 2008; ENPAA, 2009) rather than guided or co-ordinated by an overarching national objective for Protected Landscapes.

In the lead up to issuing their own statements, the National Park Authorities have invested increasing effort in debate and discussion on the best options for National Parks, summarising the main impacts likely to affect them, identifying common issues affecting all of them, developing principles to guide work, and identifying opportunities within existing work plans to deploy these principles. These can be summarised as follows:

Issues

- National Parks are sparsely populated places that have been designated for specific purposes. As a consequence of this they are generally not taken into consideration when developing strategic and policy responses to climate change.
- The collective size of Parks together with their dispersed location throughout Britain means that they offer the potential for significant strategic responses to climate change and can play a lead role in demonstrating the value of a natural resource-led approach. They cover ~10% of Britain (~7% of Scotland, ~20% of Wales and ~8% of England), are the source of several major river systems and watersheds (for example the Rivers Dart and Exe in Dartmoor and Exmoor, Rivers Forth, Tay, Earn and Endrick in Loch Lomond, the Usk in the Brecon Beacons, the Derwent in the North York Moors, The Broads catchment is the sink for several major river systems including the Waveney, Yare, Wensum and Bure), as well as the highest peaks and most low lying areas. Together with the suite of Areas of Outstanding Natural Beauty, this strategic role expands further still.
- Whilst the geology, geomorphology, boundaries and distribution of National Parks are permanent features, the quality, robustness and patterns of landscapes and land uses within them are alterable by human intervention and by natural responses to human and environmental factors.
- The people-centric nature of the Category V Protected Landscape designation means that local people and wider society can be given every opportunity to be part of the decision making process in response to climate change. Involving new people beyond the realms of macro-economics and the natural sciences can help to ensure that communities are open minded to the changes ahead (Hulme, 2007).
- National Parks contain [parts of] ecosystems and [entire] human communities; in these fragile but also extreme environments natural resources and people are affected equally by the elements.

- At the same time, National Parks are especially vulnerable to the physical impacts of climate change given their upland and montane, wetland, riverine, woodland, floodplain and coastal habitats and biomes.
- Whether the long term prognosis remains one of longer, drier summers and warmer, wetter, stormier winters or colder, more severe winters as a consequence of changes to North Atlantic circulation systems, these habitats and biomes are still strongly affected.
- National Parks are at risk from a wide range of impacts including:
 - loss of snow (which affects Arctic alpine flora and moisture availability for insects and birds)
 - reduction in freezing and seed vernalisation
 - decline in heather (*Calluna vulgaris*) and other dwarf shrubs
 - increased winter survival of heather beetle (*Lochmaea suturalis*), affecting the viability of heather moorland, as well as the spread of other invasive species and plant pathogens
 - increase in bracken encroachment (*Pteridium aquilinum*)
 - dry moorlands at risk from increased incidence of wildfires
 - increased survival of agricultural pathogens and parasites
 - increased erosion, run off and flash flooding
 - low river flows for prolonged periods each year
 - coastal squeeze, accelerated coastal erosion and coastal and inland flooding
 - saline intrusion into freshwaters
 - increased leisure demand on natural resources
 - risk of lost income to habitat-related enterprises (shooting, angling, water recreation, farm-based tourism)
 - decay and loss of limestone features in karstic landscapes.

Cross-cutting themes that emerge from the issues

- Using natural processes to achieve reduced surface water runoff within river catchments, providing flood control within and 'downstream' of National Parks;
- Improving water quality and water conservation within and downstream of National Parks
- Restoring ecological connectivity between sites by restoring hydrological connectivity
- Focusing habitat connectivity within ecosystems on larger and more robust habitat patches, whilst reducing the incidence with other incompatible land uses
- Conserving and restoring soils
- Tolerating and understanding changes within landscapes in response to contemporary societal and environmental needs
- Changes to human use of natural resources and landscape patterns
- Insufficient understanding of the issues affecting National Parks and effective action required to address them
- Changing landscapes will affect the special qualities of the Parks, the aesthetic, experiential, spiritual and sense of place elements that people come to enjoy.

Principles that could guide responses to cross-cutting themes

- Britain should have expectations of what can be achieved within National Parks in response to climate change

- Given the vital importance of enlisting public support and engagement, Category V Protected Landscapes, where human biogeography is integral to the ecosystems within them, have a significant role in the national response to the impacts of climate change
- Where localised land abandonment occurs as a consequence of socio-economic changes, it is a short-term, temporary phase in the ever changing history of land use
- Farming has an expanded role through integrated land management and high nature value farming alongside food production
- As well as habitats and species, ecosystems need to be understood and conserved
- Ecosystem services cannot be provided if the infrastructure for healthy biodiversity is not there or is functioning poorly
- Air, soil and water quality are the backbone of all ecosystem management
- In the short term every effort must be made to maximise the quality and extent of current biodiversity in order to maximise opportunities for survival of species and maintenance of ecosystem services, 'buying time' for wildlife and conservation to adapt
- In a changing climate, the role of site-based conservation for biodiversity is essential in the short term but needs adjusting for the mid- and long term (Edward-Jones et al., 2007) to include conservation of the wider countryside
- There must be a willingness to make tough choices; in the short term (next 20 years) maximum effort should be made to conserve 'at risk' habitats such as upland hay meadows and lowland raised bogs until a better solution emerges or adverse impacts of climate change overtake best possible efforts
- The wildlife corridor that is really required is the wider countryside itself; anthropogenic climate change underlines the extreme urgency of the need to concentrate on encouraging farmers and other land managers through real incentives, to produce good quality food and other products (such as timber) in a high quality landscape. This is arguably the biggest and best adaptation to climate change for biodiversity purposes (and also a mitigation measure, since it would imply sympathetic management of soil and water and achieving lower food miles etc.) and it has always been the only sustainable way to manage land.

However, twenty years since the Rio Earth Summit and nearly 10 years since climate change became a mainstream policy issue, National Park Authorities still lack the national policy or legislative provision to play a lead national and regional role in responding to climate change through landscape management. In 2008, the former co-Chair of the IPCC, Professor Sir John Houghton explained that the world has only 100 months, that is only 8 years, to avoid the global average annual atmospheric temperature exceeding 2°C, i.e., until 2016/2017, beyond which point there is a strong risk of runaway climate change. Jane Davidson Welsh Assembly Minister for Environment, Sustainability and Housing repeated this 100 month deadline during her speech to the Welsh Association of National Park Authorities on November 5th 2008 and also in her speech to the Royal Architects Association on November 20th 2008⁷. At the current rate of progress, the author of this Chapter is

⁷<http://www.architecture.com/Files/RIBAProfessionalServices/Regions/Wales/JaneDavidsonspeech.pdf>.

uncertain that Britain and the global community will do enough in time to avoid this outcome.

There is still concern within National Park Authorities that focusing on climate change distracts conservation effort from other issues such as biodiversity conservation and that the job to conserve biodiversity is far from over (National Assembly for Wales, 2011). It would be naive to assume that all actions to address climate change will also benefit biodiversity, though undoubtedly some, such as blanket bog restoration (to conserve water and carbon-rich peat), wetland habitat restoration (to retain water and improve water quality) and woodland management (to improve woodland structure, carbon sequestration potential, retard surface runoff and provide biofuel) can do so. However, National Park Authorities possess limited knowledge of the 'climate status' of habitats and species within the Parks and, being small organisations, possess limited means to influence their management. The strategic importance of the British uplands has generated significant research into the different issues affecting the uplands (for example Clark et al., 2010) but leaves National Park Authorities relying on collaborations and external expertise to be able to keep up with and take advantage of research findings; there is no UK-based organisation doing this on their behalf. Despite the involvement of National Parks as study areas and case studies in the 'national discussion' about the strategic importance of the British uplands in a changing climate (for example Reed et al., 2009; Natural England, 2009a, b; 2010, b; National Assembly for Wales, 2009), there is still a failure to recognise the modified and enhanced role that National Parks and National Park Authorities should make, based upon modern purposes and duties.

3. Policy consultation fatigue

During the development of national policy responses and the improving integration of climate change and biodiversity conservation policy (Natural England, 2009a, b; Welsh Assembly Government, 2011), National Park Authorities have found themselves responding repeatedly to overlapping and seemingly repetitive consultations (Table 1). Whilst on the one hand the welcome attention to environmental matters since the emergence of climate change as a leading issue has given the conservation profession a stronger voice, on the other hand the volume of consultation perhaps has betrayed a national uncertainty over what to do for the best, as well as a lack of sufficient political will across all sectors. Despite the publication of IPCC reports in 1990 (and three subsequent reports) and three UKCIP reports since then, there still is not a comprehensive land-based mitigation and adaptation action plan being implemented in Britain.

In attempts to rationalise the consultations, the National Park Ecologists of the 15 Park Authorities published a joint statement on climate change (Association of National Park Authorities, 2008). In this, they highlighted that despite the space available within the Parks to experiment with mitigation and adaptation plans, generating the critical mass for public responses to climate change may be limited by their small populations and low economic base. They state that climate change has both accelerated the speed at which biodiversity conservation needs to take place and expanded the complexity of the task. The biodiversity within designated sites and in the wider countryside has developed in response to historic farming practices; therefore maintaining and enhancing it is equally dependent upon maintaining suitable farming practices. The increased numbers of people that may visit the

Parks during prolonged warm and dry spells will increase the footpath erosion pressure on upland habitats, meaning that additional investment in erosion control measures will be required. In the short term, information needs include better inventories on soil carbon and water resources. In the mid-term, there may be value in undertaking habitat zoning exercises to identify core biodiversity zones and there is a need for joint working by the National Park Authorities and for closer working relationships with the statutory conservation agencies.

Consultation	Improving resilience and self-sufficiency	Green-house gas emissions	Localised renewable energy generation	Improving civic involvement and responsibility	Soil carbon, water catchment management	Enhancing the role of farming for climate change	Use of public buildings to provide district heating	Reducing food miles, increasing local supplies	New rail infrastructure required	Changes in and losses to seasonal water supplies	Inland re-alignment	Developing the role of National Parks	Habitat fragmentation already a major issue	Biodiversity conservation and climate change measures	Peak oil and climate change	Regulatory assessments of national policies	Ecological footprints of rural areas and National Parks	Land use planning
Welsh Assembly Government Climate Change Adaption Action Plan 2007	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Sustainability Committee Inquiry on the Future of the Uplands in Wales		●	●	●	●	●						●						
Wales Climate Change Group: adaptation sub-group		●	●	●	●	●		●		●		●						
Land Use Climate Change Group 2010	●	●	●	●	●	●		●			●	●			●			
Welsh Assembly Government Climate Change Strategy 2009		●	●		●							●			●			
Welsh Assembly Government Axis 2 consultation (Common Agricultural Policy) 2008		●	●	●	●	●				●	●	●			●	●	●	

Table 1. A summary of points made in selected consultations by the Welsh Association of National Park Authorities⁸.

⁸ A full list of consultation responses provided by the Welsh National Park Authorities is available on http://www.nationalparks.gov.uk/wanpa/wanpa-policy/wanpa-consultation_responses.htm.

In its climate change position statement, ENPAA (2009) set a range of objectives shared by the English Authorities. These covered sustainable land management including conservation and restoration of peat lands and woodlands and the carbon reserves they contain; increasing natural carbon storage and supporting 'low carbon farming'; using the town and country planning process to help develop low carbon rural communities including renewable energy generation appropriate for a protected landscape; adaptation to climate change within the landscape including identifying habitat networks and safeguarding access to the countryside; and communicating climate change issues and solutions to Park residents and visitors, including working with young people, influencing behaviour and increasing engagement and volunteering.

In its position statement on climate change, the Welsh Association of National Park Authorities (WANPA, 2010) stated that the contribution made by the Authorities is beginning to be recognised nationally. Through the Park Management Plans, land use development plans and Sustainable Development Funds, the Authorities possess the tools for integrated approaches to land management. Being relatively undeveloped areas, successful carbon dioxide emissions reduction in the Parks will mainly be achieved within the existing built and historic environment and through improved land management. Being people-focussed designations, National Parks enable recognition of the barriers to behavioural change required to address climate change. Suitable renewable energy systems can be developed on land and inshore whilst economic and environmental resilience are achievable through integrated, co-operative land management. Major contributions to biodiversity conservation will adjust as the climate changes, as will the continuing contribution made to the provision and management of access to areas for recreation on landscape features.

These sorts of policy initiatives show genuine intent by the National Park Authorities to be taken seriously in the national response to climate change. They are also in step with international recommendations for managing ecosystems in order to continue to meet human needs (EASAC, 2009; TEEB, 2010; World Resources Institute, 2005) and with the IUCN management guidelines for Category V Protected Landscapes.

3.1 Climate change making National Parks more visible

National Park Authorities are striving to develop coherent responses to climate change (Table 2), with numerous initiatives underway in the Parks, many led by the National Park Authorities themselves. The scope and detail of the projects illustrate a strong commitment to addressing climate change but requires an over-arching strategy or championing of this work, either by the Authorities or their sponsoring bodies. In the absence of overarching guidance however, perhaps diversity and variety, rather than unification, are strengths of this work. It has the potential to generate added value and diversity of approach and it provides further impetus to help redefine the role of National Parks in the eyes of the public.

To take two examples, the first a local initiative to make full use of natural resources and the second a regional initiative to identify how to reduce carbon emissions within the landscape. Based within the Brecon Beacons National Park, The Green Valleys⁹ helps individuals and communities to survey for and install micro-hydro-electricity systems in order to generate renewable electricity. Profits earned from UK Government feed-in-tariffs can then be re-invested in further energy and community-based projects. The Green Valleys also supports

⁹ <http://www.thegreenvalleys.org/>

National Park	Habitat management	Improving habitat connectivity	Other biodiversity management	Management of private land	Grant giving	Land use planning	Other policy development	Partnership projects	Renewable energy generation	Education and information	Added value projects	Public access management	Catchment-sensitive farming	Reducing carbon emissions	Low carbon projects	Regional climate change strategies	One planet/ecological footprint projects	Research
Brecon Beacons	●		●		●	●	●	●	●	●	●	●		●	●	●	●	●
Dartmoor	●		●		●			●	●					●	●		●	
Lake District	●		●		●	●		●	●	●					●			
New Forest	●		●		●			●	●					●				
Norfolk and Suffolk Broads	●		●		●		●	●		●								●
North York Moors	●		●		●		●	●	●	●					●			
Peak District	●		●		●			●		●					●			●
Pembrokeshire Coast	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●
Snowdonia	●		●		●	●		●	●				●	●			●	

Table 2. A summary of actions led by nine National Park Authorities in response to climate change, based upon information provided. Whilst other habitat conservation and sustainable development projects underway might also contribute to climate change mitigation and adaptation (for example peat land restoration projects), the Table summarises only those that are underway in direct response to climate change. The absence of a particular project initiative does not necessarily indicate that this work is not underway but reflects the scope of information volunteered for this Chapter.

community woodland groups who purchase or lease woodlands in order to harvest the wood fuel, manage biodiversity, support woodland-based education projects and generate an income from wood and value-added products. Other community-related benefits include capacity-building and giving members of communities the confidence to try out new ideas such as local food growing, biodiesel clubs and other energy efficiency measures. In the Lake District National Park, The Low Carbon Lake District Initiative¹⁰ has committed to setting a carbon budget for the Park. This will be based upon an estimate of total carbon emissions, with measures implemented to achieve annual reductions in line with England-

¹⁰<http://www.lakedistrict.gov.uk/index/caringfor/policies/climatechange/lowcarbonlakedistrict.htm>

wide targets. Notably, the missing element from all the projects summarised is an understanding of the management of soil carbon within Protected Landscapes. This complex issue, though a 'frontline' one in policy discussion, is only now being supported with relevant research on how to manage this resource (Natural England, 2009a, b; Clark et al., 2010).

4. Conclusions and way ahead

National Park Authorities are responding to the climate challenge in the absence of a UK national policy for climate change in Protected Landscapes. The pace of the national response to climate change lags behind that of emerging evidence and behind the pace called for in 2008 by Professor Sir John Houghton. The recognition of a revised role for National Parks lags further behind still. Pioneering projects within National Parks (Table 2) are achieved under existing resource constraints relying on a historic skill set, and they are largely unnoticed by the British people. The array of natural resources in the Parks offers a cost-effective means of investing in climate change mitigation and adaptation measures; working with the grain of nature will be more cost-effective than not doing so (Stern, 2006; Pitt, 2007).

The Category V Protected Landscape is a model designation for building resilient and adaptive approaches to life through integrated landscape management. Within the Brecon Beacons National Park for example, the National Park Management Plan is centred upon the theme of "managing change together," giving scope for the flourishing of nascent transition movements currently underway. Organisations like The Green Valleys lead the way in micro-hydro-electricity generation and local capacity building and increase the scope for National Park Authorities to assist local people to develop autonomous, sustainable and resilient solutions to future change. Given the slow pace of change at a national level, local collective effort and co-operation can help to speed up national responses as a consequence of the diversity of minds, energy and ideas at work. Just as conservation in the wider countryside, alongside the management of designated sites and nature reserves, is the only truly effective way to conserve biodiversity, so too the only effective response to climate change is through the diversity of thought and collective will achieved by local action, complimented by appropriate and responsive national strategies.

A puzzling omission from all national policy responses to climate change is the likely influences of spiralling fuel costs in the face of declining supplies, so-called peak oil (Pitt, 2009; ODAC & PCI, 2008). Fuel and energy costs are of particular importance within National Parks where the ecological footprint (Dawkins et al., 2008) is higher than the national average as a consequence of the poor rates of return on these resources. Mitigation and adaptation solutions that rely upon machinery and agriculture will be moderated by peak oil. On top of the effects of climate change, agricultural change is inevitable in response to the effects of peak oil and the energy descent that will follow. A possible outcome might be fewer or more targeted use of machines and increasing costs of plastic (for example silage wrap), lower petro-chemical inputs (pesticides and fertilisers) used in food production and higher costs of feedstuffs. This, and increasing water shortages in the face of climate change and unsustainable demand increases from all sectors, may have a negative impact on the scale and extent of farming, with production systems shrinking in size whilst intensifying in a smaller area overall, provided that fuel prices and water supplies support this. In other words, despite the current 'feed the world' mantra that is at large within agricultural policy

circles, the heavy reliance of current farming practices on fossil fuel and water may inhibit this response. Consequently, as fuel costs take their toll, the area of land under productive farming may shrink, which may release more land for biodiversity by default, and which might or might not be managed. This land could enter into 'high nature value' systems within Less Favoured Areas (ELO & CLA, 2009) or within agri-environment schemes. It could also be promoted to communities as new open space to provide for local food production (allotments, small holdings, farm gardens etc), woodland growth and so on. The agricultural pressures that affect farmers will be the same in every competitive nation including those providing farm export markets, with a possible outcome that export markets shrink as countries focus on becoming more self-sufficient and resilient and the costs of imports and exports rise with rising fuel prices.

The gradual integration of national policy for biodiversity conservation and climate change is exemplified in two policy initiatives in Wales and England, "A Living Wales" (Welsh Assembly Government, 2011) and "Making Space for Nature" (Lawton et al., 2010). Looking just at the Welsh policy initiative, A Living Wales seeks to re-evaluate the current approaches to biodiversity conservation in follow up to the failures to meet the 2010 European commitment to halt biodiversity losses. The aim is to develop a *Natural Environment Framework* that achieves integrated environmental management incorporating biodiversity conservation, ecosystem management and mitigating and adapting to the effects of climate change. The Welsh National Park Authorities and the National Association for Areas of Outstanding Natural Beauty each submitted replies to consultation responses, with the Authorities also supporting the reply provided by the Welsh Institute of Countryside and Conservation Management¹¹ (Table 3). The Framework has the potential to embed environmental management within the governance and future economic development of Wales and to provide an overarching plan, within which a clear role for National Parks could be defined. With this comes an opportunity to redefine National Park purposes, for example:

Proposed first purpose:

- To conserve and enhance the ecosystems, biodiversity, cultural heritage and historic environment of the National Parks

Proposed second purpose:

- To achieve the sustainable use of the Park's natural resources and ecosystem services whilst enhancing the special qualities of the National Parks

Proposed third purpose:

- To promote opportunities for the understanding and enjoyment of the special qualities of the Parks by people

Proposed duty for the National Park Authorities:

- In pursuit of these purposes foster the environmental, social and economic resilience of local communities and individuals within the Park.

This sort of redefinition of National Parks would acknowledge the wider role that they play, and it would give the Authorities the freedom to push further ahead with the sorts of initiatives summarised in this Chapter. It would also emphasise the leading role that National Parks make towards biodiversity conservation within the Protected Area network (Robins, 2008, IEEM, 2010).

¹¹ www.natur.eu.com

Finally, nurturing diversity of thought, innovation and capacity building in land management can be achieved through deploying agri-environment schemes (Axis 2 Common Agricultural Policy) in a more entrepreneurial way. In order to accelerate the emergence of a resilient farming industry that prizes natural resources, agri-environment schemes could be used to support both landscape-based and smaller farm business 'start up' projects based upon high nature value and natural resource management. Currently the approach is for a government to use agri-environment schemes to purchase ecosystem services (PES) from the land manager. Under an entrepreneurial scheme, the smaller projects would be invited to bid for a smaller start-up 'loan' (or other suitable arrangement) in a business incubation model. This would support land management-based enterprises in soil, water, renewable energy, woodland and biodiversity management, helping the manager to improve the marque value of his or her existing food and livestock enterprises. Local conservation organisations would offer support through an expanded and 'collegiate' farming advisory service to advise these start-up businesses, drawing in other advisors too. The marque value of these new businesses would be expanded through sustainable tourism and local businesses, which in turn would benefit from the outputs and outcomes of the new farm ventures.

The advising bodies and other stakeholders would also help to draw in external investment and corporate sponsorship from sectors that from now on will be willing to invest in carbon and water management and renewable energy, as a means of fulfilling their climate change obligations. Land-based resource management projects offer a long term and secure investment because land resources are always there, providing permanent and essential ecosystem services whilst they are well managed. Within a Natural Environment Framework, the quality of land-based resources will be more assured too. This sort of investment would be viewed as a 'sure thing' by investors because the supply would be renewable rather than finite; and the seed capital would have been provided by the agri-environment scheme. It is not inconceivable that the private sector might wish to collaborate in order to create additional agri-environment schemes in fulfilment of its public obligations and commercial advantage.

The national government would be guaranteed a 'return on its loan' because the start up businesses would be incentivised by the need to maximise and grow the high nature value of their products, i.e., they would want to put in the work to make it successful, calling in the advice and assistance offered when needed in order to help guarantee a positive outcome. Private sector input would also guarantee this because providing public benefits will become mandatory either through legislation or public demand; allowing the supported farm businesses to fail will not be an option for an investor. This would also ensure careful selection of the start up ventures to receive support.

The success of the start up venture would provide the government or private sector agri-environment funder with a market basis for monitoring the success of this element of the scheme; therefore detailed biological monitoring *might not always* be required because the higher the market value, the higher the return based upon the quality of the ecosystem providing the service. The funder might even require a guaranteed capital return on the start up capital above a certain threshold, to be re-invested in another start up, or they could require the customer to do this for them, thereby keeping the agri-environment money circulating and growing rather than dwindling in supply as the equity declines as it would in the PES model.

This approach would create diversified, resilient, adaptable and distinctive local markets in different parts of a country, whereas a single agri-environment scheme is constrained by its

	Fully supportive of A Living Wales, with provisos	Conserving wider countryside	Subservience of environment to economy	A Living Wales will cost more and require additional skills	Unrealistic implementation timetable	All-Wales ecosystem management plan required	Ecosystem monitoring should build on existing approaches	Precautionary principle is important	Weaknesses of ecosystem evaluation methods	Conflicting policies undermine environmental management	Stronger duty required for biodiversity conservation	Must build on, not abandon the current approaches	Can build on existing social and natural capital	Ecosystem services mgmt not always compatible with biodiversity conservation	Protected landscapes and Areas provide appropriate implementation and evaluation for A Living Wales	A Living Wales must incorporate wider issues	A Living Wales risks developing a unilateral reporting process	A Living Wales should implement the existing CBD principles	Public education and understanding is fundamental	No reference to peak oil
WANPA	●	●	●	●	●	●	●	●	●	●	●		●	●	●					
NAAONB	●	●				●			●	●		●	●	●	●					
Natur ¹²	●			●				●				●		●	●	●	●	●	●	●

Table 3. A summary of the main issues raised in response to A Living Wales consultation, to which Welsh National Park Authorities and Areas of Outstanding Natural Beauty contributed. The response by Natur was very comprehensive (see footnote).

‘one size fits all’ methodology. A diversified and localised market would be more likely to grow, based upon the expansion and multiplication of strong and successful models, the added value of recruiting new ideas and people locally and the increased localised confidence and positive feedback encouraging more people to become involved. It would also encourage new entrants to land management and farming, to help build the confidence and entrepreneurship that will be essential beyond the 2013 CAP reforms, as well as raise the profile of this modern approach to integrated land management. Larger landscape-based projects could be developed as cluster projects to provide a framework involving other initiatives to maximise the benefits of natural resource management, for example localised food production, wood biomass, hydro-electricity generation, linking with smaller site-based projects, education and interpretation projects.

¹² Natur is the Welsh Institute of Countryside and Conservation Management. Its full response to the consultation is available here http://natur.eu.com/cms_items/f20101204145237.pdf.

The smaller start up projects would find further support and gain contextualisation from the landscape-based projects. Initiatives such as The Green Valleys could be invited to assist with the development of community-based carbon neutralisation projects, where for example investment in small scale, community-based hydro-electricity generation produces a profit from feed-in tariffs, which is then invested in further energy projects, as well as local food production and upland and wetland habitat restoration. Creating this sort of independent social enterprise could be a very cost-effective model for investing agri-environment cash too, producing real socio-economic returns that have public value because they can be measured in terms of publicly beneficial outcomes, as well as cash.

This cost-effective and repeatable approach would help to ensure that a real, resilient and growing market is established for ecosystem services and public benefits. It offers real scope for agri-environment schemes to buy much more than a simple one-off transaction paid to individual farmers and landowners; it guarantees a real entrepreneurial market rather than a range of single PES 'events' based upon what is affordable. It keeps the money circulating.

4. Acknowledgments

With thanks to my colleague ecologists for contributions from the following National Park Authorities in Britain: Ian Barker (New Forest National Park Authority), Phil Taylor (Lake District NPA), Karen Shelley-Jones (Peak District NPA), Mike Howe (Pembrokeshire Coast NPA), Andrea Kelly (Broads Authority), Michael Graham (North York Moors NPA), Gill Thompson (Northumberland NPA) and Norman Baldock (Dartmoor NPA).

5. References

- ANPA. (2008) Britain's National Parks as test beds for ecological mitigation and adaptation to the impacts of climate change – an agenda for action. A statement by the Ecologists of the National Parks of England, Scotland and Wales. Association of National Park Authorities, May 2008.
- Bass, M.S., Finer, M., Jenkins, C.N., Kreft, H., Cisneros-Heredia, D.F., McCracken, S.F., Pitman, N.C.A., English, P.H., Swing, K., Villa, G., Di Fiore, A., Voigt, C.C., and Kunz, T.H. (2010) Global Conservation Significance of Ecuador's Yasuni National Park. PLOS ONE, Volume 5:1, Article e8767.
- Batterbee, R.W., Curtis, C.J. and Binney, H.A. (2004) *The Future of Britain's Upland Waters*. Proceedings of meeting 21 April 2004, Environmental Change Research Centre, University College London.
- Berry, P.M., Dawson, T.P., Harrison, P.A. and Pearson, R.G.. (2002) Modelling potential impacts of climate change on bioclimatic envelope of species in Britain and Ireland. *Global Ecology and Biogeography*, Volume: 11,6 pp 453-462
- Boitani, L., Cowling, R.M., Dublin, H.T., Mace, G.M., Parrish, J., Possingham, H.P., Pressey, R.L., Rondinini, C. and Wilson, K.A. (2008) Change the IUCN protected area categories to reflect biodiversity outcomes. PLOS BIOLOGY, Volume 6, 3, pp 436-438.
- Brooks, T.M., Wright, S.J. and Sheil, D. (2009) Evaluating the Success of Conservation Actions in Safeguarding Tropical Forest Biodiversity. *Conservation Biology*, Volume 23, 6, pp 1448-1457.

- Clark, J.M., Gallego-Sala, A.V., House, J.I., Orr, H.G., Freeman, C., Prentice, I.C., Smith, P. and Semenov, M.A.. (Editors) (2010) *Climate Change and the British Uplands*. Climate Research Special Report 24, Volume 45.
<http://www.int-res.com/abstracts/cr/v45/>
- Commission for Rural Communities. (2010) High ground, high potential: a future for England's upland communities.
- Dawkins, E. Paul, A., Barratt, J., Minx, J. and Scott, K. "Wales' Ecological Footprint Scenarios 2020," (2008) Stockholm Environment Institute report to the Welsh Assembly Government
<http://www.sei.se/editable/pages/sections/implement/WalesEFreport.pdf>
- Del Barrio, G., Harrison, P.A., Berry, P.M., Butt, N. Sanjuan, M.E., Pearson, R.G. Dawson, T.. (2006) Integrating multiple modelling approaches to predict the potential impacts of climate change on species' distributions in contrasting regions: comparison and implications for policy. *Environmental Science and Policy*, Volume 9, 2, pp 129-147.
- DETR (2000) Climate Change - draft UK programme. Department for the Environment, Transport and Regions.
- DETR (2000) Potential UK Adaptation Strategies for Climate Change. Department for the Environment, Transport and Regions.
- DoE. (1994) Biodiversity: *The UK Steering Group Report*. Department of the Environment, UK Government.
- Dudley, N., Parrish, J.D., Redford, K.H. and Stolton, S. (2010) The revised IUCN protected area management categories: the debate and ways forward. *ORYX*, Volume 44, 4, pp 485-490.
- EASAC (2009) Ecosystem services and biodiversity in Europe. European Academies Science Advisory Council policy report 09
- Edward-Jones, G., Harris, I.M., Dyer, J. and Wragg, A. (2007) Climate proofing rural resource protection policies and strategies in Wales. Science Report SC030298, Environment Agency.
- ELO & CLA. (2009) The climate challenge and the land manager; a European perspective. European Landowners' Organisation and Country Land and Business Association statement for the UNFCCC COP15, Copenhagen, December 2009.
- ENPAA (2009) Climate Change Statement. England's National Park Authorities Association.
http://www.enpaa.org.uk/climate_change_statement
- ENPAA. (2010) England's National Parks: Beacons for Biodiversity. Report by England's National Park Authorities Association to mark the 2010 International Year of Biodiversity.
http://www.enpaa.org.uk/england_s_national_Parks_-_beacons_for_biodiversity.pdf.
- Environment Agency. (2008) Climate change and river flows in the 2050s. Environment Agency Science Report SC030240/SR "Continuous Estimation of River Flows", ISBN 978-1-84432-874-1, April 2008. Accessed on April 26th 2011, available on <http://publications.environment-agency.gov.uk/pdf/SCHO1008BOSS-e-e.pdf>.
- Harrison, P.A., Berry, P.M. And Dawson, T.P., editors (2001) Climate change and nature conservation in Britain and Ireland: modelling natural resource responses to climate change (the MONARCH project). UKCIP Technical Report, Oxford.

- Honnay, O., Verheyen, K., Butaye, J., Jacquemyn, H., Bossuyt, B. and Hermy, M. (2002) Possible effects of habitat fragmentation and climate change on the range of forest plant species. *Ecology Letters*, Volume 5, pp 525-530
- Hossell, J.E., Briggs, B. and Hepburn, I.R. (2000) Climate Change and UK Nature Conservation. A review of the impact of climate change on UK species and habitat conservation policy. ADAS for the Department of Environment, Transport and the Regions and the Ministry of Agriculture, Fisheries and Food.
- Hossell, J.E., Ellis, N.E., Harley, M.J. and Hepburn, I.R. (2003) Climate change and nature conservation: Implications for policy and practice in Britain and Ireland. *Journal of Nature Conservation*, Volume 11, pp 67-73.
- Hossell, J.E.. (2000) Literature review of the implications of climate change for species, habitats and the wider countryside. Department of the Environment, Transport and Regions.
- Hulme, M., Conway, D. and Lu, X. (2003) Climate Change: An Overview and its Impact on the Living Lakes. 8th Living Lakes Conference. Norfolk Broads 2003.
- Hulme, M., Turnpenny, J., Jenkins, G., (2002), Climate Change Scenarios for the United Kingdom: The UKCIP02 Briefing Report. Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich, UK.
- Hulme, M. and Jenkins, G. (1998) Climate Change Scenarios for the UK. UKCIP Technical Report No. 1.
- Hulme, M. (2007) The limits of the Stern Review for climate change policy-making. Tyndall Centre. British Ecological Society Bulletin March 2007, pp 20-21.
- IEEM. (2010) Position Statement on Ecological Networks in Protected Areas. Institute of Ecology and Environmental Management, November 2010. Accessed on April 26th 2011, available on http://www.ieem.net/docs/IEEM_Position_Statement_on_Ecological_Networks_and_Protected_Areas.pdf.
- Jackson, S.F., Walker, K and Gaston, K.J. (2009) Relationship between distributions of threatened plants and protected areas in Britain. *Biological Conservation*, Volume 142, 7, pp 1515-1522.
- Janssen, J. (2009) Sustainable development and protected landscapes: the case of The Netherlands. *International Journal of Sustainable Development and World Ecology*, Volume 16, 1, pp 37-47.
- Kharouba, H.M. and Kerr, J.T. (2010) Just passing through: Global change and the conservation of biodiversity in protected areas. *Biological Conservation*, Volume 143, pp 1094-1101.
- Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow, R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.J., Tew, T.E., Varley, J., & Wynne, G.R. (2010) *Making Space for Nature: a review of England's wildlife sites and ecological network*. Report to DEFRA (Department for Environment, Transport and Regions).
- Leroux, S.J., Krawchuk, M.A., Schmiegelow, F., Cumming, S.G., Lisgo, K., Anderson, L.G. and Petkova, M. (2010) Global protected areas and IUCN designations: do the categories match the conditions? *Biological Conservation*, Volume 143, 3, pp 609-616.

- Lucas, P.H.C. (1992) *Protected Landscapes*. Chapman & Hall, London xvi + 282 + indexpp. ISBN 0412 45530 7.
- Natural England. (2010) *Vital Uplands: A 2060 vision for England's upland environment*. <http://naturalengland.etraderstores.com/NaturalEnglandShop/NE210>
- Natural England. (2009a) *Upland Ecosystem Services: assessing the links between environment, land management and service delivery for 4 key services*. Natural England Commissioned Report NECR028.
- Natural England. (2009b) *Economic valuation of upland ecosystem services*. Natural England Commissioned Report NECR029.
- National Assembly for Wales. (2011) *National Assembly for Wales Sustainability Committee. Inquiry into Biodiversity*, January 2011. <http://www.assemblywales.org/bus-home/bus-guide-docs-pub/bus-business-documents/doc-laid.htm?act=dis&id=208859&ds=2/2011>
- National Assembly for Wales. (2009) *Inquiry into the Future of the Uplands in Wales*.
- Perry, P.M., Dawson, T.E., Harrison, P.A. and Pearson, R.G. (2003) *Impacts of Climate Change and the Implications for Conservation. Why be concerned about exotic and invasive species?* Environmental Change Unit, University of Oxford.
- ODAC & PCI. (2008) *Preparing for Peak Oil; Local Authorities and the Energy Crisis*. Prepared by the Oil Depletion Analysis Centre and the Post Carbon Institute. Accessed on 25th April 2011, available on http://www.odac-info.org/sites/odac.postcarbon.org/files/Preparing_for_Peak_Oil.pdf
- Phillips, Adrian, (2002). *Management Guidelines for IUCN Category V Protected Areas: Protected Landscapes/Seascapes*. IUCN Gland, Switzerland and Cambridge, UK. xv + 122pp. ISBN: 2-8317-0685-8
- Pitt, M. (2008) *The Pitt Review: Learning Lessons from the 2007 Floods*. Accessed April 25th 2011, available on http://webarchive.nationalarchives.gov.uk/20100807034701/http://archive.cabinetoffice.gov.uk/pittreview/thepittreview/final_report.html.
- Pitt, R. (2009) *Peak oil and energy uncertainty; information for local Authorities*. Welsh Local Government Association February 2009.
- Reed, M.S., Bonn, A., Slee, W., Beharry-Borg, N., Birch, J., Brown, I., Burt, T.P., Chapman, D., Chapman, P.J., Clay, G.D., Cornell, S.J., Fraser, E.D.G., Glass, J.H., Holden, J., Hodgson, J.A., Hubacek, K., Irvine, B., Jin, N., Kirkby, M.J., Kunin, W.E., Moore, O., Moseley, D., Prell, C., Price, M.F., Quinn, C.H., Redpath, S., Reid, C., Stagl, S., Stringer, L.C., Termansen, M., Thorp, S., Towers, W. and Worrall, F.. (2009) *The future of the uplands*. Land Use Policy, Volume 26S, pp. S204-S216.
- Robins, M. (2008) *Protected Landscapes – sleeping giants of English biodiversity*. ECOS, Volume 29, 1, pp 75-86.
- Sinnadurai, P. (2008) *Future Parks in Future Climates – Scalable Solutions*. Second Electronic System-Integration Technology Conference, University of Greenwich November 2008. http://ieeexplore.ieee.org/search/freesrchabstract.jsp?tp=&arnumber=4684317&queryText%3Dfuture+Parks+future+climates+scalable+solutions%26openedRefinements%3D*%26searchField%3DSearch+All

- Stern, N. (2006) The Stern Review on the Economics of Climate Change. UK Government, accessed on 25th April 2011, available on http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/stern_review_report.htm.
- TEEB (2010) The Economics of Ecosystems and Biodiversity. <http://www.teebweb.org/Home/tabid/924/Default.aspx>
- Thomas, C.D., Cameron, A., Green, R.E., Bakkenes, M., Beaumont, L.J., Collingham, Y.C., Erasmus, B.F.N., Ferreira de Siqueira, M., Grainger, A., Hannah, L., Hughes, L., Huntley, B., van Jaarsveld, A.S., Midgley, G.F., Miles, L., Ortega-Huerta, M.A., Peterson, A.T., Phillips, O.L and Williams, S.E.. (2004) Extinction risk from climate change. *Letters to Nature*. Nature 8 January 2004
- UKCP (2009) UK Climate Projections. <http://ukcp09.defra.gov.uk/>
- WANPA (2009) Wales Climate Change Strategy – Programme of Action. Written response to consultation. Welsh Association of National Park Authorities.
- WANPA. (2010) National Parks Wales: 21st century pioneers. Climate Change position statement by the Welsh Association of National Park Authorities. Accessed on April 26th 2011, available on http://www.nationalparks.gov.uk/national_parks_wales_position_statement_-_climate_change.pdf.
- Welsh Assembly Government. (2000) Changing Climate, Challenging Choices - The Impacts of Climate Change in Wales from Now to 2080 - summary report February 2000
- Welsh Assembly Government. (2000) Wales: Changing Climate, Challenging Choices - a scoping study of climate change impacts in Wales - May 2000
- Welsh Assembly Government. (2001) Climate Change Wales; Learning to Live Differently.
- Welsh Assembly Government. (2007) Policy Statement for the National Parks and National Park Authorities in Wales: “Working together for Wales”.
- Welsh Assembly Government. (2010) *Land Use Climate Change Report*. Land Use Climate Change Group report to the Welsh Assembly Government.
- Welsh Assembly Government (2011) A Living Wales: a new framework for our environment, our countryside and our seas.
- World Resources Institute. (2005) Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, DC.



Climate Change - Research and Technology for Adaptation and Mitigation

Edited by Dr Juan Blanco

ISBN 978-953-307-621-8

Hard cover, 488 pages

Publisher InTech

Published online 06, September, 2011

Published in print edition September, 2011

This book provides an interdisciplinary view of how to prepare the ecological and socio-economic systems to the reality of climate change. Scientifically sound tools are needed to predict its effects on regional, rather than global, scales, as it is the level at which socio-economic plans are designed and natural ecosystem reacts. The first section of this book describes a series of methods and models to downscale the global predictions of climate change, estimate its effects on biophysical systems and monitor the changes as they occur. To reduce the magnitude of these changes, new ways of economic activity must be implemented. The second section of this book explores different options to reduce greenhouse emissions from activities such as forestry, industry and urban development. However, it is becoming increasingly clear that climate change can be minimized, but not avoided, and therefore the socio-economic systems around the world will have to adapt to the new conditions to reduce the adverse impacts to the minimum. The last section of this book explores some options for adaptation.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Paul Sinnadurai (2011). Protected Landscapes Amidst the Heat of Climate Change Policy, Climate Change - Research and Technology for Adaptation and Mitigation, Dr Juan Blanco (Ed.), ISBN: 978-953-307-621-8, InTech, Available from: <http://www.intechopen.com/books/climate-change-research-and-technology-for-adaptation-and-mitigation/protected-landscapes-amidst-the-heat-of-climate-change-policy>

INTECH
open science | open minds

InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2011 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike-3.0 License](https://creativecommons.org/licenses/by-nc-sa/3.0/), which permits use, distribution and reproduction for non-commercial purposes, provided the original is properly cited and derivative works building on this content are distributed under the same license.

IntechOpen

IntechOpen