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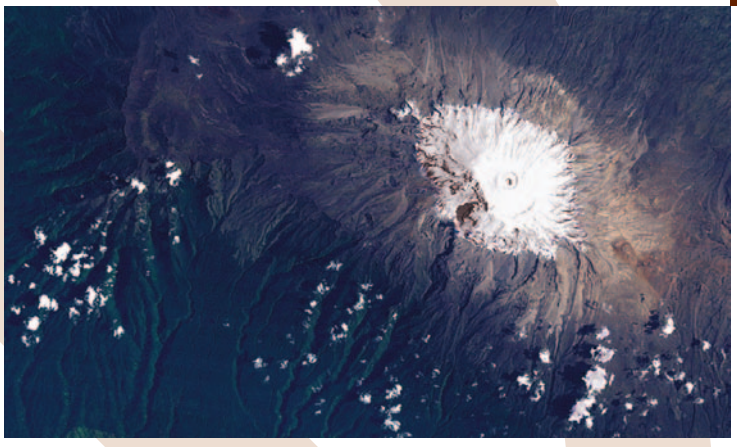

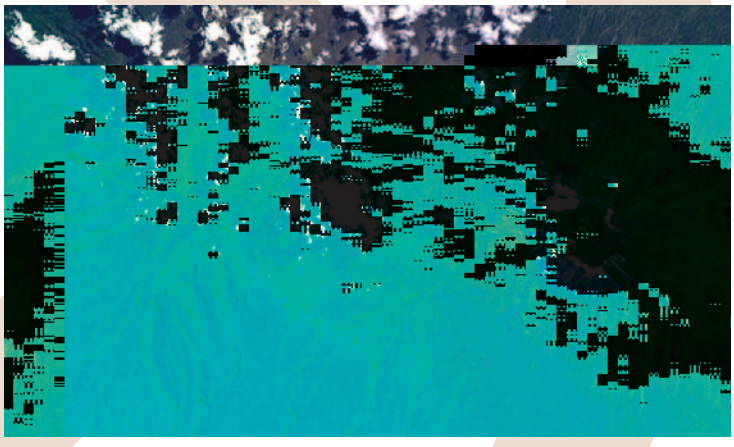

Climate Change and World Heritage

Report on predicting and managing the impacts of climate change on World Heritage

and

Strategy to assist States Parties to implement appropriate management responses

United Nations
Educational, Scientific and
Cultural Organization

Climate Change and World Heritage

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Foreword

The 1972 UNESCO World Heritage Convention *is the principal instrument for identifying and protecting, for the benefit of current and future generations, the outstanding natural and cultural heritage of the world, and encouraging international cooperation for its conservation. Climate change has now emerged as one of the most serious threats impacting on the conservation of this heritage.*

The World Heritage Committee has recognized this emerging threat and responded at its 29th session by launching an initiative to assess the impacts of climate change impacts on World Heritage and define appropriate management responses. Accordingly, a meeting of experts was held in March 2006 in order to prepare a Report and a Strategy to assist States Parties in addressing this threat, and these documents were endorsed by the Committee at its 30th session in July 2006.

The fact that climate change poses a threat to the outstanding universal values of World Heritage sites has several implications for the 1972 Convention*. Lessons learnt at some sites show the relevance of designing and implementing appropriate adaptations measures. Research at all levels would also have to be promoted in collaboration with the various bodies involved in climate change work, especially for cultural heritage where the level of involvement of the scientific community needs to be enhanced. The global network of World Heritage sites is ideally suited to build public awareness and support through sharing of information and effective communication on the subject, given the high-profile nature of these sites.*

Protecting and managing World Heritage sites in a sustainable and effective manner is a shared responsibility under the Convention*. Therefore, there is a need to publicize all available information on the threats posed by climate change and the potential measures for dealing with them. This publication in the World Heritage Papers Series, comprising the report on 'Predicting and managing the effects of climate change on World Heritage' and a 'Strategy to assist States Parties to implement appropriate management responses' is part of that overall effort.*

UNESCO's World Heritage Centre is committed to working closely with all stakeholders including the States Parties to the 1972 Convention*, other international conventions and organizations, the civil society and the scientific community to address the multiple challenges posed by climate change to the precious and fragile cultural and natural heritage of the world.*

Francesco Bandarin
Director of the UNESCO World Heritage Centre

Provisions and initiatives of the process of the United Nations Framework Convention on Climate Change relevant to the *World Heritage Convention*

Message from the UNFCCC Secretariat

The UN Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol contain a number of provisions that are relevant for addressing the concerns of the* World Heritage Convention *including how to ensure adaptation to the adverse impacts of climate change on the World Heritage sites.

The ultimate objective of the UNFCCC is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. The objective of the Framework Convention is reinforced by a number of articles which fall into two main categories: those related to actions to cut net emissions of greenhouse gases and so reduce climate change, and those that relate to actions taken to help communities and ecosystems cope with changing climate conditions.

This Convention provides for countries to cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods.

The Framework Convention stipulates that developed countries should assist developing countries that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects. It also addresses the specific needs of the Least Developed Countries (LDCs) for responding to climate change.

The Kyoto Protocol provides for innovative 'flexibility mechanisms' to lower the overall costs of achieving emissions targets. These mechanisms are meant to enable Parties to access cost-effective opportunities to reduce emissions or to remove carbon from the atmosphere.

In order to initiate the implementation of the provisions of the UNFCCC and the Kyoto Protocol, Parties have over the years agreed on many decisions that mandate actions on climate change, and many outcomes have been achieved.

Parties to the UNFCCC are: developing and submitting national reports containing inventories of greenhouse gas emissions by source and removals by sinks using agreed guidelines, adopting national programmes for mitigating climate change, developing strategies for adapting to its impacts, promoting technology transfer and the sustainable management of resources, enhancing greenhouse gas sinks and reservoirs (such as forests). In addition, the countries are taking climate change into account in their relevant social, economic, and environmental policies and cooperating in scientific, technical, and educational matters, as well as public awareness.

It is important to mention that national reports provide an opportunity for each Party to communicate its information, and where relevant, regional efforts to implement the Framework Convention based on agreed guidelines. The Conference of the Parties uses this information to assess and review the effective implementation of the Convention and assess the overall aggregated effect of steps taken by Parties. These reports have therefore the potential for and can serve to promote the national, regional and global effort aimed at mainstreaming climate change. They also provide for the consideration of climate change in development planning, poverty eradication and sustainable development.

In order to respond to the needs for assessing the impacts, vulnerability and adaptation, the UNFCCC secretariat has created a compendium on methods and tools to evaluate adaptation options and web pages to facilitate access to information on methods to evaluate adaptation options. It has conducted expert meetings and workshops with the participation of intergovernmental organizations, United Nations organizations and the community of users to identify opportunities for cooperation.

In the area of technology transfer, the UNFCCC secretariat has prepared a number of reports which are directly or partially relevant to adaptation, including technical papers on: coastal adaptation technologies, and enabling environments with specific references to adaptation technologies.

In 2006, the secretariat produced a technical paper on the application of environmentally sound technologies for adaptation to climate change. This paper contains an overview of: the current knowledge and understanding of adaptation to climate change, a framework for assessing technologies for adaptation to climate change, the process of technology development and transfer as relevant to adaptation to climate change, examples of important technologies for adaptation in five sectors (coastal zones, water resources, agriculture, public health, and infrastructure), together with three case studies for each sector, and a synthesis of findings that have implications for climate policy. The paper argues that many technologies exist to adapt to natural weather-related hazards and that these technologies can also play an important part in reducing vulnerability to climate change. Hard and soft technologies are available to develop information and raise awareness, to plan and design adaptation strategies, to implement adaptation strategies, and to monitor and evaluate their performance. The paper provides examples of technologies that can be employed to accomplish them.

In addition, the secretariat has established a technology information system (TT:CLEAR) which includes following elements relating to adaptation: inventory of existing adaptation centres; adaptation technology projects (mainly from national communications of both Annex I and non-Annex I Parties); and an adaptation technologies database.

The secretariat is facilitating Parties to undertake capacity-building activities related to the needs for vulnerability and adaptation assessment and implementation of adaptation measures in developing countries and countries with economies in transition. Furthermore efforts are underway to develop a web-based information clearing house that would support networking and partnership activities between Parties, intergovernmental organizations and non-governmental organizations, and to promote informal exchanges of information on actions relating to education, training and public awareness.

Realizing the need to obtain adequate funding for adaptation, COP 7 agreed to establish three new funds. The Special Climate Change Fund under the UNFCCC is to support, inter alia, the implementation of adaptation activities where sufficient information is available, and the Least Developed Countries (LDCs) Fund should support, inter alia, the preparation and implementation of national adaptation programmes of action (NAPAs), which will communicate priority activities addressing the urgent and immediate needs and concerns of the LDCs, relating to adaptation to the adverse effects of climate change. A third fund, the Adaptation Fund, was established under the Kyoto Protocol. Only the Adaptation Fund is yet to become operational.

The climate change process has also adopted the Nairobi Work Programme (NWP), the objective of which is to assist all Parties, in particular developing countries, including LDCs and SIDS, to improve their understanding and assessment of impacts, vulnerability and adaptation, and to make informed decisions on practical adaptation actions. It is also expected that the outcomes of this programme will include enhanced capacity at all levels to select and implement high priority adaptation actions; improved information and advice to the COP; enhanced cooperation among Parties, relevant organizations, business, civil society and decision makers; enhanced dissemination of information; and enhanced integration of adaptation with sustainable development. The focus areas of the NWP include: data and observations, methods and tools, climate modelling and downscaling, climate-related risks and extreme events, socio-economic information, adaptation planning and practices, technologies for adaptation research, and economic diversification.

Acknowledging the fact that most of the States Parties to the **World Heritage Convention** *are also Parties to the UNFCCC, it is possible for the World Heritage Committee to collaborate with the UNFCCC secretariat through activities such as: presenting information at the climate change meetings, being involved in the NWP, encouraging experts to exchange views using the guidelines that have been used in the UNFCCC process, and encouraging respective national focal points to work together on climate change issues.*

The World Heritage Committee could take advantage of the information and products that have been developed by other organizations through the climate change process. Many international organizations are undertaking considerable work on climate change impacts, vulnerability and adaptation, although not all of it is focused on decisions of the COP.

Statement by Ahmed Djoghlaf,

Executive Secretary, Convention on Biological Diversity, delivered to the World Heritage and Climate Change Expert Meeting held at UNESCO, Paris, on 16 and 17 of March 2006

Ladies and Gentlemen,

Climate change, through temperature increases ('global warming'), sea-level rise, changes in precipitation patterns, and increased frequencies of extreme weather events, is exerting considerable impacts on the Earth's biodiversity. Recent findings by the scientific community suggest that global warming is causing considerable shifts in species spatial distributions, consistent with earlier predictions by climate change models, and that spring is arriving earlier in temperate latitudes. Entire regions are also suffering from the effects of global warming; in particular, boreal and polar ecosystems. The incidence of pest outbreaks, particularly in forest ecosystems, is correlated with changes in ambient temperatures. The recent extinction of at least one vertebrate species, the golden toad, is directly attributable to the effects of contemporary climate change.

Although past changes in the global climate resulted in major shifts in species ranges and marked reorganization of biological communities, landscapes, and biomes during the last thousands of years, these changes occurred in landscapes that were not as fragmented as today, and with little or no pressures from human activities. This means that on the one hand, current climate change coupled with other human pressures is stressing biodiversity far beyond the levels imposed by the global climatic change that occurred in the recent evolutionary past. On the other hand, this also suggests that while designing activities aimed at mitigating the impacts of climate change, biodiversity considerations are essential.

The impacts of climate change on biodiversity are of major concern to the Convention on Biological Diversity (CBD). At its fifth meeting in 2000, the Conference of the Parties drew attention to the serious impacts of loss of biodiversity on terrestrial and marine ecosystems, and on people's livelihoods and requested the Convention's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to establish an ad hoc technical expert group which, between 2001 and 2003 carried out an in-depth assessment of the inter-linkages between biodiversity and climate change and its implications for the implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol. One of the report's main findings is that there are significant opportunities for mitigating climate change, and for adapting to climate change while enhancing the conservation of biodiversity. The report also identifies a suite of tools, including the ecosystem approach of the Convention, that can help decision makers to assess the likely impacts and make informed choices when designing and implementing mitigation and adaptation projects.

At its seventh meeting in 2004, the Conference of the Parties to the CBD further requested SBSTTA to develop advice for promoting synergy among activities to address climate change at the national, regional and international level, including activities to combat desertification and land degradation, and activities for the conservation of and sustainable use of biodiversity. Another expert group on biodiversity and adaptation to climate change was then established which undertook a detailed assessment on the integration of biodiversity considerations in the implementation of adaptation activities to climate change. SBSTTA welcomed the report at its eleventh meeting late last year, and requested the expert group to further refine its contents. One of the main findings of the report is that the ability of natural and managed ecosystems to adapt autonomously to climate change is insufficient to arrest the rate of biodiversity loss and that directed adaptation towards increasing ecosystem resilience be promoted.

Collectively, the findings of these two reports provide comprehensive advice and guidance on how to mainstream biodiversity into climate change activities, at the biophysical level and at the level of tools and practical approaches. This information can be applied to the management of protected areas in general, and to World Heritage sites in particular, in order to mitigate and adapt to climate change. The Secretariat of the Convention on Biological Diversity is fully committed to exploring ways and means to enhance its collaboration with the World Heritage Committee on this topic, bearing in mind the challenge we all face to reduce significantly by 2010 the rate of biodiversity loss in the world as a contribution to poverty alleviation and to the benefit of all life on earth.

Executive Summary

In the past few decades scientists have assembled a growing body of evidence showing the extent of change of the earth's climate and that human activities play an important role in this change. This warning has led international, regional, and national organizations to develop dedicated programmes to assess and manage the impacts of climate change (e.g. the assessment recently conducted by the Convention on Biological Diversity). In this context, and following Decision 29 COM 7B.a of the World Heritage Committee in 2005, the present Report which has been prepared following the meeting of the Group of Experts in March 2006, aims at reviewing the potential impacts of climate change on World Heritage properties and suggesting appropriate measures to deal with them.

The unprecedented rate of increase of global temperatures that has been recorded during the 20th century is the highest in the last millennium. And, according to the Intergovernmental Panel on climate Change (IPCC), most of this increase is attributable to human activities. The increase of global average atmospheric surface temperature is related to the greenhouse effect as a consequence of enhanced emissions of greenhouse gases. Increased global temperature is just one of the consequences of the impacts of human activities on the climatic equilibrium of the planet, with modifications of precipitation patterns, droughts, storminess, ocean temperature and acidification, sea-level rise, etc. Projections of numerical models show that this trend is very likely to be confirmed in the future. Such changes are impacting on World Heritage properties, and if the trend is confirmed, these impacts will become even more threatening.

In this scenario, the conservation of World Heritage natural sites may be jeopardized. Increased ocean temperature and acidification pose a threat to marine biodiversity. Many marine World Heritage sites are tropical coral reefs whose exposure to bleaching events is increasing, possibly leading to massive extinction of coral reefs. The increase of atmospheric temperature is also leading to the melting of glaciers worldwide (in both mountainous and Polar Regions). Lastly, terrestrial biodiversity may also be affected with species shifting ranges, changes in the timing of biological cycles, modification of the frequency and intensity of wildfires, migration of pests and invasive species, etc.

World Heritage cultural sites are also exposed to this threat. Ancient buildings were designed for a specific local climate. The migration of pests can have adverse impacts on the conservation of built heritage. Increasing sea level threatens many coastal sites. And the conditions for conservation of archaeological evidence may be degraded in the context of increasing soil temperature. But aside from these physical threats, climate change will impact on social and cultural aspects, with communities changing the way they live, work, worship and socialize in buildings, sites and landscapes, possibly migrating and abandoning their built heritage.

The fact that climate change poses a threat to the outstanding universal values (OUV) of some World Heritage sites has several implications for the World Heritage Convention*. In this context, the relevance of the processes of the* World Heritage Convention *such as nominations, periodic reporting, and reactive monitoring must be reviewed and suitably adjusted. It is also time to design*

appropriate measures for monitoring the impacts of climate change and adapting to the adverse consequences. In the worst case scenario, the OUV of a given site could be irreversibly affected (although it is recognized that climate change is one among a range of factors affecting the site), and the World Heritage Committee needs to consider the implications that this would have under the World Heritage Convention.

Several actions can be contemplated in the short term to prevent the impacts of climate change on World Heritage properties, define appropriate adaptation measures, and enhance the sharing of knowledge among stakeholders. Such initiatives should be conducted in close collaboration with relevant bodies already involved in climate change and/or heritage and conservation issues, such as the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC), the Convention on Biological Diversity (CBD), the UNESCO Man and the Biosphere programme, the Ramsar Convention on Wetlands and the UNESCO conventions dealing with cultural heritage.

The management plans of all sites potentially threatened by climate change should be updated to ensure sustainable conservation of their OUV in this context. The impacts of climate change on World Heritage properties must be assessed through appropriate monitoring and vulnerability assessment processes. Potential mitigation measures at the level of the sites and within the World Heritage network should also be investigated, although mitigation at the global and States Parties level is the mandate of the UNFCCC and its Kyoto Protocol. The importance of climate change threats also justifies the need to implement appropriately tailored risk-preparedness measures. As far as remedial measures are concerned, lessons learnt at several sites worldwide show the relevance of designing and implementing appropriate adaptations measures. The effectiveness of several actions has been demonstrated at a number of sites in the past, such as: increasing the resilience of a site by reducing non-climatic sources of stress, preventively draining a glacial lake to avoid the occurrence of an outburst flood, improving dykes to prevent coastal flooding and supporting traditional methods to protect a site from sand encroachment.

Concerning the sharing of knowledge, research at all levels should be promoted in collaboration with the IPCC and other bodies involved in climate change research, especially for cultural heritage where the level of involvement of the scientific community is currently not as much as it is for natural heritage. The global network of the World Heritage sites is also an opportunity to build public and political support through improved information dissemination and effective communication.

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Background

Doñana National Park, Spain

© Renato Valterza

Introduction

The scientific community now widely agrees on the fact that human activities are disturbing the fragile climatic equilibrium of our planet. The resulting climate change is defined by the United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, as 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. The UNFCCC thus makes a distinction between 'climate change' attributable to human activities altering the atmospheric composition, and 'climate variability' attributable to natural causes. Predicting and managing the impacts that climate change will have on World Heritage is a real challenge, but considering the importance of the issue, it is now timely to face this problem.

The Intergovernmental Panel on Climate Change (IPCC) states in its Third Assessment Report that 'The Earth's climate system has demonstrably changed on both global and regional scales since the pre-industrial era, with some of these changes attributable to human activities'. To limit the amplitude of climate change, mitigation (reducing the emission and enhancing the sinks of greenhouse gases) is needed, but the same report mentions that 'adaptation is a necessary strategy at all scales to complement climate change mitigation efforts'.

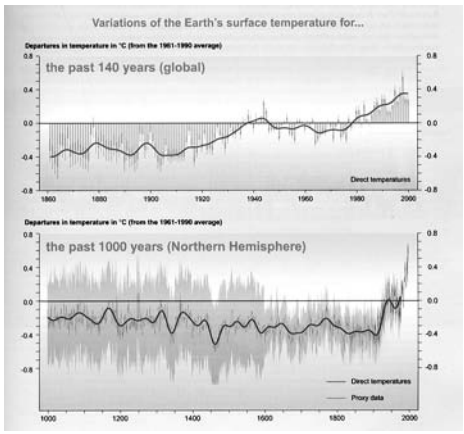
According to Dr Martin Parry (co-chair of Working Group II of the IPCC) policy-makers need to contemplate immediate actions. First, because we should not wait for anticipated climate change to happen before taking action, as then it might be too late. And second, because appropriate management responses consist in a 'no regret-policy' since efforts to reduce the vulnerability and increase the resilience of sites to existing non-climatic pressures and threats would also reduce their vulnerability to climate change related stresses.

Lastly, the IPCC also insists on the fact that 'the impact of climate change is projected to have different effects within and between countries. The challenge of addressing climate change raises an important issue of equity'.

Overview of climate change

Human induced perturbation of the climate system

The history of the planet has been characterised by frequent changes in climate. During the 20th century, the average global temperature increased by 0.6 °C. This increase is likely to have been the largest of any century during the past 1,000 years. The IPCC states that 'there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities'. Human activities have lead to the increase of atmospheric concentrations of greenhouse gases and changes in land use, inducing an increase of global averaged atmospheric temperatures. The current rate of increase of greenhouse gases is unprecedented during at least the past 20,000 years.



The Earth's surface temperature has increased by about 0.6 °C over the record of direct temperature measurements (1860-2000, top panel) - a rise that is unprecedented, at least based on proxy temperature data (tree rings, corals, ice cores, and historical records that have been calibrated against thermometer data) for the Northern Hemisphere, over the last millennium (bottom panel).

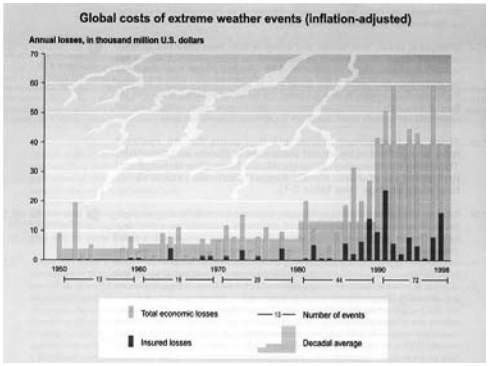
*IPCC, 2001: Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA, 398 pp.

But the temperature increase is just one of the many indicators for the ongoing climate change that is observed and expected to increasingly impact on people and their environments, including species, ecosystems and protected areas around the world. Changes in climate patterns are already being felt now at the local scale, as shown by observations, for instance, in the United Kingdom: temperatures are already rising, provoking more rainfall in the wetter north of the country but less rainfall in the dryer south. Indirect consequences include the cost of weather related natural catastrophes that significantly increased since 1953, according to the records of insurance companies worldwide.

Change in climate patterns and perturbations of the geophysical equilibrium

As a consequence of increasing atmospheric temperatures ('global warming'), additional changes in geophysical features are expected, as follows:

- Change of precipitation patterns.
- Increase in the frequency of warm episodes of the El Niño-Southern Oscillation (ENSO).



The economic losses from catastrophic weather events have risen globally 10-fold (inflation-adjusted) from the 1950s to the 1990s, much faster than can be accounted for with simple inflation. The insured portion of these losses rose from a negligible level to about 23% in the 1990s. The total losses from small, non-catastrophic weather-related events (not included here) are similar. Part of this observed upward trend in weather-related disaster losses over the past 50 years is linked to socio-economic factors (e.g., population growth, increased wealth, urbanization in vulnerable areas), and part is linked to regional climatic factors (e.g., changes in precipitation, flooding events).

*IPCC, 2001: Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA, 398 pp.

- Change of the frequency, intensity and seasonality of extreme events such as droughts, fires, heavy precipitations, floods, storms, tropical cyclones.
- Rise in sea level (caused by glacier retreat, ice melt and thermal expansion of sea water in response to higher temperatures) with serious implications for low-lying coastal areas and islands.
- Increase of carbon dioxide levels in the atmosphere and dissolved in the oceans causing increased marine acidification.

Projected climate change

The extent of future temperature increase is difficult to project with certainty since scientific knowledge of the processes is incomplete and the socio-economic factors that will influence the magnitude of such increases in the future are also uncertain. And even if carbon dioxide emissions are reduced significantly over the coming years, significant increases in temperature and sea-level rise would occur, resulting in major changes in climatic patterns mentioned above (rainfall regimes, risks of drought, intensity of rainfall, flooding, storms, tropical cyclones, etc). These effects would be even more exacerbated in a 'business as usual' scenario.

Several key indicators are used in the scientific literature to describe climate change among which: greenhouse gas composition (in particular CO_2), surface temperature, precipitation (rain, snow, hail), snow cover, sea and river ice, glaciers, sea level, climate variability, extreme weather events. The assessment reports of IPCC constitute the most authoritative reference on the extent of variation of these indicators that can be attributed to climate change.

According to the European Environment Agency, there is growing scientific confidence in the ability of climate models to project future climate. The main expected changes as a result of climatic change, and according to current scientific knowledge are:

- an increase by 1.4 to 5.8 °C by 2100 in global mean temperatures;
- an intensification of the hydrological cycle, with increased intensity of rainfall events; but at the same time more frequent droughts in arid and semi-arid areas;
- an increase in global sea level of 0.09 to 0.88 m by 2100;
- an increased frequency of storm surges locally.

Some potentially extreme outcomes remain unclear, such as a long-term melt of the Greenland ice sheet, a collapse of West Antarctic ice sheet and a change of Gulf Stream in the North Atlantic.

2

Predicting and managing the impacts of climate change on World Heritage

The Great Barrier Reef, Australia

© GBRMPA Image collection

Impacts of climate change on natural and cultural World Heritage

Impacts of climate change on natural World Heritage

Brief overview of the main impacts

Most of the changes in the climatological indicators listed above may have adverse impacts on natural World Heritage properties:

- Ice caps, glaciers and permafrost, sea ice, ice and snow cover especially in polar and mountain regions are melting.
- Temperatures and atmospheric CO_2 concentrations are increasing and impact directly or indirectly on plant and animal species and, in turn, on ecosystems.
- Coral reefs are bleaching.
- The growing season of plants is lengthening, plant and animal ranges are shifting poleward and upward in elevation, and with the help of increased temperatures and atmospheric CO_2 concentrations, invasive alien species increasingly impact upon indigenous species (see following section on terrestrial ecosystems).
- The composition and configuration of biotic communities is changing because of climate-change induced species range shifts and extinctions.

All these physical and biological changes affect ecosystem functioning, such as in relation to nutrient cycling, and the provision of ecosystem goods and services with significant impacts on human livelihoods. Thus, socio-economic activities, including agriculture, fishery and tourism, are also being impacted on increasingly, for example through changes in freshwater supply. Finally, climate change interacts with other global change drivers such as land-use change and socio-economic change, potentially exacerbating impacts on people and their environment.

Impacts on terrestrial biodiversity

Climate change will impact a wide range of biomes. As far as terrestrial biodiversity is concerned, the range of potential impacts includes:

For species distributions:

- Individualistic species responses in latitudinal and altitudinal directions.
- Individualistic species responses to warmer/cooler and drier/moister conditions.
- Geographic variation in the magnitude of species responses to the changing conditions.
- Species range shifts/losses due to range expansions, contractions and eliminations.
- Species range shifts relative to reserve boundaries: net loss/gain of species in reserves.
- Local, regional and global extinctions of species due to the changing conditions.
- Migration of invasive alien species and/or pathogens and parasites.

For community composition and configuration:

- Changes in presence/absence and relative/absolute abundance (evenness/richness).
- Formation of non-analogue communities (new species assemblages).

For ecosystem functioning, services and states:

- Changes in phenology (the timing of events such as flowering).
- Changes in nutrient cycling and natural resource supply (e.g. water).
- Changes in predator-prey, parasite-host, plant-pollinator and plant-disperser relationships.
- Changes in ecosystem services such as pest control, pollination and soil stabilisation.
- Ecosystem switches following changes in ecosystem functioning and disturbance regimes.

For disturbance regimes:

- Changes in the intensity, frequency and seasonality of extreme events such as fires, floods, droughts.
- Changes in human land-use pressures (global change synergies).

Consequently, various types of terrestrial ecosystems are at risk, including:

- Small and/or isolated protected areas.
- Protected areas with high-altitude environments.
- Protected areas with low-altitude environments.
- Protected areas with rare or threatened species with restricted habitats or home ranges.
- Protected areas with species at the limits of their latitudinal or altitudinal range.
- Protected areas with abrupt land-use transitions outside their boundaries.
- Protected areas without usable connecting migration corridors.
- Protected areas with rare or threatened species near the coast.
- Protected areas with interior wetlands.

Illustrative examples of impacts of climate change on terrestrial biodiversity are given in Box 1 and Box 2 on p.19 for the World Heritage sites of Doñana National Park (Spain) and Cape Floral Region (South Africa).

BOX 1
Potential climate change impacts on the Doñana National Park (Spain) [1]

The Doñana National Park and World Heritage property, in southern Spain, is the largest and most comprehensive conservation area in Iberia and covers an area of 50,000 hectares.

1. Hulme and Sheard, 1999. Climate Change Scenarios for the Iberian Peninsula. Climatic Research Unit, Norwich. Online: www.cru.uea.ac.uk/~mikeh/research/wwf.iberia.pdf.

Dessication of the wetland areas of the Park as a result of increased water use has resulted in the loss of some 100 plant species during the last 80 years. Further dessication of the wetlands can be expected in the region with increased temperatures of between 1.4 °C and 3.8 °C and reduced annual precipitation of between 5 and 10 per cent by the 2050s.
The Park is home to 365 recorded species of resident and migratory birds. It provides an ideal winter habitat for species such as the greylag goose and the teal that stop at the park on the migration route from western Europe to West Africa. It also provides an important spring nesting ground for African and Mediterranean birds such as the spoonbill. Nearly 20,000 greater flamingos use the area as a feeding zone. The Doñana National Park is the most important site for wintering ducks in Spain.
The winter droughts of the 1990s have already had a severe impact upon the area, a situation that is likely to become considerably more acute in the future as the climate of southern Spain dries. The park exists at an altitude between sea level and 40 m. Sea level in the region has risen by about 20 cm over the last century and future rises in sea level may further threaten these remaining wetland areas through saltwater inundation which threatens the survival of this important migratory bird habitat. Scenarios suggest further rises in sea level of between 20 cm and 110 cm by the end of next century.

BOX 2
Potential climate change impacts on the Cape Floral Region (South Africa) [2]

The Cape Floral Region World Heritage site consists of 8 protected areas covering 553 000 ha and characterised by an outstanding plant diversity, density and endemism. Based on supporting evidence by experiments, observations and modelling, climate change might be the most significant threat facing this diversity over the next 50 to 100 years. Projected changes in soil moisture and winter rainfall could result in a changed species distribution. This would affect the range restricted and locally rare species with limited dispersal ability and the climate sensitive relict wetland species that characterize the floristic region. Climate change might also affect the values of the site through drought mortality, the breaking up of highly specialized mutualisms and impacts on existing disturbance regimes such as fire. The first impacts of climate change on the region's biodiversity are already becoming apparent and many more impacts are expected. Bioclimatic modelling provides an excellent risk assessment but key knowledge gaps need to be closed by experimental and observational studies.
Potential strategies include investing in focussed research and developing a monitoring system, perhaps with the involvement of the public. Conservation planning should also be integrated with climate risk assessment and a coordinated regional effort should be established to analyse information and assess the risk of biodiversity loss. It is also important to increase the topographic diversity and landscape connectivity of protected areas by creating migratory corridors, to reduce or remove other stresses on the ecosystem and to strengthen risk preparedness, in particular for fires.

Impacts on mountainous ecosystems

Increasing atmospheric temperature is causing glaciers to melt worldwide. As far as mountainous glaciers are concerned, widespread retreats are being observed and will cause the melting of a number of glaciers, among which many are listed as World Heritage sites. The melting of glaciers has obvious consequences for the aesthetic values of these sites. But it will also have an impact on surrounding ecosystems:

- Glacier melting leads to the formation of glacial lakes. The banks of such lakes are made of moraines (accumulated earth and stones deposited by the glacier) that may collapse when the lake fills up and may thus lead to sudden, violent flooding in the valley. Any flood of this sort has disastrous consequences for the population and for the biodiversity of the entire region. Immediate disasters may be averted, however, by artificially draining the glacial lakes to avoid such outburst floods.
- The annual melting of mountainous glacier also drives the hydrological cycles of entire regions. But as the ice recedes, there will first be floods, and some time later, water supply will cease to be available, eventually leading to famine and pandemic disease.

Threats to terrestrial biodiversity mentioned above also apply to mountainous ecosystems. Shifts in tree-line are already being observed and this mechanism poses an important threat to many mountainous species.

Illustrative examples of impacts of climate change on mountainous glaciers are given in Box 3 and Box 4 on p.20 for the Sagarmatha National Park (Nepal) and the Huascarán National Park (Peru) World Heritage sites.

2. Bomhard & Midgley, 2005. Securing Protected Areas in the Face of Global Change: Lessons Learned from the South African Cape Floristic Region. A Report by the Ecosystems, Protected Areas, and People Project. IUCN, Bangkok and SANBI, Cape Town. Online: www.iucn.org/themes/wcpa/pubs/theme.htm#climate.

BOX 3
Potential climate change impacts on the Sagarmatha National Park (Nepal) [3]

In Sagarmatha, Nepal, air temperatures had been rising by 1 °C since the seventies, leading to a decrease in snow and ice cover of 30% in the same period and replacing a 4000 m high glacier on Mount Everest by a lake. Glacier lake outburst floods are now much more frequent, creating serious risks for human populations and having implications for the water supply in South Asia and the flow of major rivers such as the Ganges, Indus and Brahmaputra.

BOX 4
Potential climate change impacts on the Huascarán National Park (Peru) [4]

A number of effects of climate change are being monitored and studied at the Huascarán National Park, in particular the accelerated glacier melting, resulting in changes in the quality and quantity of water coming from the mountains and in greater risks of land slides and lake outburst events and the migration of certain species to higher altitudes. Such outburst floods in the Huascarán National Park threaten a nearby cultural World Heritage site: Chavin. Other effects such as the disappearance of certain native species, the increased pressure on certain park resources and the alteration of rain patterns are not yet quantified. Two million people are depending on water originating from the National Park and their demand on water resources is increasing. Possible solutions include: strengthening the park authority, the cooperation between public entities and private sector through the Huascarán Working Group and implementing a number of specific projects in the field of research and education related to climate change.

Impacts on marine ecosystems

The rise of ocean temperature threatens many marine species among which coral reefs that, in many areas, live close to their upper thermal limit. Several coral reefs are listed as World Heritage sites, partly because they host infinitely complex ecosystems in which a myriad of species of fish and aquatic vegetation are interlocked in a mutually profitable interdependence (see the example in Box 5).

BOX 5
Potential climate change impacts on the Great Barrier Reef (Australia) [5]

The Great Barrier Reef (GBR) is the world's largest coral reef ecosystem in the world (2100 km, 344,400 km²; and 2900 individual reefs). It is also among the world's most diverse ecosystems (1500 species of fish, 400 species of corals, and several thousands species of molluscs) and was listed under all 4 natural World Heritage criteria. The GBR Marine Park Authority (GBRMPA) is the responsible Australian Government authority, and the site is divided into zones which permit a range of activities under controls. The sustainability of this World Heritage site is sensitive to any change in the following climate parameters: sea level rise, sea temperature increase, storm frequency and intensity, precipitation, drought, land run-off, changing oceanic circulation, and ocean acidity. Of central concern are the acute and cumulative impacts of coral bleaching, which are triggered when the GBR experiences anomalously high water temperatures. It is important to note, however, that coral bleaching is a major threat to coral reefs everywhere. And the threat is not amenable to management in the short to medium term. [6]
In 1998 and 2002, major bleaching events occurred in the region. In 2002, between 60 and 95 per cent of corals were affected. Corals of most of the reefs recovered well but a small percentage (less than 5 per cent) of reefs suffered high mortality, losing between 50 and 90 per cent of their corals. As a response, a climate change Response Programme (2004 – 08) was developed to better understand and respond to climate change threats and to prepare an annual Coral Bleaching Response Plan and a climate change Action Plan. The Coral Bleaching Response Plan aims at detecting and measuring bleaching and other short and long term impacts (Satellite imagery, aerial and underwater surveys, community observations) and has received worldwide recognition (and was adapted for the Florida Keys and Indonesia for example). The climate change Action Plan aims at sustaining ecosystems, industries, and communities by identifying and implementing relevant management actions, adapting policy and fostering collaborations.
In addition, partnerships have been developed such as 'Bleach Watch' and NGO partnerships (IUCN, TNC, WWF). Outcomes include policy congruence, international recognition, research coordination and investment, stakeholder partnerships, community partnership teams and knowledge bases.

3. Communication of Martin Parry (Co-chair of working group II of the Intergovernmental Panel on Climate Change) at the expert meeting on Climate Change and World Heritage (UNESCO HQ, Paris, 16-17 March, 2006)
4. Communication of Pablo Dourojeani (the Mountain Institute) at the expert meeting on Climate Change and World Heritage (UNESCO HQ, Paris, 16-17 March, 2006)
5. Communication of Greg Terrill (Assistant Secretary, Heritage Division Australian Department of Environment and Heritage) at the expert meeting on Climate Change and World Heritage (UNESCO HQ, Paris, 16-17 March, 2006)
6. Australian Institute of Marine Science *Annual Report* 2001-2, p 18

The GBR management actions are recognized as world's best practice[7] and that the GBR has relatively low bleaching to date, but further events will be inevitable. The main challenge is to increase broad resilience, which requires multifactor efforts and in many respects adaptation, continuation and enhancement of current efforts. To increase the broad resilience of the GBR Marine Park, in 2004, the GBRMPA increased the percentage of no-take area within the Marine Park from 5% to 33%. Also, the Australian Government is working closely with the Queensland Government on the Reef Water Quality Protection Plan, which aims to halt and reverse the decline in water quality entering the Marine Park by 2013.

Impacts of climate change on cultural World Heritage

Climate change has implications for natural and societal systems (agriculture, human health, forestry, and infrastructure) including natural and cultural heritage. The assessment of the impacts of climate change on cultural World Heritage must thus account for the complex interactions within and between natural, cultural and societal aspects.

Direct physical impacts of climate change on cultural World Heritage

A number of direct impacts of climate change can be expected to play a role:

- Archaeological evidence is preserved in the ground because it has reached a balance with the hydrological, chemical and biological processes of the soil. Short and long cycles of change to these parameters may result in a poorer level of survival of some sensitive classes of material (see the example for the cultural sites in the Yukon Territory, Canada, see Box 6)
- Historic buildings have a greater intimacy with the ground than modern ones. They are more porous and draw water from the ground into their structure and lose it to the environment by surface evaporation. Their wall surfaces and floors are the point of exchange for these reactions. Increases in soil moisture might result in greater salt mobilisation and consequent damaging crystallisation on decorated surfaces through drying.
- Timber and other organic building materials may be subject to increased biological infestation such as migration of pests in altitudes and latitudes that may not have been previously concerned by such threats.
- Flooding may damage building materials not designed to withstand prolonged immersion, and post flooding drying may encourage the growth of damaging micro-organisms such as moulds (see the example for the World Heritage sites of the Historic City of London, Box 7 below). Rapid flowing water may also erode buildings.
- Increases in storminess and wind gusts can lead to structural damage.
- Movable heritage may be at risk from higher levels of humidity, higher temperatures and increased UV levels.
- Desertification, salt weathering and erosion is threatening cultural heritage in desert areas such as the Chinguetti Mosque in Mauritania (see Box 8 on p. 22).

BOX 6
Potential impacts of climate change on cultural sites in the Yukon Territory (Canada)[8]

The 19th-century whalers' settlements of Herschel Island in the Yukon Territory (Canada) are currently on the Canadian World Heritage Tentative List for their outstanding cultural value (Site of Ivvavik / Vuntut / Herschel). However, the deterioration of the permafrost is leading to ground slumping which is affecting many of the historic grave markers and even caskets buried in graveyards around Pauline Cove. Some caskets are tumbling with the slumping soil and are being broken up and pushed out. Consequently, the value of this site is threatened, even before its nomination on the World Heritage List.

BOX 7
Potential impacts of climate change on World Heritage sites of London, UK (Westminster Palace, Westminster Abbey and Saint Margaret's Church; Tower of London; Maritime Greenwich)

The United Kingdom Climate Impacts Programme has suggested that the sea level will rise in the Thames estuary between 0.26 m and 0.86 m higher on average by the 2080s than it was between 1961 and 1990. The Thames estuary is tidal with tides being occasionally enhanced by weather conditions in the North Sea. Pressure on the flood plain of the Thames is projected to get larger as the tides become higher over the next few years.
The Thames Barrier was designed to protect life, land and property against the highest tides and storm surges. It was expected to be used 2/3 times per year. It is now being used 6/7 times per year.

7. Global Coral Reef Monitoring Network 'Status of coral reefs of the world 2004'; WWF 'Climate change and World Heritage sites', Australia, 2006; D. Rothwell, 'Global Climate Change and the GBR', report for EDO, CANA, Greenpeace, Australia, 2004

8. Communication of Douglas Olynyk (Yukon Territorial Government and ICOMOS Canada) at the expert meeting on Climate Change and World Heritage (UNESCO HQ, Paris, 16-17 March, 2006)

One overtopping of the Barrier will have an indirect cost to UK economy of £30 billion and it can be predicted that flooding will inundate at least the World Heritage site closest to the Thames, namely the Palace of Westminster and the Tower of London. The Thames Barrier can go to 2025 before the 1000 year return flood event is exceeded. World Heritage site managers need to engage in the wider planning processes for a new Thames Barrier, in flood management planning for London and in development and land-use planning. The Management Plans of World Heritage sites should incorporate climate change adaptation in their guiding principles for management over the next 25-30 years and in the quinquennial revision of the management objectives.

BOX 8
Potential impacts of climate change on the Chinguetti mosque (Mauritania)

This World Heritage site is situated on the edge of the Sahara desert. It is home to a remarkable collection of Islamic manuscripts as well as a 13th-century mosque with a massive square minaret towering over the town. The town has provided a trading post for travellers on routes from the east carrying cargoes of gold and ivory. The wealth of the community traditionally meant that money was available to preserve the buildings from the climate in what is an extremely hostile environment.
The combination of the decline in trade and loss in income has increased the threat from the encroaching desert which constantly threatens the town's buildings, especially the mosque. Chinguetti's buildings are also regularly subjected with seasonal flooding with the subsequent erosion caused by the water run-off.

Social impacts of climate change on cultural World Heritage [9]

Changes to cultural heritage caused by climate change cannot be viewed separately from changes in society, demographics, people's behaviour, the impact of conflicting societal values and land-use planning which will also need to evolve in the face of climate change. In World Heritage terms, cultural heritage is now defined very widely to include individual sites, buildings or structures as well as urban or rural landscapes which may include dynamics that are not only subject to climate change but also contribute to climate change.

9. The issues mentioned in this paragraph refer to cultural heritage properties, although, to some extent, it also applies to natural heritage properties.

Cultural impacts of climate change on cultural World Heritage [10]

Climate change will have physical, social and cultural impacts on cultural heritage. It will change the way people relate to their environment. This relationship is characterised by the way people live, work, worship and socialize in buildings, sites and landscapes with heritage values. Climate change and the socio-economic changes that will result will have a greater possible impact on the conservation of cultural heritage than climate change alone. This combined effect needs to be explored more fully and this can be done in the context of World Heritage, as World Heritage sites provide excellent examples of test cases.

Interconnection of physical and social impacts

Many World Heritage sites are living places which depend on their communities to be sustained and maintained. Climate change has consequences for the whole of human existence and the products of human creativity. In the case of cultural World Heritage sites these consequences will be manifest in at least two principal ways: direct physical effects on the site, building or structure and the effects on social structures and habitats that could lead to changes in, or even the migration of, societies that are currently sustaining World Heritage sites. The implications of the latter are not well understood, even if the nature of the impacts will vary depending on the nature of the World Heritage sites.

Interconnection of physical and cultural impacts

The character of cultural heritage is closely related to the climate. The rural landscape has developed in response to the plant species that are able to flourish in different climatic regimes. The urban landscape and the built heritage have been designed with the local climate in mind. The stability of cultural heritage is, therefore, closely tied to its interactions with the ground and the atmosphere. Where World Heritage sites are in use by local communities there may be pressure for significant adaptive changes to allow use and occupation to continue. Even where this is not the case, there can be very direct physical effects.

Summary of changes in climate change indicators and related impacts on cultural heritage

In the context of complex interactions such as mentioned in the previous paragraph, one needs to define indicators to assess the overall impact of climate on cultural World Heritage. Climate change can be subtle and can occur over a long period of time. However, some climate change parameters such a freezing, temperature and relative humidity shock can change by large amounts over a short period of time. To identify the greatest global climate change risks and impacts on cultural heritage, the scientific community uses the climate parameters tabulated on the opposite page (Table 1).

10. Idem

Table 1. **Principal climate change risks and impacts on cultural heritage**

Climate indicator	Climate change risk	Physical, social and cultural impacts on cultural heritage
Atmospheric moisture change	- Flooding (sea, river) - Intense rainfall - Changes in water-table levels - Changes in soil chemistry - Ground water changes - Changes in humidity cycles - Increase in time of wetness - Sea-salt chlorides	- pH changes to buried archaeological evidence - Loss of stratigraphic integrity due to cracking and heaving from changes in sediment moisture - Data loss preserved in waterlogged / anaerobic / anoxic conditions - Eutrophication accelerating microbial decomposition of organics - Physical changes to porous building materials and finishes due to rising damp - Damage due to faulty or inadequate water disposal systems; historic rainwater goods not capable of handling heavy rain and often difficult to access, maintain, and adjust - Crystallisation and dissolution of salts caused by wetting and drying affecting standing structures, archaeology, wall paintings, frescos and other decorated surfaces - Erosion of inorganic and organic materials due to flood waters - Biological attack of organic materials by insects, moulds, fungi, invasive species such as termites - Subsoil instability, ground heave and subsidence - Relative humidity cycles/shock causing splitting, cracking, flaking and dusting of materials and surfaces - Corrosion of metals - Other combined effects eg. increase in moisture combined with fertilisers and pesticides
Temperature change	- Diurnal, seasonal, extreme events (heat waves, snow loading) - Changes in freeze-thaw and ice storms, and increase in wet frost	- Deterioration of facades due to thermal stress - Freeze-thaw/frost damage - Damage inside brick, stone, ceramics that has got wet and frozen within material before drying - Biochemical deterioration - Changes in 'fitness for purpose' of some structures. For example overheating of the interior of buildings can lead to inappropriate alterations to the historic fabric due to the introduction of engineered solutions - Inappropriate adaptation to allow structures to remain in use
Sea-level rises	- Coastal flooding - Sea-water incursion	- Coastal erosion/loss - Intermittent introduction of large masses of 'strange' water to the site, which may disturb the metastable equilibrium between artefacts and soil - Permanent submersion of low lying areas - Population migration - Disruption of communities - Loss of rituals and breakdown of social interactions
Wind	- Wind-driven rain - Wind-transported salt - Wind-driven sand - Winds, gusts and changes in direction	- Penetrative moisture into porous cultural heritage materials - Static and dynamic loading of historic or archaeological structures - Structural damage and collapse - Deterioration of surfaces due to erosion
Desertification	- Drought - Heat waves - Fall in water table	- Erosion - Salt weathering - Impact on health of population - Abandonment and collapse - Loss of cultural memory
Climate and pollution acting together	- pH precipitation - Changes in deposition of pollutants	- Stone recession by dissolution of carbonates - Blackening of materials - Corrosion of metals - Influence of bio-colonialisation
Climate and biological effects	- Proliferation of invasive species - Spread of existing and new species of insects (eg. termites) - Increase in mould growth - Changes to lichen colonies on buildings - Decline of original plant materials	- Collapse of structural timber and timber finishes - Reduction in availability of native species for repair and maintenance of buildings - Changes in the natural heritage values of cultural heritage sites - Changes in appearance of landscapes - Transformation of communities - Changes the livelihood of traditional settlements - Changes in family structures as sources of livelihoods become more dispersed and distant

Survey on the impacts of climate change on World Heritage properties worldwide

A questionnaire survey was launched by the World Heritage Centre in 2005 among all States Parties to the *World Heritage Convention* to assess the extent and nature of the impacts of climate change on World Heritage properties and action taken to deal with such impacts.

Of the 110 responses received from 83 States Parties, 72% acknowledged that climate change had an impact on their natural and cultural heritage. Forty-six countries mentioned that they were undertaking specific actions to deal with the issue although most of these actions were limited to the monitoring of the impacts of climate change. Thirty-nine countries reported dedicated research was underway. Forty-nine countries mentioned that political support was being mobilized, although this concerned mostly awareness-raising actions.

Seventy-one countries declared themselves to be interested in participating in programs and initiatives aimed to address climate change impact on World Heritage sites. Fifty of those specifically offered pilot sites and eleven co-financing opportunities.

A total of 125 World Heritage sites were mentioned specifically as threatened by climate change.

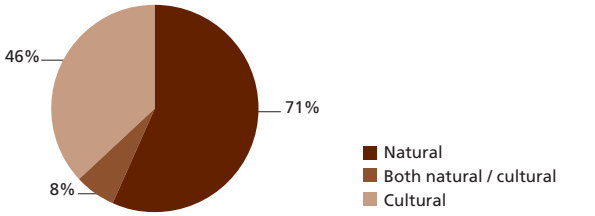
Seventy-nine of these sites were listed as natural or mixed (both cultural and natural) heritage along the following distribution in terms of biomes:
- 16 coastal marine sites (among which 7 coral reefs).
- 14 glacier sites and 7 mountainous sites.
- 28 terrestrial biodiversity sites.
- 14 mixed biomes and other type of sites.

The climate change impacts observed for natural World Heritage properties were:
- Glacial retreat and glacier melting (19 sites).
- Sea-level rise (18 sites).
- Loss of biodiversity (17 sites).
- Species migration and tree-line shift (12 sites, 6 for tree-line shift).
- Rainfall pattern changes and occurrence of droughts (11 sites).
- Frequency of wildfires (9 sites).
- Coral bleaching (6 sites).
- Coastal erosion (4 sites).
- Sea water temperature and salinity change (1 site).
- Hurricane, storms, cyclones (1 site).

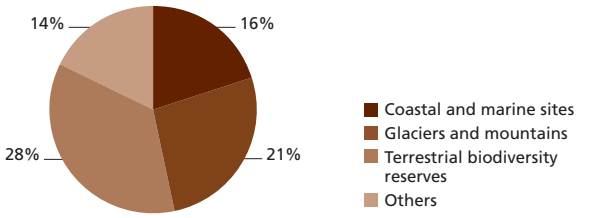
Climate change threats on 46 cultural World Heritage sites were reported. Almost all cultural sites were 'human-built structures' such as archaeological ruins, churches, mosque, temples, fortress, etc. Only 4 sites referred to cultural landscapes (among which 2 are traditional agricultural systems).

The climate threats raised for cultural World Heritage sites were:
- Hurricane, storms (11 sites).
- Sea-level rise (9 sites).
- Erosion (both wind and water driven) (8 sites).
- Flooding (7 sites).
- Rainfall increase (4 sites).
- Drought (3 sites).
- Desertification (2 sites).
- Rise in temperature (1 site).

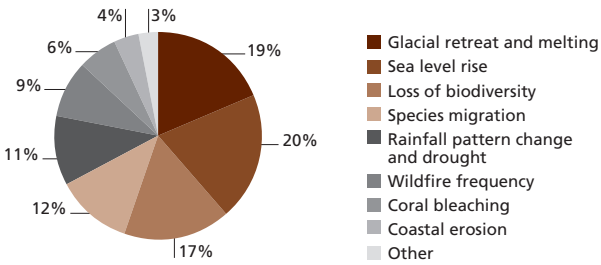
Type of sites affected by climate change



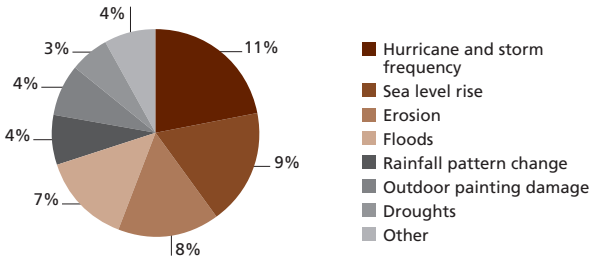
Type of biomes for natural World Heritage sites



Threats of climate change reported for natural World Heritage properties



Threats of climate change reported for cultural World Heritage properties



Implications for the *World Heritage Convention*[11]

Introduction

The *World Heritage Convention* is a unique multilateral environmental agreement as it recognizes that parts of the cultural and natural heritage are of outstanding universal value and therefore need to be preserved as part of the heritage of humankind. The key test for inclusion of cultural and natural properties on the World Heritage List is that of meeting the criteria of outstanding universal value (OUV), which are assessed through a rigorous evaluation process by the Advisory Bodies of the *World Heritage Convention*. Once the properties are inscribed on the World Heritage List they benefit from the *World Heritage Convention* as an important tool for international cooperation; however their conservation and management is the primary responsibility of the State Party where the property is located (Article 4).

In a sense natural World Heritage properties represent a unique subset of the world's global network of over 100,000 protected areas. Since natural World Heritage sites are distributed around the world and represent a variety of ecosystems they are exposed to impacts from climate change of different kinds, magnitudes and rates.

Ongoing climate change threats on World Heritage

The present and potential future impacts of climate change on biodiversity and ecosystems are well studied and documented. Many of the impacts of climate change mentioned in section 2.1.1 are already being observed, or are expected to occur in the short to medium term, in a number of natural World Heritage sites[12]. Climate change could amplify and accelerate major existing management problems and threats affecting the integrity of these properties: species and habitat change, resource extraction, inefficient site management, invasive species and, in some cases, armed conflicts. In addition a number of natural World Heritage properties show already high natural sensitivity and low capacity to cope with these social and environmental impacts; which increasingly require the use of innovative adaptive management mechanisms.

Implications in the context of the *World Heritage Convention*

In the specific context of the *World Heritage Convention*, climate change raises many concerns that are of critical nature for the future implementation of the *World Heritage Convention*. Natural World Heritage sites are inscribed on the World Heritage List if they meet one or more of the criteria of outstanding universal value and also meet the conditions of integrity[13]. At present, if a site is threatened by serious and specific danger – both ascertained and/or potential danger – it can be inscribed in the List of World Heritage in Danger (paragraph 180, *Operational Guidelines*). The *World Heritage Convention* also notes that if a property loses the characteristics which warranted its inscription on the World Heritage List it can be deleted from the List (paragraph 176(e), *Operational Guidelines*). Furthermore the States Parties of the *World Heritage Convention* have the duty of ensuring the protection, conservation and transmission to future generations of the properties located on its territory (Article 4). Therefore, within the context of the *World Heritage Convention*'s legal framework, climate change poses a number of critical questions:

- Should a site be inscribed on the World Heritage List while knowing that its potential OUV may disappear due to climate change impacts?
- Should a site be inscribed on the List of World Heritage in Danger or deleted from the World Heritage List due to the influence of impacts that are beyond the control of the concerned State Party?
- Could a particular State Party, making use of Article 6(3) of the *World Heritage Convention* blame another State Party for their responsibility on climate change?
- Should the *World Heritage Convention* – and its associated *Operational Guidelines* seriously consider the fact that for some natural properties it will be impossible to maintain the 'original' OUV values for which they were originally inscribed on the World Heritage List, even if effective adaptation and mitigation strategies are applied; therefore requiring an 'evolving' assessment of OUV values?
- Given the long-term nature of climate change impacts should the consideration of OUV be deliberately considered in a longer time frame context?

The questions posed above are pertinent as there is little doubt that climate change will impact on the natural values and integrity of World Heritage sites, thus affecting their outstanding universal value and, potentially, their listing as a natural World Heritage property. If a site was inscribed for its glaciers, and the glaciers melt, is it 'no glaciers – no World Heritage site'? A similar problem may arise from climate change-related degradation of coastal ecosystems due to sea-level rise. Natural disasters triggered by extreme weather events may cause severe and irreversible impact on geological, geomorphologic and physiogeographic heritage (criterion viii). Most importantly, physical and biological changes affect ongoing ecological and biological processes and natural habitats through species range shifts and extinctions, changes in community composition and configuration and changes in ecosystem functioning (criteria ix and x). Potentially, the World Heritage List as we know it today could be changed drastically.

11. Most issues mentioned in this section (prepared by IUCN) refer to natural heritage properties, while the majority of them apply also to cultural heritage.
12. Dudley, 2003. No Place to Hide: Effects of Climate Change on Protected Areas. WWF Climate Change Programme, Berlin. Online: www.worldwildlife.org/climate/pubs.cfm.
13. See paragraphs 77-78 and 87-95 of the *Operational Guidelines for the Implementation of the World Heritage Convention* (OG). Online: whc.unesco.org/en/guidelines.

Implementing appropriate management strategies

At the same time, extreme weather events, physical and biological changes and increasing pressures from other human activities affect the conditions of integrity of the properties, thus requiring appropriate adaptation and mitigation management. Therefore, should this new management requirement be considered a prerequisite for a site to meet the conditions of integrity? The integrity required for inscription of natural World Heritage sites might however prove to be an asset when it comes to alleviating climate change impacts through 'healthy' landscapes and seascapes. Climate change impacts are also likely to give added importance to well managed and designed buffer zones which link World Heritage sites with the surrounding landscape.

The possible implications for the *Operational Guidelines*

As mentioned above, accounting for climate change impacts in the evaluation, monitoring, reporting, and conservation of World Heritage sites is an important task, and it may have implications in the working processes of the World Heritage Committee.

Therefore, in the face of climate change, it is appropriate to assess whether the procedures outlined in the current *Operational Guidelines for the Implementation of the World Heritage Convention* are adequate, and also to clarify the role of the *World Heritage Convention* and its Committee in dealing with this issue. It is particularly timely and imperative to prepare a tailored climate change strategy for World Heritage.

What can be done with respect to climate change and World Heritage?

Experience and lessons learned on addressing climate change stress the need for using a number of management responses at national and local levels. These responses are applicable in the context of the *World Heritage Convention* and the possible options are synthesized in the main strategy presented in Section 3 and described in detail below.

International conventions

Addressing climate change issues at different levels requires the development of synergies and partnerships with other multilateral environmental agreements and initiatives that are also working on this issue. Therefore, it is important for the World Heritage Committee to establish closer working links with many other following programmes and initiatives.

The UNFCCC and the Kyoto Protocol

The major accomplishment of the United Nations Framework Convention for climate change (UNFCCC, 1992) was to recognize the problem of climate change. In the early 1990s there was less scientific evidence on climate change. The UNFCCC recognized that the climate system is a shared resource whose stability can be affected by emissions of carbon dioxide and other greenhouse gases. Governments were required to gather and share information about greenhouse gas emissions and national policies. They were to launch national strategies for addressing greenhouse gas emissions with the ultimate objective *'to achieve […] stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system […] within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner'* (Article 2 of the UNFCCC). The heaviest burden for combating climate change was placed on developed countries, recognizing that emissions in less economically developed countries would rise to ensure vital economic development. The Framework was a document that was to be amended and augmented over time, the first addition being the Kyoto Protocol (1997).

The Programme of work (Buenos Aires) requested further implementation of actions including:

- data and modelling, vulnerability and adaptation assessment and implementation;
- that the Global Environment Facility report on support of the programme;
- that the UNFCCC secretariat organize regional workshops to facilitate information exchange and integrated assessments on adaptation reflecting regional priorities.

The Subsidiary Body for Scientific and Technological Advice (SBSTA) was requested to develop a structured five-year programme of work on impacts, vulnerability and adaptation. The draft list of activities (2006-2008) include methods and tools, data and observations, climate modelling and downscaling, thresholds, socio-economic data, adaptation practices, research, adaptation platform and economic diversification.

In the meantime three new funds have been established, a data base on local coping strategies was made available, capacity-building frameworks have been agreed on, a Consultative Group of Experts (CGE) has developed hands-on training materials and a seminar on the development and transfer of technologies for adaptation took place in June 2005.

The World Heritage Committee could collaborate with the UNFCCC secretariat on climate change issues by presenting information at the Conference of the Parties (COP) and subsidiary bodies meetings, being involved in the SBSTA 5-year work programme, encouraging exchange of experts and by using UNFCCC guidelines. National Focal Points of both Conventions could also work together on climate change issues.

UNESCO's Programme on Man and the Biosphere (MAB)

The MAB Ecosystem based research focus includes research on sustainability, minimizing biodiversity loss and carbon sequestration issues. A number of priority ecosystems have been identified, including mountains, dry and arid lands, humid tropics, coastal zones and small islands as well as urban areas. Biosphere reserves have been used as a network for testing ways and means of minimizing biodiversity loss (2010 target), and addressing threats and opportunities posed by climate change.

The high environmental sensitivity of coupled human-environment systems in mountain areas provides ideal circumstances for studying global change impacts. The UNESCO MAB Programme has therefore, together with the Mountain Research Initiative (MRI), launched a project on Global Change in Mountain Regions (GLOCHAMORE) which will attempt to address global change issues by reviewing the state of global change research in selected mountain biosphere reserves. These will then be used as pilot study areas for implementing activities that will help in assessing the impacts of global change on mountain environments and people. The biosphere reserves selected to take part in the initial stages of the project include a number of World Heritage sites.[14] Therefore, the *World Heritage Convention* and the UNESCO MAB Programme could cooperate and coordinate their activities in the field of developing and implementing monitoring, adaptation and mitigation options for World Heritage sites and Biosphere Reserves in mountain ecosystems.

In addition, there is considerable overlap and synergy between Biosphere Reserves and Ramsar sites (85), Biosphere Reserves and World Heritage sites (74) and all three (18) and these could specifically provide sustainable development approaches to improve carbon sequestration, livelihoods and minimizing biodiversity loss.

Ramsar Convention on Wetlands (1971)

The attention to climate change issues is growing in the framework of the Ramsar Convention[15] leading to the Conference of the Parties (COP8, Valencia 2002) and the documents prepared for this including 'Climate Change and Wetlands: Impacts, Adaptation and Mitigation.[16]

There are plans to update and to look specifically into additional sources of information on wetland ecosystems and species including inland and coastal wetlands as well as peatlands. Resolution VIII.3 which was adopted by the contracting parties states '… that climate change is occurring and may substantially affect the ecological character of wetlands and their sustainable use' and '… that wetlands could play a role in adapting to and in mitigating climate change'.

A major component of adaptation that needs further attention is the assessment of the vulnerability of wetlands to climate change. Many wetlands are vulnerable to climate change either due to their sensitivity to changes in hydrological regimes and/or due to the other pressures from human activities.

The management challenges include addressing the impacts of multiple pressures where climate change is an added pressure. Wetlands are vulnerable to climate change and have limited adaptive capacity. Therefore innovative solutions are required. Management plans need to consider impacts from climate change and other pressures, have to minimize changes in hydrology from other human activities, to reduce non-climate pressures, to monitor the changes. Monitoring is essential to look at the effectiveness of adaptation options and steps to rectify any adverse effects should be part of the adaptive management strategy. A key limitation to implementing adaptation and mitigation options for wetlands is the lack of knowledge of wetland hydrology, functioning, their uses and past and present management. Pilot research projects at wetland World Heritage sites, which are also Ramsar sites, could help to fill this gap.

Contracting Parties to the Ramsar Convention have to manage wetlands to increase their resilience to climate change and variability (extreme climatic events - floods and droughts) and promote wetland and watershed protection and restoration. The Ramsar Convention recognizes that climate change impacts will vary between different wetland types and overall adaptation options are required. Again, the capacity of different regions to adapt to climate change depends upon their current and future states of socio-economic development and their exposure to climate stresses. In general, the potential for adaptation is more limited for developing countries, which are also projected to be more adversely affected by climate change.

A number of World Heritage sites are also Ramsar sites,[17] and any response strategies for wetland World Heritage sites should build on previous work, in particular under the Ramsar Convention. The sites in common include the Danube Delta, Everglades, Doñana National Park, Lake Baikal. The Ramsar Convention particularly concentrates on wise and sustainable use through the ecosystem approach. Wetlands sustainability is sensitive to any change in climatic parameters as temperature and precipitation; in addition, by 2080 about 20% of existing coastal wetlands could be lost to sea-level rise.

14. www.unesco.org/mab/mountains/home.htm.
15. IUCN, 1999. Wetlands and Climate Change. Exploring Collaboration between the Convention on Wetlands (Ramsar, Iran, 1971) and the UN Framework Convention on Climate Change. Online: www.ramsar.org/key_unfccc_bkgd.htm.
16. Ramsar, 2002. Climate Change and Wetlands: Impacts, Adaptation and Mitigation. Ramsar COP 8 DOC 11. Online: www.ramsar.org/cop8/cop8_doc_11_e.htm.
17. www.ramsar.org/world_heritage.htm.

Convention on Biological Diversity (CBD)

This Convention covers a wide range of issues related to the conservation and sustainable use of biodiversity. The impacts of climate change on biodiversity are already a major concern to the Convention on Biological Diversity. In 2000, the Conference of the Parties (COP) drew attention to the serious impacts of loss of biodiversity on terrestrial and marine ecosystems, and on people's livelihoods and requested the Convention's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to establish an ad hoc technical expert group. This group carried out an in-depth assessment of the inter-linkages between biodiversity and climate change. There are significant opportunities for mitigating climate change, and for adapting to climate change while enhancing the conservation of biodiversity. The report also identified tools to help decision makers to assess impacts and make informed choices for mitigation and adaptation projects.

In 2004, the 7th COP (Kuala Lumpur, 2004) promoted synergy among the activities to address climate change, including desertification and land degradation, conservation, sustainable use of biodiversity, and the development by 2010 of national-level conservation strategies that are specifically designed to be resilient to climate change. Another expert group on biodiversity and adaptation to climate change was established, which undertook a detailed assessment. One of the main findings is that the ability of natural and managed ecosystems to adapt autonomously to climate change is insufficient to halt the rate of biodiversity loss and that adaptation towards increasing ecosystem resilience should be promoted. If one considers the example of species shifting ranges, although past changes in the global climate resulted in major shifts in species ranges, and biomes, these changes occurred in landscapes that were not as fragmented as today, and with fewer pressures from human activities. Therefore, one of the focus of the CBD includes the creation of corridors to protect biodiversity from the effects of climate change, and further, to recognize the important role that protected areas can play in mitigating some of the impacts of climate change.

These findings provide advice and guidance on how to mainstream biodiversity into climate change activities, at the biophysical level and at the level of tools and practical approaches. This information can be applied to the management of protected areas in general, and to World Heritage sites in particular, in order to mitigate and adapt to climate change.

Links between the conventions

It is recommended that close and effective linkages with these conventions and programmes be an integral element of any initiative relating to climate change and World Heritage properties. Further consultation is essential with the secretariats of these conventions and programmes.

Also it is important to note the 'Issue Based Modules (IBM)' initiative being developed by UNEP in partnership with UNEP-WCMC and IUCN for the coherent implementation of the biodiversity-related Multilateral Environmental Agreements (MEAs). The pilot phase of this project has identified 'Climate Change' as one of the 4 IBMs. The IBMs bring together all the decisions of these MEAs on that particular issue and provide guidance to the States Parties for their implementation.

Designing management plans accounting for the issue of climate change

If a Management Plan is specifically designed and formatted to foster its use as a working document which can be updated on a regular basis, then it can become a key tool in the effective stewardship of World Heritage sites under threat from climate change and actions in response to climate change can be flexibly introduced throughout the document.

The following specific actions to adapt to climate change might be necessary at a regional or local level to ensure a continuous redefinition of adaptation strategies as climate projections are refined:

- Enhancement of appropriate education and traditional skills.
- Rigorous ongoing monitoring and maintenance.
- Research to support national/regional decision-making.
- Planning for emergency preparedness.
- Re-evaluation of management priorities in response to climate change.
- Training on the various problems and possible responses to climate change in all aspects of conservation activity namely, development of traditional skills, monitoring, management and emergency preparedness.

Level of actions (site, local, landscape, State Party, regional or thematic, global level) and networking

Involvement of local communities

A strong focus also needs to be put on local knowledge systems and the way that they understand and adapt to changes in climate. Communities need to be a part of the overall process of understanding and dealing with climate change (e.g. as mentioned in the case studies on the Huascarán National Park, see Box 4 on p.17). Local influential sectors should also be part of this process such as tourism (e.g. in the Great Barrier Reef region, see Box 5 on p.17), or industry (such as mining in the Huascarán National Park, see Box 4 on p.17). This participation would include management planning and implementation, monitoring, and so on.

Landscape-based approach

Potential threats would take many forms and would affect different types of heritage in different ways. Therefore we think of heritage in an integrated manner,

including landscapes, settlements (urban and rural), buildings, and objects and collections. Consequently, sites should be envisaged in a broader environment and in relation to system planning.

Networking

'Natural and social systems of different regions have varied characteristics, resources and institutions, and are subject to varied pressures that give rise to differences in sensitivity and adaptive capacity' (Intergovernmental Panel on Climate Change Technical Summary, p.44) This quotation indicates clearly the global impact of climate change. However the challenges need to be addressed at a regional level, with responsibility for adaptation being taken locally.

The schematic below (Figure 1) illustrates the links between impacts, challenges and responses. It suggests that local managers will need to explore the potential for developing or adapting existing management plans and actions to respond to the climate change challenges.

maintenance training and considering to initiate partnerships with research-led universities and institutions to ensure that research addresses the climate change problems that cultural heritage is expected

Research

There is a need for more research on the effects of climate change on both the physical heritage and the social and cultural processes that they are a part of. The Intergovernmental Panel on Climate Change (IPCC), set up in 1988, draws on the work of experts from around the world to provide objective information on climate change for policymakers. Their Assessment Reports provide the technical, scientific and socio-economic information on climate change, possible impacts and responses. Each report includes a Summary for Policy makers. The third Assessment Report was produced in 2001 and the fourth will be published in 2007.

Working Group II of the IPCC is charged with assessing the impact, adaptation and vulnerability of societies to climate

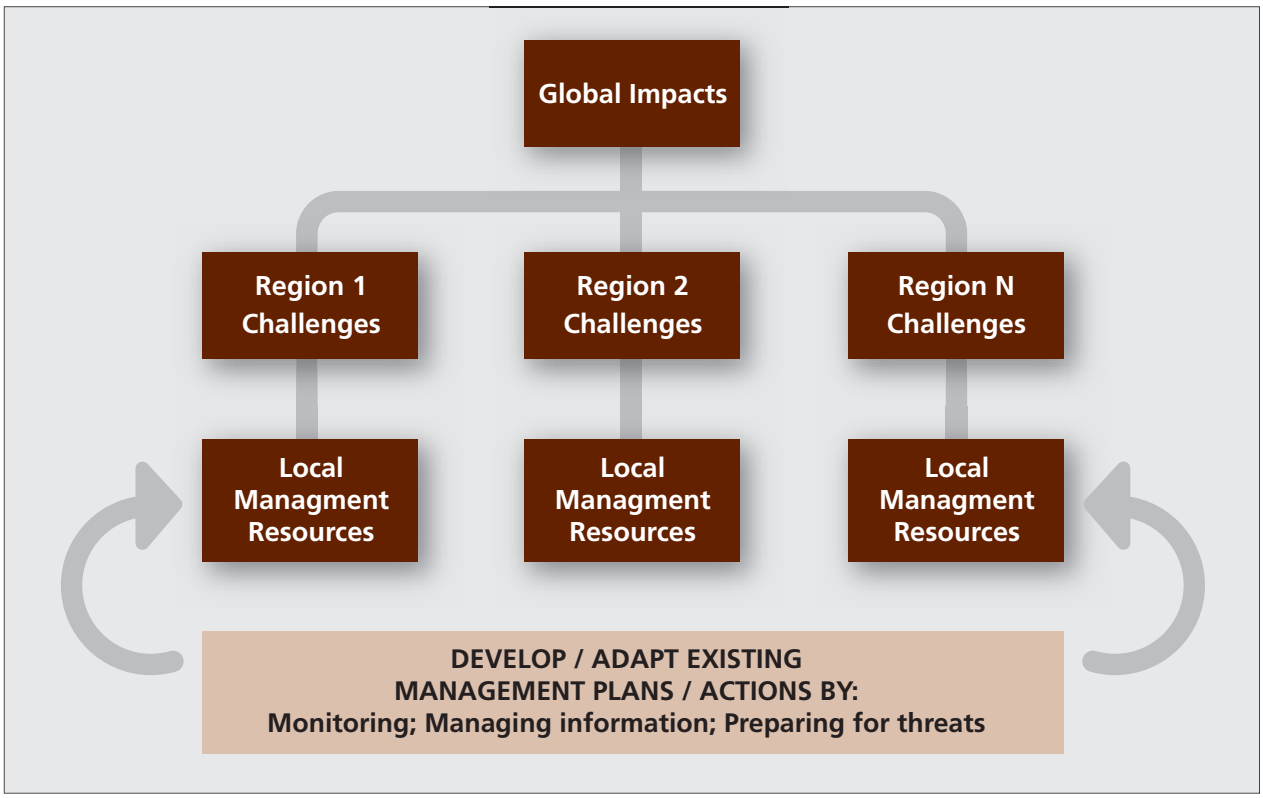


Figure 1: Schematic of the links among global, regional and local impacts and responses to climate change

No one can work alone in this complex field. Strengthening of existing networks is necessary, along with ensuring that climate change issues become a part of the exchange of information within those networks. The environmental effects on cultural heritage such as climate change are transboundary. At the very least, regional networks need to be strengthened and focussed on climate change adaptation. UNESCO Regional Offices should encourage and support local initiatives, such as community awareness, emergency preparedness and

change. The report focuses on the effect of climate change on sectors, for example ecosystems, society and settlement and the effects regionally, usually on a continental scale.

The UNESCO World Heritage Centre could engage with key climate change researchers from the Intergovernmental Panel on Climate Change to encourage them to address cultural heritage issues more directly. This should ensure that climate data of direct relevance to World Heritage are given the necessary attention.

There are several research and academic institutions and organizations worldwide[18] that are engaged in research on climate change impacts. There is need for national heritage strategies to establish collaborative programmes with such bodies.

Information management, communication, and building public and political support

Strengthening of capacity building is important for dealing with effects of climate change as well as for good communication and awareness programmes. There is a need to ensure better gathering and analysis of information to identify changing conditions related to climate change. Developing adequate monitoring where they do not exist and strengthening existing ones will be an important aspect of this effort.

Information management

Scientific understanding of traditional materials and assemblies is the foundation of sustainable management of World Heritage sites in a changing climate (including rain penetration, high summer temperatures and chloride loading). Information based on cross-field monitoring need to be sensitive to the scale and time of problems and guidance must be designed accordingly.

Not only should extreme events be documented but also short cycles of change that together can make significant changes to cultural heritage. Records of short cycle changes will gradually expand the notion of climate change impact on cultural heritage and enrich understanding of this phenomenon. A more complex issue that will need underpinning by scientific research is that of documenting cumulative processes to complement events-based data.

Information needs to be disseminated on the following specific areas of need:

- Climate change modelling and monitoring geared to cultural heritage;
- Prediction of subsidence and heave caused by extreme weather;
- Understanding of damage mechanisms and remediation due to extreme weather;
- Understanding the effect of wind-driven rain at a local level which leads to severe damp penetration;
- Understanding the effect of wind driven dust and pollutants at a local level leading to erosion and weathering;
- Understanding the effect of new pest migration and infestations, eg. termites;
- Understanding water resistance of building materials and techniques;
- Assessment of the availability of stocks of renewable materials and the development of old technologies such as lime technology;
- Environmental performance of historic buildings under extreme weather;
- The interface between fragile and very robust materials.

The notion that all cultural heritage can be saved when confronting climate change must be tackled through information on the meaning and fragility of cultural heritage including adaptation, loss and the notion of abandonment in the face of extreme weather.

Communication and building public and political support

Mobilizing public and political support for climate change adaptation and mitigation inside and outside World Heritage sites is essential. This has to range from local to regional and global approaches and involve a variety of measures: workshops, exhibitions and expositions, media campaigns, audio-visual material and popular publications which link the global phenomenon of climate change to the local and regional context. Most likely, maximum support is further gained through linking local and regional impacts to individual actions and vice versa. For example, simple and straight-forward ways of communicating the impacts and implications of climate change in a local and regional context raised considerable public and political awareness in the Cape Floral Region in South Africa (see Box 2 on p.19) – with subsequent benefits for research, decision-making, planning and management.[19]

One of the requests of the Committee in its Decision 29 COM 7B.a related to the use of the World Heritage network is 'to demonstrate management actions that need to be taken to meet [climate change] threats both within the properties and in their wider context'. To address this aspect of the Decision, it is proposed that specific World Heritage sites be used as demonstration models for countries and other stakeholders to design adaptation and mitigation strategies for World Heritage sites facing climate change challenges. Communication on this issue could occur at two levels. First, at the local and regional level where World Heritage sites are used as anchors to build site-based and national awareness and strategies (bringing together NGO's, academics, and other field-based researchers). At the second, global level, the newly developed strategies are disseminated to the World Heritage Committee, States Parties and other stakeholders through NGO networks (Advisory Bodies and other conservation NGOs), academic networks and UN bodies.

Therefore World Heritage sites could act both as 'host sites' where pilot projects are designed, developed and implemented and 'seed sites' from where the message about successful response strategies can be spread. Activities centring on World Heritage sites should wherever possible build on already existing knowledge, both scientific and stakeholder-

18. Centre for Ecological Sciences (India), The United Kingdom Meteorological Office, the South African National Biodiversity Institute, the Australian Institute for Marine Science, etc.

19. Bomhard, B., Midgley, G.F., 2005. Securing Protected Areas in the Face of Global Change: Lessons Learned from the South African Cape Floristic Region. A Report by the Ecosystems, Protected Areas, and People Project. IUCN, Bangkok and SANBI, Cape Town. Online: www.iucn.org/themes/wcpa/pubs/theme.htm#climate

specific, and may provide a framework for improved coordination. Most States Parties and site managers are expected to welcome the development and implementation of pilot projects in their World Heritage sites, particularly if external funding is available. It is suggested that States Parties could be requested to provide data and sites for pilot projects, endorse project proposals, ensure public and political support, initiate pilot projects in cooperation with relevant stakeholders, or provide financing, co-financing or in-kind support (e.g. staff, offices, and vehicles).

Another request of the World Heritage Committee at its 29th session (Durban, 2005) concerned the dissemination of information on the effects of climate change on World Heritage sites to 'reach the public at large, in order to mobilize political support for activities against climate change and to safeguard in this way the livelihood of the poorest people of our planet.' As World Heritage is tied to some of the most recognizable, renowned, iconic, and cherished destinations around the world, it is suggested to use some of these places to convey information on the direct impacts of climate change in order to reach the public and gain its support for actions. Here as well, strategies and activities should be built at different levels. Developing case studies on the impacts of climate change on a few iconic World Heritage sites would allow drawing a lot of attention from the public, the media and the policy makers. The selection of sites concerned by such case studies would obviously require further discussion with States Parties and within the World Heritage Committee.

The selected sites should represent the widest array of:
- Type of site (cultural heritage, cultural landscape, natural heritage).
- Value and significance.
- Observations of damage due to climate change.
- Proposed/managed interventions or adaptive responses such as plans or measures to counteract climate change threats.
- Future short, medium and longer-term actions to adapt to climate change for best practices advertising.

Local communities should be closely involved in the processes of investigation of the impacts of climate change and the development of adaptation strategies. The strong links between cultural and natural heritage could also be reflected in these case studies. These case studies should also be the opportunity to illustrate how adaptation measures could be developed to avoid the general feeling of discouragement of the public in the face of climate change.

Subsequently, these case studies could be used as field experimental pilot sites for the development of appropriate strategies. From these examples a number of key principles can be derived on which sustainable adaptive responses to climate change can be developed. These principles are:
- To ensure that the development of education and the teaching of traditional skills is adapted to the needs of a changing environment;
- To undertake rigorous ongoing scientific monitoring of changes in condition of cultural heritage materials;
- To recognize that maintenance measures will be tested more severely due to climate change and may require a greater proportion of available resources;
- To design flexible management planning objectives to enable priorities to be re-evaluated in response to climate change;
- To carry out scientific research to develop understand and knowledge of historic and archaeological materials to support local/regional decision-making and to place cultural values and significance in their social/environmental context.

Regarding communication issues, collaboration with relevant organizations (e.g. the United Nations Foundation) could be established. The UN Foundation has a strong expertise in using networks of local entities to work with the media and public officials to encourage greater trust and support for the UN. At a global level, a coalition of supporting partners (countries, UN bodies, NGOs, and others) could be built to design both independent and collective outreach activities to advance this agenda.

Vulnerability assessment

Natural heritage

Climate change will impact a wide range of biomes. As far as terrestrial biodiversity is concerned, the range of potential impacts includes:

Assess vulnerability of World Heritage properties and develop strategies for those at most risk

The vulnerability of natural World Heritage sites is a function of their exposure, sensitivity and adaptive capacity to the present and potential future impacts of climate change. The general objective of vulnerability assessment is to inform decision-makers of specific options for alleviating and adapting to the impacts of global change.[20] The strong variation in vulnerability by location requires a site-based analysis with simultaneous links to other sites and scales of analysis.[21] This can be applied to natural World Heritage sites since World Heritage crosses all scales, with individual sites of varying size embedded in a variety of different terrestrial and marine ecosystems around the world. State-of-the-art vulnerability assessments provide a framework for assessing the vulnerability of natural World Heritage sites based on both scientific and stakeholder-specific assessment of the exposure, sensitivity and adaptive capacity to climate changes. The promotion of these assessments by the *World Heritage Convention* will have a major impact at national and international levels.

20. Schröter et al., 2005. Assessing vulnerabilities to the effects of global change: an eight step approach. Mitigation and Adaptation Strategies for Global Change 10, 573-596.
21. Turner et al., 2003. A framework for vulnerability analysis in sustainability science. PNAS 100, 8074-8079.

A two-pronged approach is required: first, the vulnerability of natural World Heritage sites, which are particularly at risk, should be assessed by the States Parties and specific site-level mitigation and adaptation strategies should be designed and implemented in partnership with relevant stakeholders. Second, States Parties and site managers need to look beyond the individual site level and develop and implement regional and/or transboundary mitigation and adaptation strategies that reduce the vulnerability of natural World Heritage sites in a larger landscape or seascape context. Natural World Heritage sites must be seen as core sites within functioning regional networks of protected areas, conservation corridors and stepping stones. 'Healthy' World Heritage sites can contribute considerably to 'healthy' landscapes and seascapes that are better able to buffer climate change impacts. The World Heritage Centre and Advisory Bodies to the *World Heritage Convention* should encourage States Parties and site managers, in collaboration with relevant academic and research institutions, to accomplish these tasks and make available their knowledge and experience in the field of climate change adaptation and mitigation.

An eight-step approach has been developed to guide vulnerability assessments of coupled human-environment systems (see Box 9). This approach could be adopted easily for World Heritage sites and can also be used to guide future work on vulnerability under the *World Heritage Convention*. Most importantly, vulnerability assessments should not look at climate change impacts in isolation, but should rather assess the vulnerability of World Heritage sites to global change impacts in general due to the many interactions involved.

BOX 9
An eight step approach to guide vulnerability assessments[22]

1. *Define study area together with stakeholders and choose spatial and temporal scale.*
2. *Get to know place over time by reviewing literature, contacting and collaborating with researchers, spending time in the field with stakeholders and assessing nearby areas.*
3. *Hypothesize who is vulnerable to what: refine focus on stakeholder subgroups and identify driving stresses and interactions of stresses.*
4. *Develop a causal model of vulnerability:*
   - *Examine exposure, sensitivity and adaptive capacity*
   - *Formalize into model(s)*
5. *Find indicators for the elements of vulnerability*
   - *Exposure indicators*
   - *Sensitivity indicators*
   - *Adaptive-capacity indicators*
6. *Operationalize model(s) of present vulnerability*
   - *Apply model(s) to weigh and combine indicators*
   - *Apply model(s) to produce a measure of present vulnerability*
   - *Validate results with stakeholders etc.*
7. *Project future vulnerability*
   - *Choose scenarios with stakeholders*
   - *Scenarios should demonstrate full range of likely trends*
   - *Apply model(s) to produce a measure of future vulnerability*
8. *Communicate vulnerability creatively*
   - *Use multiple interactive media*
   - *Be clear about uncertainty*
   - *Trust stakeholders*

A full vulnerability assessment is no easy task given the complexity of factors, processes, and feedbacks operating within coupled human-environment systems[23] and may lie well beyond the capacities of many States Parties and site managers at present. Hence, a key role of the *World Heritage Convention* will be to establish linkages with organizations and institutions working on climate change issues, within the countries or in the region. It is also important to tailor the above approach to meet country specific needs. The general conceptual framework presented here provides a useful point of departure for assessing the vulnerability of World Heritage sites. As mentioned, this framework should be modified (simplified) to suit the specifics of a given site.

Assess future climate change scenarios through appropriate tools and guidelines

A comprehensive set of technical guidelines to assess climate change impacts and response strategies in general is available from the Intergovernmental Panel on Climate Change,[24,25] and has been reviewed from a coastal perspective.[26] Climate change impacts and response strategies have been recently discussed in detail for islands.[27]

22. For a detailed discussion see Schröter et al. (2005, Assessing vulnerabilities to the effects of global change: an eight step approach. Mitigation and Adaptation Strategies for Global Change 10, 573-596). According to them, for vulnerability assessments, the role of numerical modelling is the projection of future states of a system. Here, steps 1-3 take place prior to modelling, whereas steps 4-8 take place as part of the modelling and modelling refinement process.

23 Turner et al., 2003. Illustrating the coupled human-environment system for vulnerability analysis: three case studies. PNAS 100, 8080-8085.
24 Carter et al., 1994. IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations. Department of Geography, University College London, London.
25 Parry & Carter, 1998. Climate Impact and Adaptation Assessment: a Guide to the IPCC Approach. Earthscan, London.
26 Klein et al., 1999. Coastal adaptation to Climate Change: can the IPCC Technical Guidelines be applied? Mitigation and Adaptation Strategies for Global Change 4, 239-252.
27 Tompkins et al., 2005. Surviving Climate Change in Small Islands: a Guidebook. Tyndall Centre for Climate Change Research, Norwich.
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For natural systems[28] and protected areas,[29,30] initial lessons learnt and guidelines are available, but need to be adjusted for natural World Heritage properties. Using these guidelines for assessing regional and local levels impacts remains a challenge; therefore the *World Heritage Convention* should promote the development and testing of available guidelines based on existing experience such as WWF's 'Regional Biodiversity Impact Assessments for climate change: A guide for protected-areas managers' as well as the results from IUCN's projects in Nepal (Sagarmatha National Park) and Peru (Tambopata National Park and Inambari Biosphere Reserve) where a computer-based Decision Support System (DSS) has been developed to assess ecosystem changes over time in response to a number of social and environmental factors.

Cultural heritage

Regional and thematic approach

Regional strategies provide a link between global climate change initiatives and local management plans since climate change data is based on regional scenarios. It is therefore appropriate to build on relevant available information and to create information of common interest to World Heritage sites in a region. A regional strategy could, for example, interpret IPCC data to make them relevant to the local situation; it could promote the creation of vulnerability maps for the region and sub regions and it could provide guidance on the monitoring programmes that might be appropriate for World Heritage sites in the region which might be affected differently by different climate change parameters. Thematic groupings of sites likely to face similar threats such as archaeological, movable, coastal, mountainous or marine sites, could also be developed.

Local approach

The obligation under the *World Heritage Convention* to develop management systems for World Heritage sites provides an opportunity to integrate climate change adaptation measures in the process. Documents such as management plans should include a statement of the objectives necessary for the long term preservation of the World Heritage sites and its landscape setting, aiming to balance the interests of conservation, public access, and the interests of those who live and work in the area. The objectives could be based on:

- Identification of the outstanding values of the World Heritage site including the reasons that make the World Heritage site special and justification for its inscription as a World Heritage site. However, the protection of World Heritage site values and sympathetic land management within the area greatly depends on identifying and resolving key management issues.
- Key management issues including descriptive information used in the identification of all issues related to management needs.
- An assessment of why the World Heritage site is sensitive and vulnerable to the pressures of climate change including objectives for the management of the World Heritage site based on a strategic view over 20, 25 or 30 years, and medium-term objectives for 5 to 10 years.

Risk and vulnerability maps

No one can afford to wait for all the research to be completed for guidance on the management of cultural heritage under climate change conditions. It will be important to produce risk and vulnerability maps of World Heritage regions and sub-regions which overlay climate data and heritage site locations so that an overview of the risks to different aspects of cultural heritage can be obtained. Using this information, detailed adaptation strategies can then be developed.

Monitoring

One of the simplest forms of monitoring is that carried out by communities and the general public. However, to be effective, this monitoring requires a programme of awareness-raising about the significance of the heritage and the importance of noting and reporting change.

It is important for the sustainability of cultural heritage in the face of climate change for communities to interact across the generations by documenting past climate events and their impact on cultural heritage. This will enable the present generation to learn from the past and to pass knowledge of the specific culture of the place and its adaptive capability to future generations.

There is widespread recognition of the need for craft skills in the use of traditional materials and construction systems. What is now urgently needed is monitoring the successes and failures of procedures in the face of climate change, and research on how traditional materials and construction systems might be modified to cope with more aggressive conditions or sudden climate shock.

At the same time, there should be a focus on professional monitoring strategies. Remote sensing such as the use of satellite technology, non-destructive techniques, biosensing to assess biological damage to materials and the use of simulation tools to predict the impact of climate change on the behaviour of cultural heritage materials are needed. Specific high-tech systems and products could include:

- Instruments for monitoring environment/component/system failure.

28 Hansen et al., 2003. Buying Time: a User's Manual for Building Resistance and Resilience to Climate Change in Natural Systems. WWF Climate Change Programme, Berlin. Online: www.worldwildlife.org/climate/pubs.cfm.
29 Barber et al. (eds.), 2004. Securing Protected Areas in the Face of Global Change: Issues and Strategies. A Report by the Ecosystems, Protected Areas, and People Project. IUCN, Gland and Cambridge. Online: www.iucn.org/themes/wcpa/pubs/theme.htm#climate.
30 Bomhard & Midgley, 2005. Op. Cit.

- Remote sensing products.
- Non-destructive techniques for bio-degradation, structure and infrastructure determination.
- Wireless communication adaptation of wireless protocols to building and site sensors such as infestation surveying equipment.

Regional climate change observatories could provide opportunities for multi-disciplinary think-tanks involving both cultural heritage and natural heritage, serve to provide an early warning of extreme weather events, act as a network hub for relevant information on climate change and emergency preparedness and signpost good science and relevant training opportunities to heritage managers.

Adaptation

Natural heritage

There is a need to better link World Heritage properties with corridors and conservation-friendly land/water uses in the framework of wider landscapes/seascapes planning and management.

Response strategies that enable protected areas and protected-area networks to adapt to climate change stress the importance for approaches beyond the individual site level.[31,32] World Heritage sites are largely isolated from each other, fall in very different biogeographical and political entities, and do not share common management systems or structures. Faced with climate change, World Heritage sites must be considered in the context of the surrounding matrix of other land uses and protected areas. In most cases, response strategies for successful adaptation that do not recognize this need will fail.

Applying adaptive management responses

In many areas, promising management responses are being developed and implemented already. A number of different solutions to specific problems posed by climate change are available. Technical solutions are available in some cases, but they might not be affordable or feasible in all cases, and they might also be controversial when it comes to application to World Heritage sites, with potential impacts on the conditions of integrity. For example, in some coastal areas, reinforcing dykes and drains to deal with rising sea level have been considered as options, whereas in other coastal areas, management has favoured a planned retreat of settlements from low-lying areas. The water level of some wetlands can be controlled by regulating water inflow or outflow with dams, but increasing temperatures and decreasing precipitation will in many areas result in stiffer competition between nature and people for water.

31. Barber et al. (eds.), 2004. Securing Protected Areas in the Face of Global Change: Issues and Strategies. A Report by the Ecosystems, Protected Areas, and People Project. IUCN, Gland and Cambridge. Online: www.iucn.org/themes/wcpa/pubs/theme.htm#climate.
32. Bomhard & Midgley, 2005 OP. Cit.

Adaptation to glacier melting in mountainous areas is limited to reducing the threat posed by Glacial Lake Outburst Floods (GLOF) events by preventive lake draining as was conducted in the Sagarmatha National Park in 1998-2002 (see Box 10 below).

BOX 10
Reducing the risk of GLOF in the Sagarmatha National Park (Nepal)[33]

The Tsho Rolpa glacial lake project is one of the most significant examples of collaborative anticipatory planning by the government, donors, and experts in GLOF mitigation. Tsho Rolpa was estimated to store approximately 90-100 million m³, a hazard that called for urgent attention. A 150-meter tall moraine dam held the lake, which if breached, could cause a GLOF event in which a third or more of the lake could flood downstream. This threat led to a collaborative action by the Nepalese Government and the Netherlands Development Agency, with the technical assistance of Reynolds Geo-Sciences Ltd., supported by the United Kingdom Department for International Development. To mitigate this risk, an expert group recommended lowering the lake three meters by cutting an open channel in the moraine. In addition, a gate was constructed to allow water to be released as necessary. While the lake draining was in progress, an early warning system was simultaneously established in 19 villages downstream of the Rolwaling Khola on the Bhote/Tama Koshi River to give warning in the event of a Tsho Rolpa GLOF. Local villagers have been actively involved in the design of this system, and drills are carried out periodically. The World Bank provided a loan to construct the system. The four-year Tsho Rolpa project finished in December 2002.
The goal of lowering the lake level was achieved by June 2002, which reduced the risk of a GLOF by 20%. The complete prevention of a GLOF at Tsho Rolpa necessitates further reducing the lake water, perhaps by as much as 17 meters. Expert groups are now undertaking further studies, but it is obvious that the cost of mitigating GLOF risks is substantial and time consuming. The cost, however, is much less than the potential damage that would be caused by an actual event in terms of lost lives, communities, development setbacks, and energy generation.

There are also some attempts to design and implement national protected area networks, both terrestrial and marine, with increased resistance and resilience to climate change (e.g. Cape Floral Region, see Box 2 p.19, or the Great Barrier Reef, see Box 5 p.20). Natural World Heritage sites should be cornerstones in such networks. Some of the options available are listed in Box 11 opposite.

33. OECD report on 'Development and Climate Change in Nepal: Focus on Water Resources and Hydropower', http://www.oecd.org/dataoecd/6/51/19742202.pdf

BOX 11
Options for planning and managing protected areas faced with climate change[34]

- *Creating new protected areas*
- *Enlarging existing protected areas*
- *Creating replicates of existing protected areas*
- *Designating 'stepping-stone' or corridor protected areas*
- *Creating buffer zones of natural habitat around protected areas*
- *Increasing habitat heterogeneity within protected areas (e.g. altitudinal, latitudinal and topographic)*
- *Restoring, regulating or maintaining disturbance regimes*
- *Removing or reducing invasive alien species*
- *Reducing other environmental stresses*
- *Restoration or rehabilitation of natural habitat*
- *Translocation, reintroduction or introduction of species*
- *Expanding inventory, modelling, monitoring, sensitivity analysis, etc.*

From this box it is particularly important to stress that realistic response strategies cannot be planned without taking into account the impacts from other non-climatic stresses on natural ecosystems, such as habitat fragmentation and loss, alien and invasive species, overexploitation, pollution, sedimentation, etc which severely impede natural adaptation and mitigation strategies. Hence, there is a need for the *World Heritage Convention* to continue enhancing its work in assessing the management and conditions of integrity of World Heritage properties, both through reactive monitoring and periodic reporting.

Cultural heritage

While it may be possible to adapt to climate change by moving moveable cultural heritage away from a site, doing so could have an overall negative effect on the value of a site. Therefore, despite the fact that World Heritage sites may be subject to more severe changes in their climatic, social or cultural environment, the fact that they are by their nature immoveable means that adaptation has to take place on site.

However, in the context of enhanced desertification, abandonment of cultural heritage must be anticipated. Although the relative importance of climatic and anthropogenic factors as a cause of desertification remains unresolved, evidence shows that an increase in dust storms would result in damage to settlements and infrastructure, and will affect human health and population migration. Thus, the impact on cultural heritage could range from erosion of physical structures to the break-up of the societies and communities supporting World Heritage sites or even to abandonment, with the eventual loss of cultural memory.

Mitigation

Mitigation consists in an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases. The UN Framework Convention on Climate Change is the preferred international tool to address mitigation at the global and States Parties levels. However, some mitigation opportunities could be contemplated in the context of the *World Heritage Convention* at the level of the World Heritage sites.

First, by investigating the extent to which natural World Heritage sites contribute to the sequestration of carbon dioxide. As mentioned above, a number of World Heritage sites are also Biosphere Reserves. Consequently it would be most appropriate to conduct this assessment in collaboration with the UNESCO MAB Programme.

Second, the World Heritage Centre oversees a number of conservation projects aiming at restoring degraded habitats in natural World Heritage sites. Such activities indirectly contribute to the improvement of carbon sequestration and this could be quantified in more details.

To keep a realistic perspective, we must be aware that the total carbon dioxide sequestrated in World Heritage sites is probably limited because of the relatively limited area concerned. The benefit of mitigation at World Heritage sites is therefore likely to be negligible on a quantitative basis. Nevertheless, considering the iconic character of the World Heritage sites and the powerful communication tool of the World Heritage network, it would be most useful in terms of best practices advertising.

Along the same lines, a carbon balance could be targeted at the scale of the World Heritage, by encouraging the use of improved technology to reduce emissions throughout the World Heritage network.

Monitoring and adaptative management

Monitoring the impact of climate change is obviously an important issue, as was mentioned in the sections on 'research' and 'information management'. But the careful monitoring of adaptive management measures must also be planned in the context of climate change and World Heritage.

Monitoring climate, climate impacts and management responses is critical. Only then will one be able to tell which responses do work and which do not. But few of the existing monitoring measures are tailored to issues relevant to climate change adaptation and mitigation of

34. Shafer, 1999. National park and reserve planning to protect biological diversity: some basic elements. Landscape and Urban Planning 44, 123-153.

protected areas. Capacity-building, for example in relation to fire and risk management, is underway in many areas, sometimes already linked to the additional problems posed or accelerated by climate change. In many cases, adaptive management, if implemented properly, should help to buffer climate change impacts. Adaptive management is a systematic process of continually improving policies and practices by learning from the results of previous actions.

The lack of awareness, vision and coordination has limited the development and implementation of strategies to address climate change. As a result the funding dedicated to the issue is far from adequate, in turn decreasing the ability to deal with the issue. However, vision and awareness rooted in a local context is much more likely to bear fruit and successful pilot projects implemented in World Heritage sites with multi-stakeholder involvement could provide best practices examples with very high publicity value reaching far beyond the individual site level.

Risk preparedness

A strategy for dealing with disasters resulting from climate change should be linked with the larger disaster risk-planning and strategy efforts including the 'Strategy for Reducing Risks from Disaster at World Heritage Properties' prepared by ICOMOS, ICCROM, and the World Heritage Centre for consideration by the World Heritage Committee at the present 30th session (WHC-06/30.COM/7.2). The rationale for this strategy follows the priorities for action of the Hyogo Framework for Action 2005-2015:

- Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation by strengthening support within relevant global, regional, national and local institutions.
- Identify, assess, monitor disaster risks, and enhance early warning at World Heritage properties.
- Use knowledge, innovation, and education to build a culture of disaster planning, safety, and resilience at World Heritage properties.
- Reduce underlying risks factors.
- Strengthen disaster preparedness at World Heritage properties for effective response at all levels.

The process to define a coherent climate change strategy for cultural and natural heritage

It is critical to the development of a coherent climate change strategy that problems, solutions, examples and best practices are developed through a common process for both cultural heritage and natural heritage sites inscribed on the World Heritage List. The diagram below (Figure 2) suggests such a process, starting from the left:

- Representative sites of cultural and natural heritage are selected from each of the World Heritage regions.
- The problems which are observed/can be proved as caused by climate change are described.
- A range of responses to climate change are defined by the sites. They may differ between cultural heritage sites and natural heritage sites. Responses may include monitoring, maintaining, managing and/or carrying out further research – all within the framework provided by a site's management system. At this point best practice solutions may be considered.

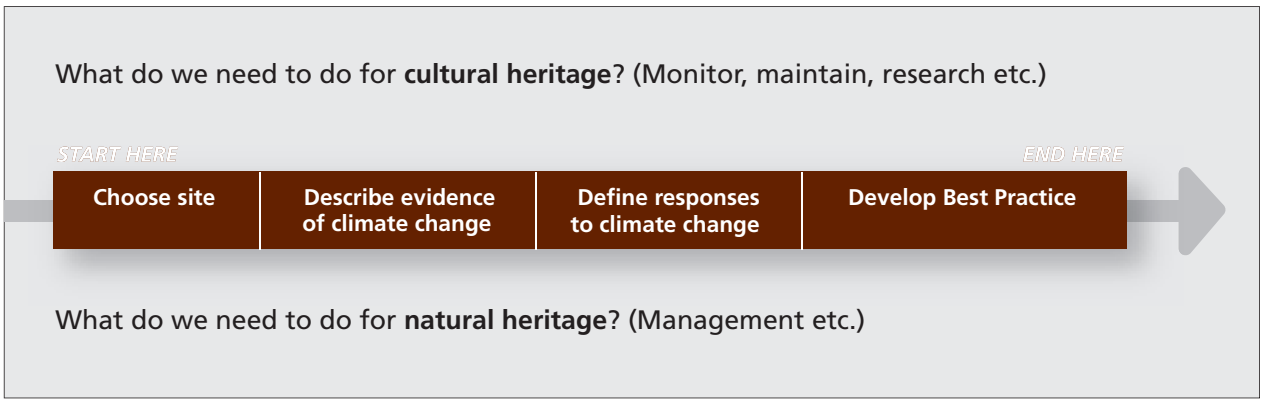

Figure 2: Process response to climate change.
Note: The implication of this process response to climate change is that more needs to be done on monitoring, research and maintenance for cultural heritage than the natural heritage which has already recognized the impact of climate change on World Heritage sites.

3

A strategy to assist States Parties to implement appropriate management responses

Cape Floral Region, South Africa

© UNESCO / Norman Guy Palmer

The strategy outlined below has been developed after a detailed analysis of the various issues elaborated in the report on 'Predicting and managing the effects of climate change on World Heritage' (Section 2). Detailed guidance on each aspect of the strategy is available in that report.

Preamble: Objectives and requirements

The potential impacts of climate change range from physical, to social and cultural aspects. As far as natural heritage is concerned, the vast majority of biomes may be adversely impacted by the effects of climate change. Experience and lessons learned on addressing climate change impacts stress the need for using a number of management responses at national and local levels. The *World Heritage Convention* provides an opportunity to develop strategies to implement relevant actions in respect of cultural and natural heritage properties threatened by climate change. Given the complexity of this issue, States Parties may request guidance from the World Heritage Committee to implement appropriate management responses to face the threats posed by climate change on their natural and cultural properties inscribed on the World Heritage List.

Therefore, the main objective of this strategy is to review the main topics that should be considered when preparing to implement preventive and/or corrective management responses to deal with the adverse impacts of climate change.

Conservation is the management of change, and climate change is one of the most significant global challenges facing society and the environment today. The actions that need to be taken to safeguard heritage are threefold:

a. Preventive actions: monitoring, reporting and mitigation of climate change effects through environmentally sound choices and decisions at a range of levels: individual, community, institutional and corporate.
b. Corrective actions: adaptation to the reality of climate change through global and regional strategies and local management plans.
c. Sharing knowledge: including best practices, research, communication, public and political support, education and training, capacity building, networking, etc.

In addition, any strategy should:

a. be achievable;
b. address a range of levels;
c. link support with other initiatives;
d. facilitate the sharing of knowledge and expertise;
e. address the practical implementation and review available resources; and
f. include immediate (short term), medium term, and long term actions.

It is noteworthy that there are strong links between natural and cultural heritage and the climate change issue could be used as an opportunity for the two parts of the *World Heritage Convention* to be brought closer together. Therefore, whereas climate change impacts will differ for World Heritage of natural and cultural types, the proposed strategy should address both types of properties jointly.

Lastly, climate change is one risk among a number of challenges facing World Heritage sites. This threat should be considered in the broader context of the conservation of these sites.

Preventive actions

Monitoring and reporting*

a. Global level actions *(World Heritage Convention):*
  i. Include climate change impacts within World Heritage periodic reporting and reactive monitoring, and other monitoring processes in order to enable global assessment.
  ii. Link with reporting and monitoring processes underway in other international processes, including drawing upon the work of the Indicator Group of the IPCC to develop indicators for World Heritage and climate change.

b. Regional (cross-State Party) / thematic actions:
  i. Include climate change impacts within any World Heritage periodic reporting and reactive monitoring processes for existing and future World Heritage properties in order to enable regional / thematic assessment.
  ii. Identify indicators and trends relevant at the regional / thematic level.

c. State Party / site level actions:
  i. Encourage site managers, to the extent possible and within the available resources, to monitor relevant climate parameters and to report on adaptation strategies.
  ii. Reduce non-climatic stress factors on the site to enhance its resilience to climate change impacts.

Mitigation**

The UNFCCC is the UN instrument through which mitigation strategies at the global and States Parties level is being addressed. However, the World Heritage community could participate in climate change mitigation at the level of the World Heritage through:

a. Global level actions *(World Heritage Convention):*
  i. Provide information to IPCC and UNFCCC on the impacts of climate change on World Heritage sites to assist them in tailoring mitigation strategies.

* See page 35 (Monitoring).
** See page 37 (Mitigation).

b. State Party / site level actions:

i. Identify and promote synergies between adaptation and mitigation (i.e. any adaptation measure should seek ways in which to mitigate).

ii. Encourage site managers to reduce emissions of greenhouse gases at the level of the sites.

Corrective actions: Management, adaptation, and risk management*

The States Parties need to be aware of the risks posed by climate change and that clear short term actions are needed and possible:

a. Global level actions *(World Heritage Convention):*

i. Include climate change as an additional source of stress in the Strategy for reducing risks from disasters at World Heritage properties which is presented as a separate working Document (*WHC-06/30.COM/7.2*), including approaches to vulnerability assessment.

ii. Request new and existing sites to integrate climate change issues into new and revised management plans (as appropriate) including: risk preparedness, adaptive design and management planning.

b. Regional (cross-State Party) / thematic actions:

i. Integrate climate change into any new or existing regional thematic management plans, programmes and events.

ii. Identify climate change threats specific to regional /thematic aspects.

c. State Party / site-level actions:

i. Conduct climate change vulnerability analysis, risk assessment, adaptation, and develop appropriate management plans.

ii. Consider climate change as well as other challenges when developing nominations - such as by ensuring landscape connectivity, defining appropriate boundaries and buffer zones, in order to achieve better resistance and resilience to climate change impacts.

iii. Develop tailored programmes (including guidance, capacity building and financial assistance or assistance for developing project proposals) for specific sites. The implementation of pilot projects at selected World Heritage sites is a key step in the development of successful and appropriate management responses.

Collaboration, cooperation, and sharing best practices and knowledge

International cooperation with other conventions, instruments and institutions*

a. Global level actions *(World Heritage convention):*

i. Build on appropriate existing initiatives of the UNFCCC, CBD, UNCCD[35], MAB, IOC, Ramsar, International Human Dimensions Programme on Global Environmental Change (IHDP), the UNESCO conventions on cultural heritage, the International Committee of the Blue Shield, the Organization of World Heritage Heritage Cities, in accordance with their mandates.

ii. Brief the Biodiversity Liaison Group (Heads of the Secretariats of five Conventions) on World Heritage and climate change.

iii. Inform Conferences of the Parties (COP) and Subsidiary Bodies on Scientific and Technical Advice (SBSTA) of relevant conventions, on World Heritage and climate change.

iv. Explore financing options, including from the private sector, the Global Environmental Facility (GEF), the Food and Agriculture Organization (FAO) for agricultural landscapes, etc.

b. Regional (cross-State Party) / thematic actions:

i. Identify existing regional / thematic efforts to be explored in each region.

ii. Link existing institutions at the regional level, including regional standard setting instruments, and the UN University regional programs.

iii. Explore financing options from the GEF.

c. State Party / site level actions:

i. Link national focal points of the various conventions and programmes.

ii. Explore financing options from the GEF for the implementation of site based pilot projects.

Communication, education, training, capacity building, raising awareness, and sharing good practices, information, and knowledge*

a. Global level actions *(World Heritage Convention)*:

i. Inform the UNFCCC of the impacts of climate change on World Heritage in order to include these aspects into their guidelines for national communications.

ii. Ensure that climate change impacts and environmental education are integrated in general training programmes (of the World Heritage Centre and Advisory Bodies) by preparing training material and running specific courses on the impacts of climate change.

iii. Oversee the organization of international workshops to improve networking and share experience, especially across north-south and south-south States Parties.

* See pages:
- 30 (Designing management plans accounting for the issue of climate change),
- 33 (Vulnerability assessment),
- 36 (Adaptation),
- 37 (Monitoring and adaptative management),
- 38 (Risk preparedness).

** See page 28 (International conventions).

35. United Nations Convention to Combat Desertification.

*** See pages:
- 30 (Level of actions and networking).
- 32 (Information management, communication, and building public and political support).

iv. Develop communication strategies taking advantage of the World Heritage global network to inform the public and policy makers about the impacts of climate change on World Heritage sites and build public and political support for actions to address the situation.

b. Regional (cross-State Party) / thematic actions:

i. Raise awareness within regional organizations and training institutions and among States Parties.

ii. Ensure that training courses on risk assessments, reporting, adaptation and monitoring are coordinated with other international institutions, Advisory Bodies, and secretariats of other conventions.

c. State Party / site level actions:

i. Provide information to decision-makers, stakeholders, local communities, users of the sites, site managers, and other heritage specialists about the impacts of climate change on sites, management responses, possible assistance, existing networks, specific training, courses, and long- distance learning opportunities.

ii. Encourage site managers to feed back their expertise at the global *(World Heritage Convention)* level, such as by developing case studies on best practices and lessons learnt to be shared with other site managers.

Research*

At all levels, links between research and monitoring actions should be explored.

a. Global level actions *(World Heritage Convention):*

i. Establish cooperation with IPCC to assess the impacts of climate change on World Heritage; investigate opportunities to mention issues related to World Heritage in future climate change assessment reports.

ii. Work with international donors to promote research on physical, cultural and social aspects.

iii. Develop coordinated approach to research on the impacts of climate change on cultural World Heritage, including impacts as result of changes in society (i.e. movement of peoples, displacement of communities, their practices, and their relation with their heritage).

b. Regional (cross-State Party) / thematic actions:

i. Promote the development of risk and vulnerability maps for regions and sub-regions which overlay climate data and World Heritage site locations.

c. State Party / site level actions:

i. Collect and document information on the impacts of past and current climate change on World Heritage sites.

ii. Review previous periodic reports, as it could lead to the identification of past impacts of climate change on World Heritage, which may not have been attributed to climate change at the time of the original report.

iii. Assess continuing effectiveness of traditional skills and use of traditional materials and traditional practices in light of climate change as a basis for developing proposals for adapting them to cope with climate change.

iv. Collaborate with national, regional, or global research institutions on specific aspects.

Legal issues

After having considered the range of actions to be undertaken in the framework of the management of climate change impacts on World Heritage, the group of experts considered that when the *Operational Guidelines* are next revised, the possibility of including climate change related aspects could be explored.

* See page 31 (Research).

Appendices

Conclusion and steps ahead

Huascarán National Park, Peru

© Renzo Uccelli

Conclusion and steps ahead

While endorsing the Report and Strategy at its 30th session, the World Heritage Committee desired that these documents be disseminated widely to the World Heritage community and the public at large. It is hoped that this publication will serve that broader purpose, together with another publication recently brought out by the Centre, which is a compilation of case studies highlighting the impacts of climate change on World Heritage properties, *Case Studies on World Heritage and Climate Change,* UNESCO, March, 2007.

Further, at the behest of the Committee, a draft policy document has been prepared on the subject for consideration at its 31st session (23 June – 2 July 2007) and adoption by the General Assembly of States Parties to the Convention later in the year. Relevant elements of the Strategy are also being mainstreamed into various processes of the Convention, including nominations, reactive monitoring, periodic reporting, international assistance, capacity building, as well as into the strategy for reducing risks from disasters at World Heritage properties.

While opportunities are being explored with donors for implementing pilot projects on vulnerability assessment and adaptation at some World Heritage sites, the impacts of climate change can be effectively addressed only when the strategy outlined in this publication is applied at the field level. It is for this purpose that the World Heritage Committee has requested States Parties and all partners concerned to implement this strategy to protect the outstanding universal values, integrity and authenticity of World Heritage sites from the adverse effects of climate change, to the extent possible and within the available resources.

The very significant challenges which climate change poses to World Heritage sites can not be effectively dealt with by any one organization. It calls for a collective response and the *World Heritage Convention*, which promotes international cooperation for heritage conservation, can be an effective mechanism for mobilizing such support from relevant organizations, conventions and processes.

Appendices

Chinguetti mosque, Mauritania

© UNESCO / Galy Bernard

Expert Meeting of the *World Heritage Convention* on the Impacts of Climate Change on World Heritage

The World Heritage Committee at its 29th session (Durban, 2005) requested the World Heritage Centre (WHC), in collaboration with the Advisory Bodies, interested States Parties and petitioners who had drawn the attention of the Committee to this issue, to convene a broad working group of experts on the impacts of climate change on World Heritage (Decision 29 COM 7B.a). The Committee took this decision noting 'that the impacts of climate change are affecting many and are likely to affect many more World Heritage properties, both natural and cultural in the years to come'. The Committee requested the broad working group of experts to:

- review the nature and scale of the risks posed to World Heritage properties arising specifically from climate change;
- jointly develop a strategy to assist States Parties to implement appropriate management responses; and
- prepare a joint report on 'Predicting and managing the effects of climate change on World Heritage' to be examined by the Committee at its 30th session (Vilnius, 2006).

The World Heritage Committee also accepted the generous offer by the State Party of the United Kingdom to host such a meeting of the working group of experts.

The expert meeting of the *World Heritage Convention* on 'Climate Change and World Heritage', whose mandate was established by Paragraphs 7 and 9 of the aforementioned Decision 29 COM 7B.a, took place on 16 and 17 March, 2006 at the UNESCO Headquarters in Paris.

The meeting was prepared after a rigorous and extensive consultation process between a core group, comprising the World Heritage Centre, the Advisory Bodies, and experts from the State Party of the United Kingdom. The United Nations Foundation (UNF) provided crucial financial support to the World Heritage Centre to enable some of the preparatory and follow-up actions. The agenda, list of participants and background documents for the expert meeting were prepared through collaboration between the core group. A background document compiled information on the assessment and management of the impacts of climate change in the context of World Heritage. A number of case studies on the impacts of climate change on specific World Heritage sites were also submitted by many experts for consideration by the participants to the meeting.

The meeting brought together experts from 15 States Parties from various backgrounds ranging from researchers involved in climate change issues to sites managers. Other relevant international conventions: the UNFCCC;[36] the Ramsar Convention on wetlands; the CBD,[37] of various international programmes such as UNEP,[38] IPCC,[39] UNESCO MAB[40] and IOC[41] and representatives of 7 non-governmental organizations were also represented.

Opening session: The participants were welcomed by Mr Francesco Bandarin (Director of the World Heritage Centre) and Ms Ina Marciulionyte (Chairperson of the World Heritage Committee) opened the meeting. Mr Martin Parry (Co-chair of Working Group II of the IPCC) gave a keynote address on the implications of climate change for World Heritage. Mr Kishore Rao (Deputy Director of the World Heritage Centre) presented an overview of the decision of the World Heritage Committee, the agenda, the objectives of the meeting, the strategic requirements and reported on the results of the climate change questionnaire survey of States Parties.

Presentations to the plenary: The climate change activities of relevant international conventions were presented to the plenary. A statement from the CBD was read on behalf of Mr Ahmed Djoghlaf (Executive Secretary of the CBD). Ms Habiba Gitay (World Resources Institute) presented the activities of the Ramsar Convention, Mr Festus Luboyera (UNFCCC) presented the UN Framework Convention on Climate Change, and Mr Natarajan Ishwaran (UNESCO) introduced the MAB Programme of UNESCO. A keynote speech on the impacts of climate change for cultural World Heritage was given by Ms May Cassar (University College London), and ICOMOS' network approach on climate change and heritage structures, sites and areas was presented by Mr Dinu Bumbaru (ICOMOS). Case studies on the impacts of climate change on five natural and cultural World Heritage sites were also described by relevant experts. The plenary sessions were concluded by a presentation of Ms Erika Harms (UNF) on raising public awareness and building political support.

Working sessions: The group of experts worked separately in two concurrent sessions on cultural and natural heritage issues to review the draft framework strategy to assist States Parties on implementing appropriate management responses; and to review the draft background document prepared in advance with the aim of producing a comprehensive report on 'Predicting and managing the effects of climate change on World Heritage'.

The working groups reported back to the plenary; the outcomes of the meeting were summarized by Mr Alexander Gillespie (Rapporteur of the World Heritage Committee); and Ms Ina Marčiulionytė outlined the next steps in the process.

36. United Nations Framework Convention on Climate Change
37. Convention on Biological Diversity
38. United Nations Environment Programme
39. Intergovernmental Panel on Climate Change
40. Man and the Biosphere Programme of UNESCO
41. Intergovernmental Oceanographic Commission of UNESCO

Agenda of the Expert Meeting on Climate Change and World Heritage

Special Expert Meeting of the *World Heritage Convention*:
Climate Change and World Heritage

UNESCO HQ, Paris (France) 16-17 March, 2006

16 March 2006		
09.00	Registration	
09.15 – 10.00	**Session 1 Opening Session** Chair: Mr Francesco Bandarin (Director of the WHC) Rapporteur: Dr Mechtild Rössler (Chief Europe and North America WHC)	
	Welcome	Mr Francesco Bandarin (Director of the WHC)
	Opening remarks	Ms Ina Marčiulionytė (Chairperson of the WH Committee)
	Keynote address on 'Implications of climate change for World Heritage sites'	Mr Martin Parry (Co-chair of WGII of the IPCC)
	Overview of the decision of the World Heritage Committee, the agenda, the objectives of the meeting, the strategic requirements and report on the results of the climate change survey submitted to States Parties	Mr Kishore Rao (Deputy Director of the WHC)
10.00 – 10.30 Coffee break		
10.30 – 13.00	**Session 2 Natural Heritage** Chair: Mr David Sheppard (Head of IUCN's Programme on Protected Areas) Rapporteur: Mr Guy Debonnet (WHC)	
2-5 min	Convention on Biological Diversity	Statement on behalf of Mr Ahmed Djoghlaf (Executive Secretary of the CBD)
10 min	Key issues for climate change and wetlands (on behalf of Ramsar Convention)	Dr Habiba Gitay (World Resources Institute)
10 min	United Nations Framework Convention on Climate Change	Mr Festus Luboyera (UNFCCC Secretariat)
10 min	UNESCO Man and the Biosphere Programme	Dr Natarajan Ishwaran (UNESCO, Division of Ecological and Earth Sciences)
35 min	Case Study 1: 'Towards conservation strategies for future climate change in the Cape Floral Region Protected Areas (South Africa)'	Mr Guy Midgley and Mr Bastian Bomhard [presenting author] (South African National Biodiversity Institute)
35 min	Case Study 2: The Great Barrier Reef (Australia)	Dr Greg Terrill (Australian Department of Environment and Heritage)
35 min	Case Study 3: 'Risks, points of view and conflicts in the Huascarán NP World Heritage site (Peru) due to climate change'	Mr Pablo Dourojeani (The Mountain Institute, Peru)
13.00 – 14.00 Lunch Break		

14.00 – 16.00	**Session 3 Cultural Heritage** Chair: Ms Mandy Barrie (UK Department for Culture Media and Sport) Rapporteur: Mr Joseph King (ICCROM)	
15 min	Climate change and cultural heritage	Prof. May Cassar (University College London, UK)
15 min	ICOMOS' network approach on climate change and heritage structures, sites and areas	Mr Dinu Bumbaru (ICOMOS)
35min	Case Study 4: 'Impact of climate change on the World Heritage sites of Timbuktu (Mali)'	Mr Ali Ould Sidi (Mission culturelle de Tombouctou, Mali)
35min	Case Study 5: 'Evident threats of climate change to cultural resources within existing and potential World Heritage sites in Yukon Territory, Canada'	Mr Douglas Olynyk (Yukon Territorial Government & ICOMOS Canada)
16.00 – 16.30 Coffee Break		
16.30 – 17.00	**Session 4 Awareness, communication and support** Chair: Mr Paul Hoffman (US National Park Service) Rapporteur: Ms Regina Durighello (ICOMOS)	
16.30 – 17.00	Raising public awareness and building support for 'Climate change and World Heritage'	Ms Erika Harms (United Nations Foundation)
17.00 – 18.00	Summary of key issues and discussion on previous presentations	Chairs of sessions 2 and 3
19.00 Cocktail hosted by the World Heritage Centre		
17 March 2006		
09.00	Plenary briefing on working groups procedure	Mr Kishore Rao (Deputy Director of the WHC)
09.15 – 12.30	**Concurrent Natural/Cultural Sessions**	
	Session 5.1 Cultural Heritage Review framework strategy and expected outputs. Chair: Ms Carolina Castellanos (Cultural Heritage Consultant) Rapporteur: Mr Christopher Young (English Heritage)	
	Session 5.2 Natural Heritage Review framework strategy and expected outputs. Chair: Dr Greg Terrill (Australian Department of Environment and Heritage) Rapporteur: Mr Tony Weighell (Joint Nature Conservation Committee, UK)	
12.30 – 14.00 Lunch Break		
14.00 – 16.00	**Session 5.3 Reports of concurrent sessions to the plenary** Chair: Mr Kishore Rao (Deputy Director of the WHC) Rapporteur: Prof. Alexander Gillespie (Rapporteur of the WH Committee)	
	Report by rapporteur on cultural heritage session	Mr Christopher Young (English Heritage)
	Report by rapporteur on natural heritage session	Mr Tony Weighell (Joint Nature Conservation Committee, UK)
16.00 – 16.30 Coffee Break		
16.30 – 17.30	Open discussion of the final overall draft strategy to be presented at the World Heritage Committee	
17.30 – 18.00	Concluding remarks	Ms Ina Marčiulionytė (Chairperson of the World Heritage Committee)

List of Participants to the Expert Meeting on Climate Change and World Heritage
Chairperson of the World Heritage Committee (Lithuania): Ms Ina Marčiulionytė
Rapporteur of the World Heritage Committee (New Zealand): Prof. Alexander Gillespie

AFRICA

Mali:	Mr Ali Ould Sidi
Mauritius:	Mr Sachooda Ragoonaden

ARAB STATES

Lebanon:	Dr Mohamad Khawlie
Tunisia:	Ms Marie-José Elloumi

ASIA & PACIFIC

Australia:	Dr Michael Pearson
	Dr Clive Wilkinson
	Dr Greg Terrill
	Dr John Merson
India:	Prof. N.H. Ravindranath
	Dr P.P. Bhojvaid

EUROPE & NORTH AMERICA

Canada:	Mr Douglas Olynyk
USA:	Mr Paul Hoffman
	Dr Daniel B. Fagre
United Kingdom:	Prof. May Cassar

LATIN AMERICA & THE CARIBBEAN

Costa Rica:	Mr Allan Flores
Mexico:	Ms Carolina Castellanos
Peru:	Mr Pablo Dourojeani
Brazil:	Mr Warwick Manfrinato

INTERNATIONAL CONVENTIONS AND INTERNATIONAL ORGANIZATIONS

UNEP:	Mr Max Zieren
IPCC:	Dr Martin Parry
UNFCCC:	Mr Festus Luboyera
UNF:	Ms Erika Harms
Ramsar:	Dr Habiba Gitay (affiliated to World Resource Insitute)
UNESCO/MAB:	Mr Natarajan Ishwaran
	Mr Thomas Schaaf
	Mr. Peter Dogse
UNESCO/IOC:	Mr. Christian Wild
	Mr Patricio Bernal

ADVISORY BODIES

ICOMOS:	Mr Dinu Bumbaru
	Ms Regina Durighello
ICCROM:	Mr Joseph King
IUCN:	Mr David Sheppard
	Mr Bastian Bomhard

NON-GOVERNMENTAL ORGANIZATIONS

Pro-Natura International:	Mr Guy F. Reinaud
World Wildlife Fund:	Mr Michael Case
	Ms Melanie McField
Climate Justice Programme:	Mr Peter Roderick
Environmental Defender's Office, Greenpeace Australia-Pacific:	Ms Ilona Millar
Earthwatch Institute:	Dr Marie Studer
Reynolds Geo-Sciences Ltd:	Dr John M. Reynolds

MEETING ORGANIZERS

UK Government:	Ms Mandy Barrie
Joint Nature Conservation Committee:	Mr Tony Weighell
English Heritage:	Dr Christopher Young
UNESCO/WHC:	Mr Francesco Bandarin
	Mr Kishore Rao
	Ms Mechtild Rössler
	Mr Guy Debonnet
	Mr Cédric Hance
	Mr Marc Patry
	Mr Augustin Colette

Decision *29 COM 7B.a* of the World Heritage Committee, 29th session (2005)

The World Heritage Committee,

1. Having examined Document *WHC-05/29.COM/7B.Rev* and the draft Decision 29 COM 7B.a.Rev,

2. Recognizing the work being undertaken within the framework of the UN Convention on Climate Change (UNFCC), and the need for a proper coordination of such work with the activities under the *Convention*,

3. Takes note of the four petitions seeking to have Sagarmatha National Park (Nepal), Huascaran National Park (Peru), the Great Barrier Reef (Australia) and the Belize Barrier Reef Reserve System (Belize) included on the List of World Heritage in Danger,

4. Appreciates the genuine concerns raised by the various organizations and individuals supporting these petitions relating to threats to natural World Heritage properties that are or may be the result of climate change,

5. Further notes that the impacts of climate change are affecting many and are likely to affect many more World Heritage properties, both natural and cultural in the years to come,

6. Encourages all States Parties to seriously consider the potential impacts of climate change within their management planning, in particular with monitoring, and risk preparedness strategies, and to take early action in response to these potential impacts;

7. Requests the World Heritage Centre, in collaboration with the Advisory Bodies, interested States Parties and petitioners, to establish a broad working group of experts to: a) review the nature and scale of the risks posed to World Heritage properties arising specifically from Climate Change; and b) jointly develop a strategy to assist States Parties to implement appropriate management responses,

8. Welcomes the offer by the State Party of the United Kingdom to host a meeting of such working group of experts,

9. Requests that the working group of experts, in consultation with the World Heritage Centre, the Advisory Bodies and other relevant UN bodies, prepare a joint report on 'Predicting and managing the effects of climate change on World Heritage', to be examined by the Committee at its 30th session (2006),

10. Strongly encourages States Parties and the Advisory Bodies to use the network of World Heritage properties to highlight the threats posed by climate change to natural and cultural heritage, start identifying the properties under most serious threats, and also use the network to demonstrate management actions that need to be taken to meet such threats, both within the properties and in their wider context,

11. Also encourages UNESCO to do its utmost to ensure that the results about climate change affecting World Heritage sites reach the public at large, in order to mobilize political support for activities against climate change and to safeguard in this way the livelihood of the poorest people of our planet.

Decision *30 COM 7.1* of the World Heritage Committee, 30th session (2006)

The World Heritage Committee,

1. Having examined Document *WHC-06/30.COM/7.1*,

2. Recalling Decision 29 COM 7B.a adopted at its 29th session (Durban, 2005),

3. Also recalling the submission in 2005 of four petitions by civil society and non-governmental organizations on the impacts of Climate Change on World Heritage properties, complemented by an additional petition in February 2006,

4. Further recalling paragraph 44 of the *Operational Guidelines*,

5. Thanks the Government of the United Kingdom for having funded the meeting of experts, which took place on the 16th and 17th of March 2006 at UNESCO Headquarters in Paris, and also thanks the United Nations Foundation for its support, as well as all the experts who contributed to the meeting,

6. Endorses the 'Strategy to assist States Parties to implement appropriate management responses' described in *Document WHC-06/30.COM/7.1*, and requests the Director of the World Heritage Centre to lead the implementation of the 'Global

level actions' described in the Strategy through extrabudgetary funding and also takes note of the report on 'Predicting and managing the impacts of Climate Change on World Heritage',

7. Encourages UNESCO, including the World Heritage Centre, and the Advisory Bodies to disseminate widely this strategy, the report, and any other related publications through appropriate means to the World Heritage community and the broader public,

8. Requests States Parties and all partners concerned to implement this strategy to protect the Outstanding Universal Value, integrity and authenticity of World Heritage sites from the adverse effects of Climate Change, to the extent possible and within the available resources, recognizing that there are other international instruments for coordinating the response to this challenge,

9. Invites States Parties, the World Heritage Centre and the Advisory Bodies to build on existing Conventions and programmes listed in Annex 4 of *Document WHC-06/30.COM/7.1*, in accordance with their mandates and as appropriate, in their implementation of Climate Change related activities,

10. Also requests States Parties, the World Heritage Centre, and the Advisory Bodies to seek ways to integrate, to the extent possible and within the available resources, this strategy into all the relevant processes of the *World Heritage Convention* including: nominations, reactive monitoring, periodic reporting, international assistance, capacity building, other training programmes, as well as with the 'Strategy for reducing risks from disasters at World Heritage properties' *(WHC-06/30.COM/7.2)*,

11. Strongly encourages the World Heritage Centre and the Advisory Bodies in collaboration with States Parties and other relevant partners to develop proposals for the implementation of pilot projects at specific World Heritage properties especially in developing countries, with a balance between natural and cultural properties as well as appropriate regional proposals, with the objective of developing best practices for implementing this Strategy including preventive actions, corrective actions and sharing knowledge, and recommends to the international donor community to support the implementation of such pilot projects,

12. Further requests the States Parties and the World Heritage Centre to work with the Intergovernmental Panel on Climate Change (IPCC), with the objective of including a specific chapter on World Heritage in future IPCC assessment reports,

13. Requests the World Heritage Centre to prepare a policy document on the impacts of climate change on World Heritage properties involving consultations with relevant climate change experts and practitioners of heritage conservation and management, appropriate international organizations and civil society, to be discussed at the General Assembly of States Parties in 2007. A draft of the document should be presented to the 31st session in 2007 for comments.

    This draft should include considerations on:
    a. Synergies between conventions on this issue,
    b. Identification of future research needs in this area,
    c. Legal questions on the role of the *World Heritage Convention* with regard to suitable responses to Climate Change,
    d. Linkages to other UN and international bodies dealing with the issues of climate change,
    e. Alternative mechanisms, other than the List of World Heritage in Danger, to address concerns of international implication, such as climatic change,

14. Considers that the decisions to include properties on the List of World Heritage in Danger because of threats resulting from climate change are to be made by the World Heritage Committee, on a case-by-case basis, in consultation and cooperation with States Parties, taking into account the input from Advisory Bodies and NGOs, and consistent with the *Operational Guidelines for the Implementation of the World Heritage Convention.*

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