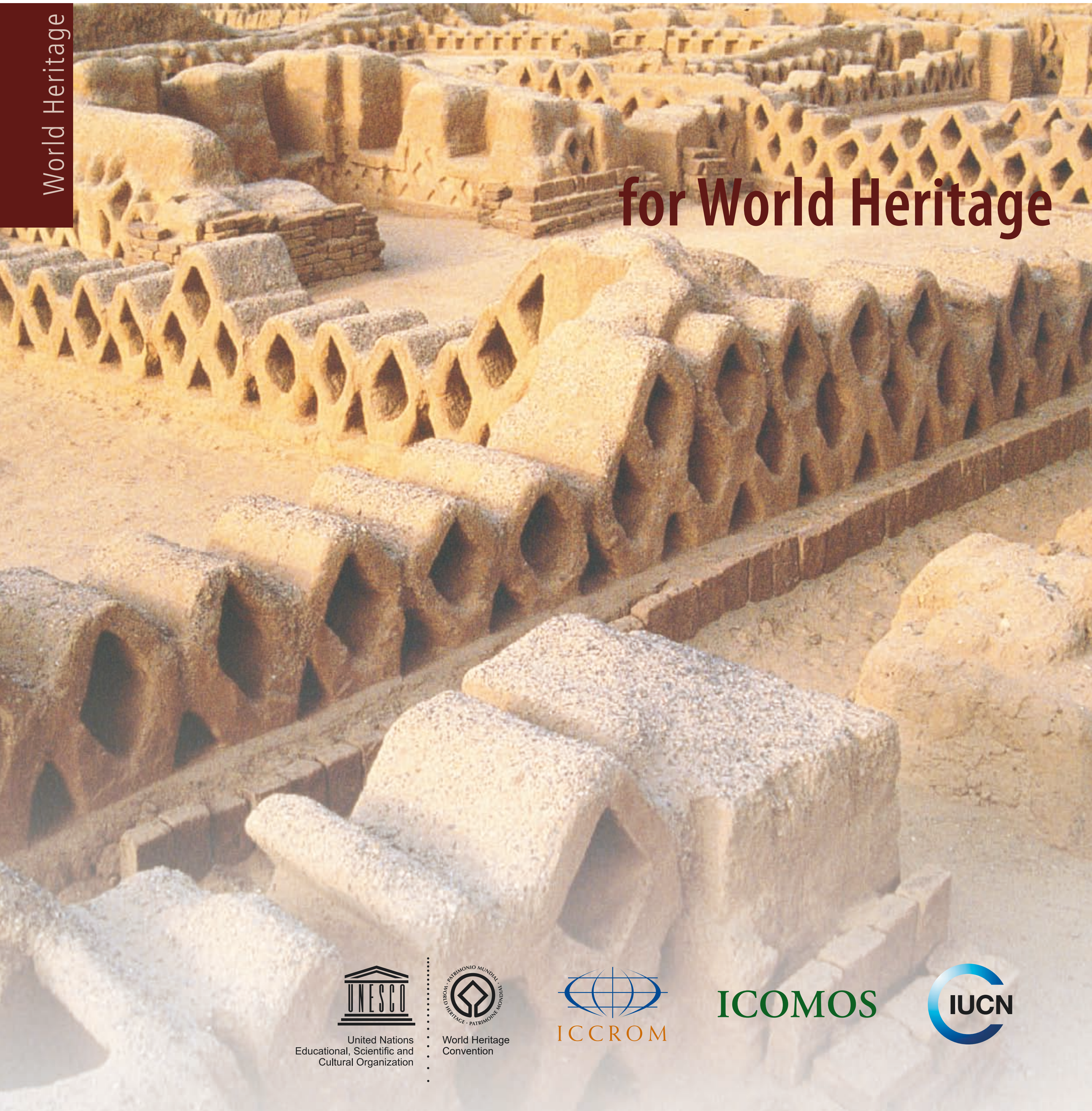
Resource Manual

World Heritage

MANAGING DISASTER RISKS

for World Heritage



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About the World Heritage Resource Manual Series

Since the World Heritage Convention was adopted in 1972, the World Heritage List has continually evolved and is growing steadily. With this growth, a critical need has emerged for guidance for States Parties on the implementation of the Convention. Various expert meetings and results of Periodic Reporting have identified the need for more focused training and capacity development in specific areas where States Parties and World Heritage site managers require greater support. The development of a series of World Heritage Resource Manuals is a response to this need.

The publication of the series is a joint undertaking by the three Advisory Bodies of the World Heritage Convention (ICCROM, ICOMOS and IUCN) and the UNESCO World Heritage Centre as the Secretariat of the Convention. The World Heritage Committee at its 30th session (Vilnius, Lithuania, July 2006) supported this initiative and requested that the Advisory Bodies and the World Heritage Centre proceed with the preparation and publication of a number of thematic Resource Manuals. The 31st (2007) and 32nd (2008) sessions of the Committee adopted the publication plan and determined a prioritized list of titles.

An Editorial Board consisting of members of all three Advisory Bodies and the World Heritage Centre meets regularly to decide on different aspects of their preparation and publication. For each manual, depending on the theme, one of the Advisory Bodies or the World Heritage Centre functions as the lead agency responsible for coordination, while the final production is ensured by the World Heritage Centre.

The Resource Manuals are intended to provide focused guidance on the implementation of the Convention to States Parties, heritage protection authorities, local governments, site managers and local communities linked to World Heritage sites, as well as other stakeholders in the identification and preservation process. They aim to provide knowledge and assistance in ensuring a representative and credible World Heritage List consisting of well-protected and effectively managed properties.

The manuals are being developed as user-friendly tools for capacity-building and awareness-raising on the World Heritage Convention. They can be used independently for self-guided learning as well as material at training workshops, and should complement the basic provisions for understanding the text of the Convention itself and the *Operational Guidelines* for implementation.

The titles in this series are produced as PDF online documents which can be freely downloaded and are also available on CD-ROM.

List of titles:
Managing Disaster Risks for World Heritage
Preparing World Heritage Nominations (November 2011)
Managing Cultural World Heritage Properties (scheduled for mid-2012)
Managing Natural World Heritage Properties (scheduled for late 2012)

Foreword

As confirmed by the 2009 Global Assessment Report on Disaster Risk Reduction, *Risk and Poverty in a Changing Climate* (UNISDR, 2009), the number of disasters around the world increases every year. To a great extent this is due to growing exposure in terms of people and assets, in turn caused by rapid economic development and urban growth in cyclone coastal areas and earthquake-prone cities, combined with poor governance and the decline of ecosystems. At the same time, climate change has been associated with the occurrence of more frequent and intense extreme weather events in some parts of the world. Disasters are today considered as one of the main factors contributing to poverty, especially in developing regions.

Although heritage is usually not taken into account in global statistics concerning disaster risks, cultural and natural properties are increasingly affected by events which are less and less 'natural' in their dynamics, if not in their cause. The progressive loss of these properties as a result of floods, mudslides, fire, earthquakes, civil unrest and other hazards has become a major concern, partly because of the significant role that heritage plays in contributing to social cohesion and sustainable development, particularly at times of stress.

In the face of these challenges, the number of World Heritage properties that have developed a proper disaster risk reduction plan is surprisingly low. This is often due to a series of misperceptions. On the one hand, there is a widespread belief that disasters are events beyond human will and control, against which little can be done. On the other hand, heritage managers and policy-makers tend to concentrate their attention and resources on what they perceive as the real priorities for their properties, i.e. pressure from development and the daily wear and tear of sites as a result of slow, cumulative processes that can be 'seen'. Finally, and somewhat ironically, the vulnerability of heritage properties to disasters is normally recognized after a catastrophic event has taken place – including by the media and donor community – when it is often too late.

The reality, of course, is different. Disasters are the combined product of hazards and vulnerabilities resulting from the complex interaction of numerous interlocking factors, many of which are very much within human control. It is therefore possible to prevent them, or at least considerably reduce their effects, by strengthening the resilience of the assets to be safeguarded. In general, moreover, the impact of a single disaster on cultural and natural properties far outstrips the deterioration caused by long-term, progressive decay and may sometimes lead to their complete obliteration. Often, therefore, disaster risks constitute the most urgent priority that heritage managers should address.

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An additional commonplace is the idea that heritage, in particular cultural heritage, would constitute a liability in the face of disaster, either because it requires efforts and resources for its protection – at a time when attention should be devoted to saving lives and properties – or because it adds to the risk, especially within traditional settlements where buildings do not conform to modern engineering standards of safety. Experience shows, on the contrary, that heritage if well maintained can positively contribute to reducing disaster risks. This is true not only for natural heritage resources that guarantee the proper functioning of ecosystems and the beneficial effect of their goods and services, but also for cultural heritage properties that – as a result of traditional knowledge accumulated over centuries – have proved to be resilient to disasters while providing shelter and psychological support to affected communities.

Recognizing these challenges, this Resource Manual prepared as part of the new World Heritage Resource Manual Series by ICCROM in collaboration with the World Heritage Centre, ICOMOS and IUCN, aims to raise the awareness of World Heritage managers and administrators of the real extent of risks associated with disasters. More importantly, it provides them with a sound methodology for identifying, assessing and then reducing these risks, with a view to preserving their heritage and ensuring that it contributes – to its full potential – to the sustainable development of their communities.

It is hoped that this manual, used in combination with training programmes, may help to achieve the much-needed shift in attitudes that would finally lead to the building of a true culture of prevention within the heritage community, while assisting in the urgent need to prepare World Heritage properties for future disasters. As challenging as this may appear, the alternative is often the loss of our precious heritage or – where possible – long and hugely expensive reconstruction.

The World Heritage Centre would like to express its gratitude to ICCROM for taking the lead in this important publication, as well as to ICOMOS and IUCN for their significant contributions.

Francesco Bandarin
Director, UNESCO World Heritage Centre

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Preface

This Resource Manual represents another step in the capacity-building activities carried out by the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) to help protect World Heritage sites that began with the publication of the *Management Guidelines for World Cultural Heritage Sites* in 1993. It further reflects the collective efforts being made by all Advisory Bodies and the UNESCO World Heritage Centre in helping World Heritage management authorities to better protect their sites. It complements *Risk Preparedness: A Management Manual for World Cultural Heritage* written by Herb Stovel and published in 1998 by ICCROM, ICOMOS and the World Heritage Centre, and highlights the increasing importance accorded to this topic today.

The conceptual frameworks and the format for the manual were agreed at a meeting held at ICCROM with the participation of Dinu Bumbaru (ICOMOS), Giovanni Boccardi (World Heritage Centre), Rohit Jigyasu (consultant), Joseph King (ICCROM), Josephine Langley (IUCN), Gamini Wijesuriya (ICCROM), Aparna Tandon (ICCROM) and Veronica Piacentini (ICCROM visiting researcher). ICCROM gratefully acknowledges their contributions both at the meeting and continually during its follow-up. Rohit Jigyasu was assigned the task of lead author in compiling the manual in consultation with Joseph King and Gamini Wijesuriya; ICCROM is indebted to all three for the final product.

In the process of developing the manual a large number of professionals made contributions in different ways. ICCROM is especially grateful to IUCN for its comments on the draft text and for providing case studies prepared by Josephine Langley, Pedro Rosabal, Tim Badman, Barbara Engels, Dave Mihalic, Simon Parker, Bastian Bomhard, Nirmal Shah, Annelie Fincke and Pascal Girot. Comments received from Giovanni Boccardi throughout the development of the manual were of immense benefit in improving its contents and have been especially appreciated.

During field testing of the manual, the Department of Archaeology of Nepal organized a workshop in Kathmandu with over twenty participants. Rohit Jigyasu, Dinu Bumbaru and Kai Weise acted as resource persons and are gratefully acknowledged, as are those who submitted written comments: Nelly Robles Garcia (Mexico), Dora Arízaga Guzman (Ecuador), Dan B. Kimball (United States), Sue Cole (United Kingdom), Michael Turner (Israel) and Herb Stovel (Canada).

ICCROM wishes to express deep appreciation to Nicholas Stanley-Price who patiently reviewed the text several times and provided a well-edited version of the manual.

Finally, appreciation is due to the staff of the World Heritage Centre, especially Giovanni Boccardi and Vesna Vujicic-Lugassy, for their continuing help and to the World Heritage Committee for allocating funds for the development of the manual.

ICCROM

Introduction

How this Resource Manual can help you with Disaster Risk Management

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What are the key objectives of the Resource Manual?

- To help the managers and management authorities of cultural and natural World Heritage properties to reduce the risks to these properties from natural and human-made disasters, as emphasized by the World Heritage Committee at its 2006 session (UNESCO / WHC, 2006, Section A.5, para. 19).
- To illustrate the main principles of Disaster Risk Management (DRM) for heritage and a methodology to identify, assess and mitigate disaster risks.
- To explain how to prepare a DRM plan based on this methodology.
- To demonstrate that heritage can play a positive role in reducing risks from disasters and so help to justify the conservation of World Heritage properties.
- To suggest how DRM plans for heritage properties can be integrated with national and regional disaster management strategies and plans.

Who is the target audience?

The manual is primarily aimed at site managers, management teams and the agencies and organizations that have a direct stake in the management of a heritage property. It can also be adapted and applied by other stakeholders, depending on their mandate and responsibilities.

What is the scope of the manual?

The manual focuses on one approach to the principles, methodology and process for managing disaster risks at cultural and natural World Heritage properties.

Considering the great variety of types of property, and many possible disaster risks, it does not attempt to be comprehensive. Disasters may result from various kinds of hazard, either natural in origin such as earthquakes and cyclones, or human-induced such as fire caused by arson, vandalism, armed conflicts or disease epidemics. The focus is on sudden catastrophic events rather than gradual, cumulative processes that can have an impact on heritage properties, such as erosion, mass tourism, drought or the spread of invasive species. Furthermore, specific technical and operational aspects (for example, how to strengthen a masonry structure against the risk from earthquake or how to set up early warning systems for a tsunami) are not covered.

The manual is concerned with planning for Disaster Risk Management at cultural heritage properties. It does not attempt to develop a general theory of cultural heritage DRM. Drawing mainly upon the available sources and published literature on DRM, it has been prepared by cultural heritage experts with some contribution from experts in the conservation of natural heritage.

How is the manual organized?

The manual is structured as a series of questions that the user might ask about preparing a DRM plan. The questions are answered by reference to a single, coherent approach to the principles, methodology and process for managing disaster risks at heritage properties. The first three sections (1 to 3) explain why DRM plans are necessary, how they relate to other management plans, and who should be involved in preparing them.

Each of the following sections (4 to 8) focuses on one step in the process of preparing a DRM plan. Throughout the manual, methodological principles are illustrated by case studies. These examples are drawn from the experience of a wide range of disaster risks, on the one hand, and from a wide range of World Heritage property types, on the other.

The appendices provide a glossary of DRM terms, a typology of common hazards, and lists of relevant organizations, sources and publications useful for further reading about DRM for heritage sites.

1 What is Disaster Risk Management and why is it important?

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1.1 Why should World Heritage site managers be concerned with DRM?

- World Heritage properties are important for national and community pride and for social cohesion. Under the World Heritage Convention, the States Parties sign up to the obligation of preserving World Heritage properties for future generations. Therefore managers of these properties are responsible for protecting their outstanding universal value.

- Disasters do happen, therefore it is best to be prepared to manage these unavoidable events.

- In times of disaster, an effective DRM plan can help to support vulnerable communities by preserving their heritage.

- Cultural and natural heritage can itself contribute towards reducing the effects of disasters in various ways; for example, the traditional knowledge systems embodied in physical planning and construction, local management systems and ecology, can not only prevent or mitigate the impact of disasters but also provide sufficient coping mechanisms to deal with post-disaster situations. Cultural properties can serve as safe havens for surrounding communities for their temporary relocation during emergencies.

- Earthquakes, floods, oil spills, conflict and the outbreak of disease cannot be entirely prevented but mitigation measures can effectively reduce the risk that these can present.

- Disasters can have great financial consequences: it is much more cost-effective to invest in preventive risk management planning before disaster has struck than to spend large amounts in post-disaster recovery and rehabilitation (the World Heritage Fund has only limited emergency funding available). Reducing the risk is the most effective management approach.

As a number of key concepts (e.g. disaster, hazard, risk) have now been introduced, the next subsection helps to define their correct usage. See also definitions in the glossary (Appendix I).

1.2 What is a disaster?

- *Disaster* is defined as a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceeds the ability of the affected community or society to cope using its own resources (UNISDR, 2002). In this manual the definition of a disaster is extended to include its impact not only on people and property but also on the heritage values of the World Heritage property and, where relevant, its ecosystems.

- *Disaster risk is a product of hazard and vulnerability.* While a hazard is a phenomenon (such as an earthquake or a cyclone) which has the potential to cause disruption or damage to cultural property, vulnerability is the susceptibility or exposure of cultural property to the hazard. Whereas a hazard is the external source of a disaster, vulnerability is the inherent weakness of the heritage property (due to its location or its specific characteristics). *It is important to bear in mind that hazards such as earthquakes can trigger disasters although they are not disasters in themselves.* (See Appendix I for definitions of these and other relevant disaster management terms.)

It is very often apparent whether a hazard is natural or human-induced, for example in the case of hurricanes or armed conflicts. However, even so-called 'natural' disasters are often the result of underlying factors resulting from human activities, such as building in flood-prone areas, felling trees, or erecting non-engineered structures with no consideration for safety norms.

1.3 What are the main types of hazard that may cause disasters?

The following are some of the most common hazards that may lead to a disaster (WMO; ICSU, 2007):

- *meteorological:* hurricanes, tornadoes, heat-waves, lightning, fire;
- *hydrological:* floods, flash-floods, tsunamis;
- *geological:* volcanoes, earthquakes, mass movement (falls, slides, slumps);
- *astrophysical:* meteorites;
- *biological:* epidemics, pests;
- *human-induced:* armed conflict, fire, pollution, infrastructure failure or collapse, civil unrest and terrorism;
- *climate change:* increased storm frequency and severity, glacial lake outburst floods (GLOFs).

Table 1 shows examples of the relationships and possible combined effect of natural and human-induced hazards.
For a more comprehensive typology of hazards, see Appendix II.

Table 1. *Relationships of natural hazards and human-induced hazards*

	Natural	Human-induced	Indirect / secondary
Meteorological	Hurricane Lightning Heavy precipitation		Flooding (coastal / rivers) Fire Mass movement
Hydrological (caused by high rainfall)	Flash flood Landslide / volcanic ash / lava / ice damming of a river Tsunami	Hydrological infra-structure failure (dams, levees, reservoirs, drainage systems) Coastal protection failure (sea walls)	Disease epidemic Pollution
Volcanic	Lava flows Pyroclastic flows Ash and block falls Gases	Mining-induced (e.g. mud volcano)	Lahars (mudflows) Landslides Tsunami Fire
Seismic	Faulting Transient shaking Permanent deformation (e.g. folds) Induced movement (liquefaction and mass movement)	Dam- and reservoir-induced mass movement Mining-induced Explosion / nuclear induced	Mass movement Fire Flood
Mass movement (of snow, ice, rock, soil mud, etc.) (induced by slow-acting erosion or one of the above)	Falls Slumps Slides Flows	Unstable mining / construction waste spoil heaps	

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1.4 What impact may disasters have on World Heritage properties?

World Heritage properties are those defined in Articles 1 and 2 of the World Heritage Convention and inscribed on the World Heritage List on the basis of their outstanding universal value, which is fulfilled through meeting one or more of the ten criteria defined in the *Operational Guidelines for the Implementation of the World Heritage Convention* (UNESCO / WHC, 2008*a*).

- All World Heritage properties can be exposed to one or more types of disaster.

- Over the last few years, natural and human-induced disasters have caused enormous losses to World Heritage properties. Examples include Bam (Islamic Republic of Iran) due to earthquake in 2003; Prambanan Temple Compounds (Indonesia) due to earthquake in 2006; the Old Town of Edinburgh (United Kingdom) due to fire in 2002; the destruction of the Bamiyan Buddhas in Afghanistan due to armed conflict and vandalism in 2001; and the Temple of the Tooth Relic in Kandy (Sri Lanka) after terrorist attack in 1998. In 2007, the Sidr cyclone in the Sundarbans (Bangladesh) led to the destruction of forest and mangroves, the drowning of fishermen and wildlife, and saltwater intrusion.

- Global climate change is also exposing World Heritage natural properties and the ecological systems that sustain life to increasing disaster risks (UNESCO / WHC, 2007). Additionally, climate cycles such as the El Niño – Southern Oscillation (ENSO) which is associated with drought and flood events, and climate change-associated variations in sea-level and storm or flood events may increase the probability of hazards in protected areas.

- Climate change may also increase impacts of disasters on World Heritage cultural properties through its effects on significant underlying risk factors. Any increase in soil moisture, for example, may affect archaeological remains and historic buildings, thereby increasing their vulnerability to natural hazards such as earthquakes and floods.

- A hazard could potentially change, degrade or destroy the aesthetics and / or the natural balance of the ecosystem of the property or the natural phenomenon for which it has been listed. For example, the Monarch Butterfly Reserve in Mexico is entirely reliant on the annual mass migration of millions of butterflies. A disease outbreak or pollution affecting the butterfly migratory route or a fire at the forest areas where they stay at the most vulnerable time of year could destroy the outstanding universal value of this property.

  Geological and geomorphological World Heritage values are not very vulnerable to hazards. However, mass movement, earthquakes or volcanic eruptions could change the characteristics of the property and flooding could hide its values from visitors.

  Functioning ecosystem processes are vulnerable to most hazards. Of the thirteen natural properties on the World Heritage in Danger List in 2008, eight were inscribed for their ecosystem process values. The 2004 Asian tsunami increased deforestation in the property inscribed as the Tropical Rainforest Heritage of Sumatra (Case Study 30). Conflicts in many of these areas and the resulting disappearance of key species and impacts on existing ecosystems can severely affect their long-term status of. In Manas (India), reintroduction of species is under way to restore the ecosystem after a period of conflict had resulted in heavy wildlife population losses (Case Study 29).

  Natural disasters play a significant role in shaping the character, function and outstanding universal value of many World Heritage properties. Therefore it is important to consider the extent of management interventions that would be allowable in a particular protected area to ensure that natural areas and their associated cultural features, if any, are maintained and natural processes can continue to evolve.

- Disasters pose risks not only to the physical attributes that carry the heritage values of the property, but also to the lives of visitors, staff and local communities living on the site or in neighbouring areas, and also to important collections and documents. They can also have negative consequences for the local economy due to the loss of tourism revenues, and for the livelihoods of local people who are dependent on the property.

  As global populations grow in number and density and are located in ever more risk-prone areas, communities are all the more vulnerable, particularly those that are poor and / or living in remote locations. Recent research has shown that in the areas adjacent to World Heritage properties, population growth is higher than the average for the rural regions in that country (Wittemyer et al., 2008). Therefore, more people may be affected by a hazard, resulting in a high disaster risk.

- In such circumstances, site managers and management authorities are under great pressure to allow activities such as resource extraction for fuel wood, rebuilding, encroachment for agriculture and for settlement, all of which place limited management budgets under great strain.

  Disasters reduce the capacity of World Heritage site managers, management authorities and rangers to monitor and enforce regulations. For example, in Comoé in Manovo-Gounda (Central African Republic), Garamba (Democratic Republic of the Congo), and Niokolo-Koba (Senegal) poaching for the illegal bushmeat trade has severely depleted wildlife populations in regions where there is little food security or few alternative livelihoods. Staff members have been unable to work in these properties due to armed rebel groups roaming across international borders in the conflict zones

This section has shown the extensive impacts that disasters can have on World Heritage properties. Section 1.5 examines how DRM aims to reduce or avoid such impacts.

1.5 What key principles of DRM are applied to heritage?

- DRM aims to prevent or reduce the negative impacts of disaster on World Heritage properties. It is primarily concerned with reducing risks to the heritage values embedded in the property (authenticity and / or integrity and sustainability), but also to human lives, physical assets and livelihoods.

- The values for which the property was inscribed on the World Heritage List should be the foundation on which all other plans and actions are based. This will help to reduce the possibility of emergency response and recovery activities having unintended negative consequences for the property.

- Various small and progressive factors may increase the vulnerability of heritage to hazards. So DRM for heritage is concerned not only with protecting the property from major hazards but also with reducing underlying vulnerability factors, such as lack of maintenance, inadequate management, progressive deterioration, or ecosystem buffering that may cause hazards eventually to become disasters.

- The risks to cultural and natural heritage that DRM must address may originate inside the property or in the surrounding environment. Therefore DRM has a significant role to play in buffer zones of World Heritage properties. Part of the iterative action may be redefining

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the buffer zones as an added layer of protection. Catchment areas, fire hazards and landslide probabilities based on geological surveys could help in developing appropriate risk management guidelines in the buffer zones. For example, World Heritage properties located in the dense urban fabric of the city of Kathmandu (Nepal) are at greater risk because of factors in the surrounding environment. The type of construction used in surrounding residential areas could result in impeded access to the World Heritage area in the event of an earthquake (Case Study 1).

CASE STUDY 1

Increased risk due to surrounding environment: earthquake risk in the World Heritage monument zones of Kathmandu Valley (Nepal)

The World Heritage monument zones of Kathmandu, Patan and Bhaktapur are located within a dense urban fabric in a region highly prone to earthquakes. Increasing urban pressure in Kathmandu Valley during the last few decades has resulted in a rapid transformation of the residential areas surrounding the World Heritage properties. These transformations, which include the addition of floors and the vertical subdivision of residential properties, are making them increasingly vulnerable to earthquakes. In the event of an earthquake, the access roads to the World Heritage property would be blocked, as a result of which fire services would not be able to gain access and evacuation of inhabitants and visitors would be very difficult.

Source: R. Jigyasu, 2002. *Reducing Disaster Vulnerability through Local Knowledge and Capacity; the Case of Earthquake Prone Rural Communities in India and Nepal,* Dr. Eng. Thesis, Trondheim: Norwegian University of Science and Technology.

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- DRM is concerned with the more positive role of using traditional knowledge and management systems in disaster mitigation as well as with passive protection. Traditional communities may not know how to respond to a major fire but they may have a specific organization for collective action in responding to a disaster. Natural heritage may also play a significant role as buffers or protection from various hazards, for example the function of mangroves in protection against coastal flooding caused by erosion or tsunami and storm surge. Functioning ecosystems also have increased capacity to store rainfall in soils, plants and wetlands during storms, thus reducing flood risk within the property and downstream of it.

DRM should be an integral component of the management of a World Heritage property and should therefore form part of the management plan. It should also be linked to disaster management systems at local, regional and national levels. This point is further discussed in Section 2.2.

- Various categories of cultural heritage property, such as historic buildings, historic towns and urban areas, vernacular settlements and housing, archaeological sites, historic gardens and cultural landscapes will have their own specific needs for disaster risk management. These are determined by the specific nature of each heritage type based on its scale and character (tangible and / or intangible, movable and / or immovable, living and / or uninhabited, and protected and / or unprotected).

Disaster Risk Management cycle

There are three main stages of Disaster Risk Management: before, during and after disasters (Figure 1). The preparedness activities to be undertaken before a disaster include risk assessment, prevention and mitigation measures for specific hazards (maintenance and monitoring, and formulating and implementing various disaster management policies and programmes). Emergency preparedness to be undertaken *before* a disaster includes measures such as creating an emergency team, an evacuation plan and procedures, warning systems and drills and temporary storage.

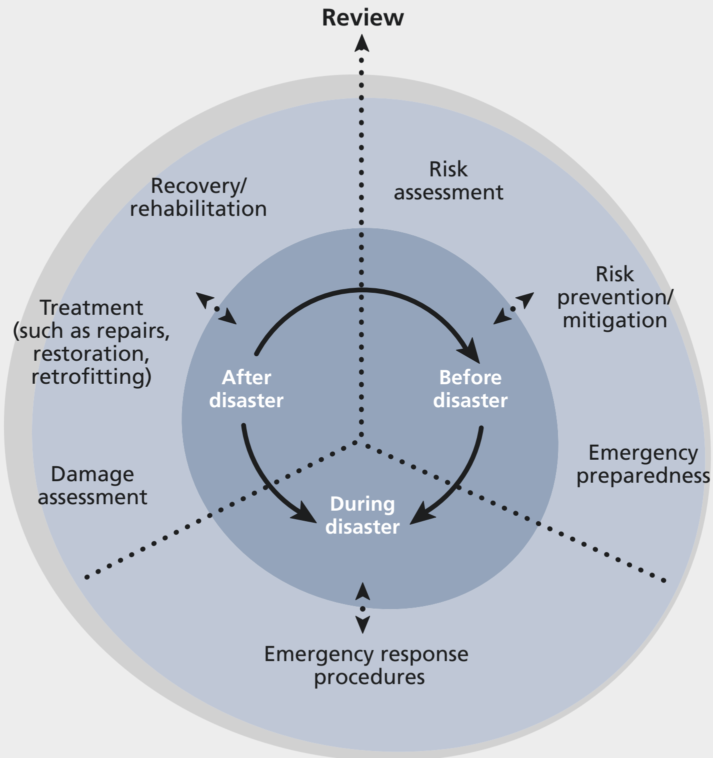

Figure 1. *Disaster Risk Management cycle*

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During a disaster situation, which is usually considered to last for the first 72 hours after the incident, various emergency response procedures for saving people as well as heritage need to be developed and practised beforehand.

Activities initiated *after* the disaster include damage assessment, treatment of damaged components of the heritage property through interventions such as repairs, restoration and retrofitting and recovery or rehabilitation activities. Note that DRM is concerned with preparedness for all these activities to be undertaken before, during and after the disaster.

The experience of responding to and recovering from a disaster provides an opportunity to review the DRM plan for the property, based on its successes and failures. In fact, periodic communication and monitoring are essential considerations throughout the DRM cycle.

The cycle is an effective tool for communicating the essential steps of DRM for cultural heritage, so it should be made available in the local language and be posted in a visible location in the site office.

Having shown how disasters can affect World Heritage properties and reviewed some of the principles of DRM for heritage, the next step is the preparation of a DRM plan.

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2 What does a DRM plan consist of?

2.1 What are the essential characteristics of a DRM plan?

- A plan is essential for providing clear, flexible and practical guidance (rather than rigid rules) for the site manager and their team. A certain flexibility should be built into the plan from the beginning.

- As with a generic site management plan, a DRM plan should not consist merely of a list of actions. Rather, it should describe the processes which, for different situations, should be followed by the responsible authorities in deciding and implementing the appropriate actions (see Figure 2 and refer back to Figure 1).

- A plan should clearly state the main objectives and process of the plan, the scope, target audience and the agency(ies) responsible for its implementation.

- Essentially, a plan is based on identifying and assessing the main disaster risks (see Section 4) that might result in negative impacts to the heritage values of the property (as outlined in its Statement of Outstanding Universal Value), as well as to human lives and assets at the site.

- It then spells out the tools, techniques and implementation strategies for prevention and mitigation, emergency preparedness and response, recovery, maintenance and monitoring. These are elaborated in Sections 5 to 8 of this manual.

- The time periods and deadlines for periodic reviews of the plan should be defined.

- Depending on the nature of the property, a plan should be as comprehensive as possible. For example, if several heritage properties are located in one city or urban area, it might be advisable to have a comprehensive risk management plan for all the heritage properties in the city. The plan would establish a system for coordinating the individual plans for each property, envisaging common activities and procedures for all the properties, especially for coordination with outside agencies such as municipality, fire, police and health services. For an example, see Case Study 2 in which the Historic Centre of Lima (Peru) requires a comprehensive plan covering all historic buildings and the surrounding area, rather than individual plans for specific buildings.

- A DRM plan can take many forms depending on the audience, for example a brochure or poster will be suitable for raising public awareness, while a report might be needed for the state agency, and a handbook / CD ROM with checklists would be more appropriate for a site manager. Whatever its format, it should be closely linked to the general management plan or system of the property (see Section 2.2). The UK National Trust's Emergency Procedures at Historic Houses is a good example of a workable plan (Case Study 3) in which concern for the welfare of the cultural heritage is placed within a larger framework of parallel concerns for life, property and the environment (see also Case Study 25 for a non-working plan).

- Copies of the DRM plan for your property should be kept securely at several locations so that these can be retrieved easily when needed, especially during a disaster.

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It should be clear how the main components of a DRM plan (Figure 2) are derived from the depiction of the DRM cycle (Figure 1). Each of the main sections of this manual is concerned with one of the steps in the plan, as follows:

- 4. *Identification and assessment:* how do you identify and assess disaster risk?
- 5. *Prevention and mitigation:* how do you prevent or mitigate disaster risks?
- 6. *Emergency preparedness and response:* how do you prepare for and respond to emergencies?
- 7. *Recovery:* how do you recover from disasters?
- 8. *Implementation and monitoring:* how do you make your plan work?

Figure 2. *Main components of a Disaster Risk Management plan*

Before starting on a plan (Section 3), questions need to be answered about how a DRM plan relates to a site management plan, and also to larger, regional plans.

CASE STUDY 2

Need for a DRM plan to be comprehensive: Historic Centre of Lima (Peru)

The Historic Centre of Lima was inscribed on the World Heritage List in 1988 as an outstanding example of an architectural ensemble, which illustrates significant stages in human history as the capital of the Spanish dominions in South America until the mid-18th century. Around 23 per cent of the officially protected monuments are located in the historic centre, including the Convent of San Francisco, the largest of its kind in the region. The region is highly prone to earthquakes and fires which have caused significant damage to cultural heritage in the past. After a major fire in December 2001 caused by fireworks, the standards of safety inside the buildings were made very stringent. Earthquakes have also caused severe damage to the historic centre in the past; the most recent devastation occurring during the August 2007 earthquake, following which repair, restoration and reconstruction work has been initiated in several monuments. However, most of the disaster preparedness • • •

CASE STUDY 2

measures until now have focused on individual monuments and do not address the risks that may originate in the urban surroundings. A comprehensive risk management strategy needs to be formulated at the urban level based upon appropriate land use, transport and evacuation routes, and the installation of emergency equipment such as fire hydrants, by closely coordinating with the municipality, fire services, hospitals and other relevant urban authorities. This should be integrated with the heritage needs at the levels of individual historic buildings and of the whole urban area.

Source: Maria D.C.C. Perez and Patricia I.G. Yague, 2007, communication by Peruvian participants at the International Training Course on Disaster Risk Management of Cultural Heritage, Rits-DMUCH, Kyoto.

CASE STUDY 3

A truly integrated approach: National Trust Emergency Procedures at Historic Houses

The National Trust for Places of Historic Interest or Natural Beauty in England developed an in-house guide in the 1980s to assist managers of National Trust Properties to ensure adequate emergency procedures. The Emergency Procedures guide was conceived as a 'working' document intended to guide staff in improving preparedness, while integrating lessons and experiences gained over time. While many organizations avoid detailed procedural manuals of this type – fearing they will not be read at the moment of emergency – the Trust suggests the critical importance of staff gaining advance familiarity with all the material in the document of relevance to their individual roles. The document is based on a core of instructions for Emergency Procedures at Historic Houses, which includes sections on policy, emergency-planning responsibilities, emergency-support team measures, immediate emergency response by emergency type, roles, staff responsibilities, communication lines and responsibilities, and salvage measures. This core is supported by a number of detailed annexes, including guidelines for establishing emergency plans at National Trust buildings, training of emergency-support teams, guidelines for rescue and protection in emergencies (specific to the materials, objects and conditions in which they are found), dealing with the press and media, general precautions for floods, and detailed descriptions of staff responsibilities for twenty-four different positions within property management hierarchies.

Source: H. Stovel, 1998, *Risk Preparedness: A Management Manual for World Cultural Heritage,* Rome, ICCROM, p. 69.

2.2 How is a DRM plan linked to the site management plan of a heritage property?

One of the main challenges to the effectiveness of a DRM plan is the lack of coordination between the site management systems for the particular heritage property and the organizational set-up, policies and procedures for disaster management in the city or region in which the property is located. Therefore the DRM plan for the heritage property should be integrated with the existing plan and procedures for site management (Figure 3).

In those cases where a comprehensive site management plan exists for a particular heritage property, the DRM plan should be well integrated with it. In cases where a site management plan does not exist, the DRM plan can stand alone but it must link to existing procedures for managing the site. In fact, formulating a DRM plan may serve as a catalyst to prepare the site management plan and can be integrated into it later.

When there are various stand-alone plans within a property, it is important to cross-reference them. For example, visitor use and fire management should be linked to the management plan and the larger-scale disaster risk reduction plans.

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An overarching general management plan is useful to ensure integration in complex sites such as serial nominations and properties that cover large areas or multiple ecosystems or physical settings.

Figure 3. *Relationship between a DRM plan and other management plans*

The following examples demonstrate those areas in which disaster management systems or plans can be integrated with the existing site management systems or plans:

- The Statement of Outstanding Universal Value and the boundaries of the property stated in the site management plan should be the reference points for assessing the risks to the heritage values of the property in the risk management plan.

- The plans, maps and management plan of the area in which the property is located need to take into consideration the geology, hydrology, climate, land use, human population characteristics (such as growth and density), transport and new developments, particularly of infrastructure, industry and mining, to reduce the existing and potential risks to the site.

- Site maintenance and monitoring systems should take into account the equipment, techniques and strategies for prevention and mitigation of risks to the property.

- The general security system of the site should also cater for the special needs that arise during emergencies.

- The evacuation plan for staff and visitors should require precise site documentation and mapping, which is an essential part of the site management system.

- For cultural heritage, a comprehensive inventory of movable and immovable heritage components is vital in order to identify the most valuable components (and their location) that are to be salvaged during an emergency. This inventory should be updated regularly, say every two years.

- For natural heritage, a comprehensive inventory of the attributes of the outstanding universal value of the property for each criterion under which it has been inscribed, such as key wildlife populations or habitat distribution, should be conducted and mapped. For the protection of genetic diversity and to promote recovery of vulnerable species, breeding and reintroduction programmes may need to be put in place.

- Due to the potential risk reduction roles that heritage property can play, coordination is essential with national and regional development and planning agencies as well as with national agencies involved in disaster planning and response. For example, site managers can ensure that their national counterparts involved in hazard and disaster planning are aware of the environmental resources for the location of displaced persons (see, for example, *Practising and Promoting Sound Environmental Management in Refugee / Returnee*

Operations, UNHCR, 2001). Without such coordinated planning, human-induced hazards can be created inadvertently during the response phase after a disaster. For example, a poor choice of location of camps for displaced people could expose them to floods and / or fire or lead to contamination of water sources. Deforestation for establishing a camp or to provide materials for shelter or energy can cause soil instability and an increased risk of landslides or flooding.

Section 2 *introduced the Disaster Risk Management cycle (Figure 1) and the three key stages of prevention / mitigation, response and recovery. These in turn form the core of the Disaster Risk Management plan, which is structured as a linear series of steps to follow in preparing a plan. However, the planning process is also cyclical in nature, with a constant feedback loop between the definition of objectives and the implementation and evaluation phases (Figure 2).*

Section 3 *reviews who should be in the team that prepares a DRM plan, and what resources are needed. You will then be ready to embark on the central components of a DRM plan (Sections 4 to 8).*

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3 How do you get started?

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3.1 Who should be members of the 'core team' for preparing a plan?

The core team should consist of the site manager or another person designated by the authorities, along with the staff members responsible for divisions and departments such as administration, maintenance, monitoring and security. It is also very important to engage the local municipality, local government, local community leaders or elders, local scientists and researchers, the disaster management agency, police, health services, and emergency response teams (e.g. firefighters, coastguard, mountain rescue). These should be involved in the process of setting up the system and formulating the plan for disaster risk management. If there are any organized local community groups, they too should be involved in the process.

It is also important to involve people who could help to identify and assess risks, for example specialist professionals such as hydrologists or seismic engineers.

In some situations, conflicts of values and interests in a heritage property may arise among various stakeholders. Those persons or groups representing varied interests in the property should be identified and engaged in the process of formulating a risk management plan. On the other hand, security may be an issue if the entire plan is made public. This aspect must be considered while engaging various stakeholders in the process.

One person should be allocated the role of representing the outstanding universal value and integrity of the property to ensure that these are fully integrated into the planning for disaster risk management. That person should reinforce the importance of these values with staff and others involved in disaster risk management.

3.2 Who are the partners and stakeholders at local level?

- Local community leaders and organizations can play a responsible role to mobilize the community for active participation in the formulation and implementation of the plan.

- Schools, hospitals, religious groups and other formal and informal institutions may need to be approached to identify potential collaboration or information-sharing.

- Particularly in remote locations, those with access to aircraft, boats or other vehicles should be encouraged to prepare for helping in evacuation or other rescue needs.

3.3 Who are the major partners and stakeholders at national and international levels?

The State Party is the primary stakeholder responsible for protecting and managing a World Heritage property, including with respect to disaster risks. National agencies which would be the key stakeholders in formulating and implementing DRM plans for World Heritage properties include:

- Agencies responsible for the national disaster management programmes and activities (civil protection, firefighting forces, flood control engineers, health officials dealing with epidemics);
- Agencies responsible for protecting and managing cultural and natural properties;
- National hazard warning systems, such as the meteorology and seismic monitoring agencies and others involved in hazard monitoring;

• Military and police forces and volunteer groups, which should be made aware of the response plans within the property and be well trained to support their implementation if required.

Therefore, the plan should be made available to all these types of agency.

At international level, the UNESCO World Heritage Centre is the key stakeholder for the protection of World Heritage properties from disasters. Several other international agencies, research and academic institutions can play an important role in disaster prevention and response, such as ICOMOS, ICOM, IUCN and the Blue Shield through their field offices or representatives. For example, the National Committee of ICOMOS played a significant role during post-tsunami recovery of the cultural sites in Sri Lanka and successfully advocated the importance of including cultural heritage values in post-disaster recovery plans (Case Study 4).

Information on ICOMOS and other relevant international organizations is given in Appendix IV.

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CASE STUDY 4

How a cultural heritage NGO can help: the role of ICOMOS Sri Lanka in post-tsunami recovery

The Indian Ocean tsunami on 26 December 2004 caused heavy destruction of the rich cultural property located in the maritime provinces of Sri Lanka. Among the heritage components that were damaged were some of the oldest religious buildings still in use, a range of secular buildings with a blend of architectural styles ranging from the local vernacular to Portuguese, Dutch and British influences, and traditional fishing villages and unique ecosystems.
ICOMOS Sri Lanka, though a small group, was in action soon after the tsunami – most members had seen the devastation within twenty-four hours of the event and a few even had had first-hand experience. Thus the National Committee decided to carry out at least a survey of the cultural properties, knowing that no other party would undertake such a study during that time of crisis.
As planners were going to be preparing development proposals for the affected areas, ICOMOS Sri Lanka issued a public statement within a week of the incident appealing to officials to recognize the cultural properties and to save them from destruction. This had the desired effect when the Sri Lankan Government agreed to allow cultural sites and monuments, along with hotels and structures relating to the fishing industry, to be permitted to remain within the newly declared buffer zone from the coastline. ICOMOS then undertook the arduous task of carrying out a survey of the cultural properties affected by the tsunami. To be meaningful, it had to be carried out as quickly as possible and the results passed to the planners to incorporate in development proposals. The support of local universities was also mustered under the supervision of ICOMOS.

Source: P. Wijeratne, 2008, Post-tsunami redevelopment and the cultural sites of the maritime provinces of Sri Lanka, in H. Meir and T. Will (eds), *Heritage at Risk: Cultural Heritage and Natural Disasters,* ICOMOS.

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3.4 What human, technical and financial resources are needed?

- Additional human resources to support the core team would include professionals from the fields of conservation and disaster risk management. Other specialist professionals such as meteorologists, climatologists, seismic engineers, hydrologists, public health experts, epidemiologists, and sociologists, etc. can also provide valuable inputs.

- Technical resources would include tools and equipment necessary to undertake various measures for assessing and reducing disaster risks to the property and its various components. For example, extinguishers, hydrants and smoke detectors make up the equipment necessary for fire prevention. Someone who can help in identifying these would be useful as part of the planning team.

- Financial resources required for the development of the plan will depend on the nature and extent of the property and its vulnerability to various hazards. A preliminary survey is required to assess the scope of work on the basis of which estimates for the projects and activities can be prepared.

- The planning team should make every effort to develop plans that can be implemented within the available resources. However, a plan may include estimates for which essential resources may be found afterwards. Local and national funding should cover all core budget requirements.

- All kinds of inventories, including lists of staff members, heritage components of the property and equipment likely to be damaged as a result of a disaster, need to be prepared and made easily accessible.

- Frequently, the resources needed to respond to and recover from disaster cannot be provided by the local site management agency. In these cases there will be a need for assistance from the local government and disaster management agencies and even greater attention from the state and national governments. With a broader agency and stakeholder response comes the need to educate those involved in the guidelines forming part of the DRM plan for the cultural heritage property, including special considerations for the protection of heritage values.

Sections 1 and 2 *have reviewed why a plan is needed and what it can do.* ***Section 3*** *has indicated who should be involved in preparing and implementing it. We are now ready to discuss the central components of a DRM plan.*

Sections 4 to 8 *address a different step in the plan (Figure 2), starting with how to identify and assess disaster risks.*

4 How do you identify and assess disaster risks?

***Section 4** reviews what information is needed in order to identify risks (4.1), then analyses potential risks (risk assessment, 4.2) to see how they can be reduced by means of good planning and management (4.3).*

Case studies are used to illustrate important points. The DRM cycle remains fundamental to the discussion (Figure 1).

4.1 What kind of information do you need to identify disaster risks to your property?

The following categories of information are essential:

- The particular attributes (tangible as well as intangible) that carry the outstanding universal value and justify the criteria for inscription of the property on the World Heritage List. Statements on authenticity and integrity are also very helpful. This information should normally be available to the site manager. The *Operational Guidelines* and other important information on the World Heritage Convention are available online from http://whc.unesco.org/.

- The factors and processes that, for each of the possible hazards affecting the property, may result in damage or deterioration. The probability of occurrence of each hazard should also be assessed.

- Geographical information on the location of the property, its boundaries, its buffer zone, its immediate surroundings, access, topography, etc.

- Geological, hydrological, and meteorological information on the nature of the climate, soil, fault lines (if any), water table, surface water such as a river, etc.

- Thematic maps of the area or region in which the property is located, such as a hazard vulnerability map. A series of generalized maps that describe the major hazards (or natural disaster hotspots) that would probably affect World Heritage properties in given regions may also be useful. These are generally available from the principal national, regional or local agencies responsible for disaster management. They are best utilized by either including a set of maps that display the location of World Heritage properties along with known natural disaster hotspots, or by providing a web link to these types of map in the plan. A good source of information on natural disaster hotspots is the World Bank Disaster Risk Management Series (Dilley et al., 2005).

  Specialized maps such as cultural heritage risk maps at national or area level, if available, can also be useful. A geographical information system (GIS) is a useful application to prepare such thematic maps. The Risk Map of Cultural Heritage in Italy is an important project that illustrates a systematic attempt at national level to map the vulnerability to risk of cultural heritage (Case Study 5).

- Information on the history of different disasters affecting the area or the property itself, obtained from historical records and from specific agencies dealing with different types of disaster.

- Inventories and the current status of existing management systems and disaster preparedness equipment and facilities in the property, such as for shelter, evacuation and rescue.

Hazard-specific equipment should also be evaluated, e.g. the different needs for floods, fires, landslides, pollution events and disease epidemics.

- The existing relevant institutions and the community within and around the property.
- The physical planning (land use, transport, infrastructure) of the area in which the property is located. This is available through local planning documents such as a master plan or regional plan.
- The condition of roads for potential evacuation.
- Local and traditional knowledge systems relevant to disaster risk reduction.
- A complete and easily accessible directory of agencies that will take action.

CASE STUDY 5

Preparing hazard vulnerability maps: Risk Map of Cultural Heritage in Italy

This initiative by the Istituto Centrale per il Restauro is aimed at preparing urgent preventive measures by taking into consideration the environmental and human conditions of Italian cultural heritage. The project has been developed over several phases. The first stage involved gathering data on the environmental risks to which cultural heritage is exposed, in order to draw up thematic maps for various natural factors such as earthquakes, volcanoes, floods or air pollution; and human factors such as theft, vandalism or tourist pressures. Information gathered from municipal databases concerning the distribution of cultural heritage was integrated to identify the areas most exposed to risk factors. The second phase involved, first, detailed cataloguing of various cultural heritage properties and their vulnerability, and second, detailed analysis of related conditions such as stone deterioration and impact of environmental pollution. The purpose is to verify over time the actual nature and rate of decay in order to improve the predictive accuracy of risk mapping. The final phase involved generation of a computer-based synthesis of the distribution and vulnerability of the cultural heritage properties identified and their associated risk factors, all represented in map form.

Source: Details of the project, with maps (http://www.uni.net/aec/).

Where little historical data are available or where monitoring gaps occur, the best available data should be used and can be amplified through ‘triangulation’, i.e. the use of multiple sources. Local knowledge can supply valuable qualitative data to help with verification.

During emergency response, the data collected are valuable in improving future response and allowing lessons to be learned.

Note: It is very important to make a clear distinction between natural hazards and disasters, as this relates to the degree of management intervention that is appropriate for a given World Heritage property. Your ability to prevent harm or loss of heritage values as a result of natural processes may be limited. So the response and recovery actions must be carefully studied. The general view that static natural or cultural heritage features can be maintained in a changing environment is being replaced with an understanding that some alterations to these values cannot be avoided. Therefore assessing disaster risks will become increasingly complex as these properties experience both gradual and sometimes catastrophic affects of climate change.

CASE STUDY 6

Communication with the public when a natural hazard is not a disaster: natural processes in Kamchatka (Russian Federation)

Recognized for all four natural heritage criteria including its outstanding geological processes, the Kamchatka World Heritage site contains twenty-nine active volcanoes. In June 2007, a landslide choked the river flowing through the Valley of Geysers in the Kronotsky Nature Preserve. This blockage submerged many of the valley's geysers. At one point the dam of rock, gravel and ice was estimated to be 4.5 million m^3.

The Valley of Geysers is a tourist attraction and the landslide and subsequent flooding of the valley attracted worldwide media attention and concern about damage to the protected area. However, the event simply represented a natural part of the ongoing processes operating within the property. Site managers can benefit from communicating clearly with the media and public about such events which, while sudden and possibly shocking, represent opportunities for increasing awareness on natural processes.

However such events do create a need for assessment of possible increased hazards to human life. In the case of this landslide, important measures include assessment and monitoring of risks and communication to ensure that tourists, researchers and people living downstream are aware of the risk of sudden flooding if the dam were to breach.

4.2 How do you analyse the factors that may cause disaster risks to your property?

The factors that may cause disaster risks to the property can be analysed through the following steps (Figure 4):

Analysis of factors

- Listing all the natural and human-induced hazards that expose the property to disaster risks. These would include primary hazards with potentially disastrous impact, such as earthquakes, as well as slow and progressive secondary hazards, or underlying risk factors, such as changes in natural vegetation due to rising ground water or changes in ground water quality due to pollution. In the case of cultural properties, secondary hazards might be the growth of vegetation on monuments and dampness from rising ground water.

  (Note that, although the focus here is hazards such as earthquakes and cyclones that have the potential to unleash disasters, secondary hazards that increase disaster vulnerability cannot be overlooked).

- Identifying the processes that might, in combination with a primary hazard, cause disaster risk to the property. These processes can be identified on the basis of:

  – evaluating the performance of existing management systems and disaster preparedness measures;
  – analysing the potential negative impacts of existing damage and deterioration patterns or phenomena, or present irreversible interventions, activities or physical planning which could contribute towards increasing the vulnerability of the property to various hazards. This can be done using various tools, and may also involve the local community, as in the Disaster Imagination Exercise described in Case Study 7.
  – analysing the underlying risk factors relating to the surrounding environment that increase the property's vulnerability. These factors may be physical, social, economic or institutional, as well as attitudinal. The physical vulnerability may be at the structural or material level. Each property should identify its specific indicators of vulnerability to be assessed for change over time. For example, the World Heritage monument zones that

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are located in the dense urban areas of Kathmandu, Patan and Bhaktapur (Nepal) are highly vulnerable in terms of their structural weakness as well as accessibility during disasters (Case Study 1).

– analysing the potential negative effect of poor restoration done in the past. For example, according to some experts, investigation at the Prambanan Temple Compounds (Indonesia) following the June 2006 earthquake revealed that the extensive damage to the main stone temples was due principally to the reinforced concrete under-structure that was introduced into the temples during prior restoration. Similar reasons were also cited by experts in explaining the damage to Bam Citadel in the Islamic Republic of Iran following the 2003 earthquake there (see also Case Study 27 on Bam).

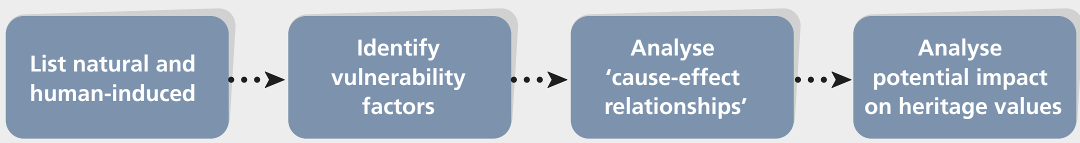

Figure 4. *Risk analysis process*

– analysing the 'cause-effect' relationships between various primary hazards and underlying risk factors that increase the property's vulnerability and expose it to disaster risk and clarify the way these interlock. Several secondary hazards (or factors) may increase the vulnerability of a property to a primary hazard. For example, secondary hazard agents such as termites and vegetation affecting a historic building may be caused by a primary hazard, such as heavy rainfall due to improper drainage and lack of maintenance. This might in turn weaken the structure of the property, making it more vulnerable to earthquake (primary hazard). At the same time, a solution to a specific hazard may increase a property's vulnerability with respect to another hazard. For example, conservation guidelines for mortars developed because of a greater incidence of flash-storms may not be appropriate in terms of earthquake resistance (Figure 5).

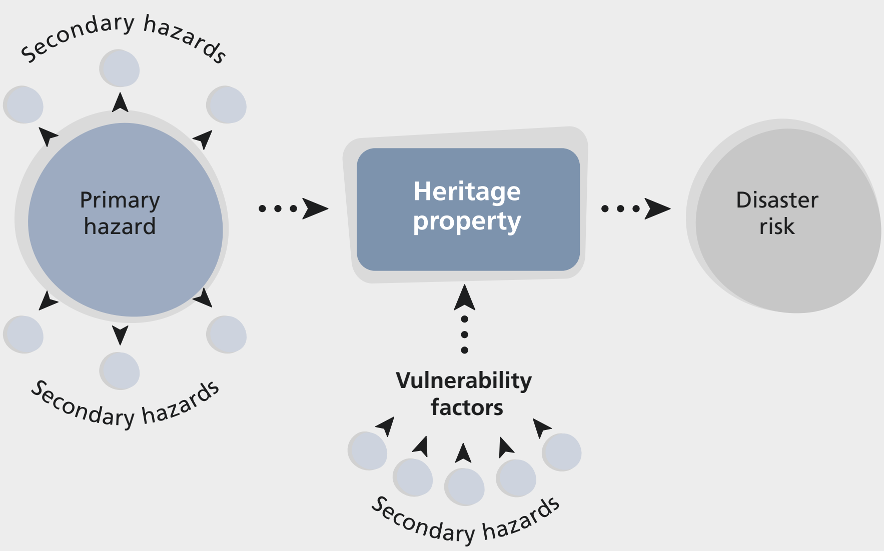

Figure 5. *Relationship between hazard, vulnerability and disasters*

CASE STUDY 7

Disaster Imagination Exercise: a method of community-based risk assessment of post-earthquake fire in historic urban areas

The Disaster Imagination Exercise is an effective tool for analysing disaster risks to cultural heritage located in urban areas by engaging the local community. The first step of this exercise is to obtain an appropriate base map of the area and fix it on a table under a transparent sheet. Based on preliminary research, legends are decided for important heritage buildings, safety areas, fire risk areas, and water sources such as hydrant, cistern, warehouse, etc. Essential areas that need to be saved in case of a fire should be decided, including cultural heritage buildings and community facilities. As the next step, the participants should imagine the scenario when a serious earthquake hits the area causing the disruption of the city water and electricity network, and subsequently mark the water resources that need electricity, for example normal hydrants, wells with pumps, etc. This should be followed by a discussion on possible earthquake damage such as road blockage, building collapse based on the hazard maps and site inspection. Next, the participants should imagine the scenario that a fire breaks out around the heritage buildings as a result of the earthquake, and consequently mark places such as restaurants where fire is likely to occur. They should try to figure out ways of firefighting by tracing the route by which usable water can be delivered to the affected site, taking into account the distance of the source, means of delivery, human resources needed, etc. As the last step of this exercise, the spread area around the fire site should be marked by a big circle and routes for salvaging treasures from heritage buildings should be discussed, based on considerations such as distance, clear route and feasibility. The findings of this exercise should be used to make proposals for disaster risk preparedness in historic urban areas.

Source: Okubo Takeyuki, 2007, Research Center for Disaster Mitigation of Urban Cultural Heritage, Ritsumeikan University, Kyoto.

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Writing disaster scenarios

The next step involves writing disaster scenarios, i.e. predictions of what the situation is likely to be at a specified time following the disaster (e.g. after one week, or after one month). Scenarios are constructed on the basis of assumptions derived from information about the current and the proposed activities and projects in the area, the management systems in place, and the vulnerability of the property to various hazards that has been previously assessed.

The development of alternative scenarios helps in assessing different possibilities and their potential impacts on heritage resource components. Scenarios are explained as narratives – as progressive sequences of events affecting each other, thereby unfolding a particular situation. Scenario planning is indeed a creative exercise, aimed at playing with various existing and potential variables in a particular context. The scenarios will have different scopes and natures, depending on whether:

- the disaster is caused by one extreme hazard (primary hazard), such as a cyclone;
- the disaster is followed by other hazards, for example an earthquake is followed by fire as in the case of the Kobe (Japan) earthquake in 1993;
- the disaster takes place when two or more hazards act simultaneously or in close association, creating a cumulative effect, as in the case of the Indian Ocean tsunami when an earthquake led to massive tsunami waves that caused heavy damage in an area affected by civil unrest, only to be followed by looting and arson.

Disaster risk scenarios need to take into consideration different variables that are specific to the nature of the property and the kind of risks to which it is exposed. For example, the oil spill model developed for Banc d'Arguin National Park in Mauritania (Case Study 8) covers a number of risks to which the property is exposed but a review identified additional issues in implementing risk reduction measures.

Useful questions to ask: What is the state of conservation of the entire property, a section of it, or specific heritage components? What could be the potential impacts of the disaster scenarios on various heritage components of your site? How do these affect the heritage values (notably the outstanding universal value and the tangible / intangible, movable / immovable attributes that support the criteria used for inscription) of the property and the associated conditions of authenticity and / or integrity?

CASE STUDY 8

Developing a contingency plan for oil spill risk reduction in Banc d'Arguin (Mauritania)

Maritime oil exploitation and transport in Mauritania's coastal waters pose a risk to the Banc d'Arguin National Park, a World Heritage site protected for its ecosystem process and biodiversity. Petrochemical extraction and transport outside the boundaries of the World Heritage site pose a threat to marine and coastal species, habitat and water quality through the risk of currents carrying oil spills and pollution into the property.

Although the State Party of Mauritania has signed the major conventions relating to marine pollution prevention and safety MARPOL (1973/1978) and Oil Spill Response (1990), there is still no National Oil Spill Response Plan, designated Oil Spill Response Authority, or experience in dealing with oil spills. However, the Government of Mauritania, with support from the Banc d'Arguin Foundation (FIBA) and IUCN, has been engaging with Woodside, a company involved in oil exploration and extraction in the offshore waters of Mauritania. A panel of independent experts on the impact of the petrochemical industry has also been established to provide oversight.

Woodside has conducted an Environmental Impact Assessment (EIA) to assess the social and environmental impact of its oil extraction activities. Part of the EIA included the modelling of currents and potential oil transport from its area of extraction. The Netherlands Commission for Environmental Assessment, at the request of the Government of Mauritania, also conducted a review of the EIA and made particular comments on the oil spill modelling and Oil Spill Contingency Plan, part of the Woodside Environmental Management Plan.

Although an oil spill model is essential for pollution risk analysis and to aid oil spill management, it is critical that the variables of the model and its assumptions are sufficiently robust to provide reliable oil spill scenarios. Such variables include seabed bathymetry, turbulence, tidal motion, wind-driven and geostrophic convection currents and large-scale drift currents. The independent review confirmed that the model was suitable but raised several concerns: the model was based only on extraction from • • •

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CASE STUDY 8

the existing Chinguetti site; and did not include scenarios for extraction at other locations or the effect of oil transport. Also, the limited expertise in the national government agencies limits the capacity of the responsible agencies to use and interpret the model and associated technical information independently. The oil spill model is an important tool for the Oil Spill Contingency Plan as a response should incorporate the following factors:

- *Volume of oil spill: which clean-up measures are suitable given the volume of the spill?*
- *Expected drift and dispersal: is the spill likely to drift towards the Banc d'Arguin or other vulnerable areas?*
- *Seasonal variation in species distribution: are migrant birds or other wildlife present and therefore more vulnerable?*
- *Stationing of response equipment: where should vacuum-cleaning ships be distributed to optimize response prior to pollutants reaching the shore?*
- *Location of floating production, storage and offloading systems (FPSO) that receive crude oil from deep-water wells and store it in their hull tanks: have protection screens been installed around the FPSO?*
- *Low vulnerability sites: are there areas where oil spills can be allowed to disperse or land without significant harm?*

A World Heritage site manager should engage with private companies and relevant government agencies to ensure that risk reduction measures are developed to protect the outstanding universal values and integrity of the property.

Sources: Netherlands Commission for Environmental Assessment, 2007, Advisory Review of the Environmental Impact Statement and Social Impact Study for the Chinguetti Offshore Oil Development Project, Mauritania (http://www.eia.nl/bibliotheek_detail_en.aspx?id=122335).
Fondation Banc d'Arguin (http://www.lafiba.org/).
R. Holland, The role of an international spill response organisation in oiled wildlife response (http://www.osrlearl.com).
Panel of independent experts on the impact of petrochemical industry in Mauritania (http://panelpetrole.mr/pa/index.php?option=com_content&task=view&id=31).

4.3 How can you evaluate disaster risks and prioritize risk reduction measures / strategies?

Disaster risks can be evaluated by assessing the level of risk on the basis of the following criteria:

A. The probability of a particular disaster scenario occurring in your property. The probability might be:

- *high*, as in the case of heavy rainfall in a temperate climate;
- *medium*, as in the case of extreme weather events in the tropics;
- *low*, as in the case of an earthquake that may happen once every fifty years.

The probability is expressed as a ratio, e.g. 1 in 100 (see Case Study 9, which is explained below).

B. The severity of the consequences of the disaster scenario on the property and its components, including people, property, livelihoods; also other physical attributes in which heritage values of the property are embedded, such as landscapes and infrastructure, the disruption of human activities, the loss of traditional knowledge, etc. (in physical, social, cultural and economic terms). A consequence is the direct effect of an event, incident or accident and can be expressed as a health effect (e.g. death, injury, exposure), a property loss in economic terms or number of structures damaged, and an environmental effect. Consequences might be evaluated in the following terms:

• catastrophic or severe;
• mild;
• gradual;
• no consequence.

These can be numerically expressed in relative terms on a scale of 0 to 1, where 0 stands for no consequence and 1 for catastrophic consequences.

C. The consequence in terms of 'loss of value' represented by the relative impact on various attributes associated with specific values of the property. Within a single property, some attributes could be absolutely essential and irreplaceable to convey the outstanding universal value, whereas others, although important, could be less crucial or more easily restored. The consequence on values would be higher in the former case, less in the latter. Therefore one of the factors for risk evaluation could be developed by devising a recovery index for attributes that can be restored.

The level of risk to the site for a particular scenario is assessed vis-à-vis the probability, severity of consequence on people, lives and livelihoods, and potential loss of values (Figure 6).

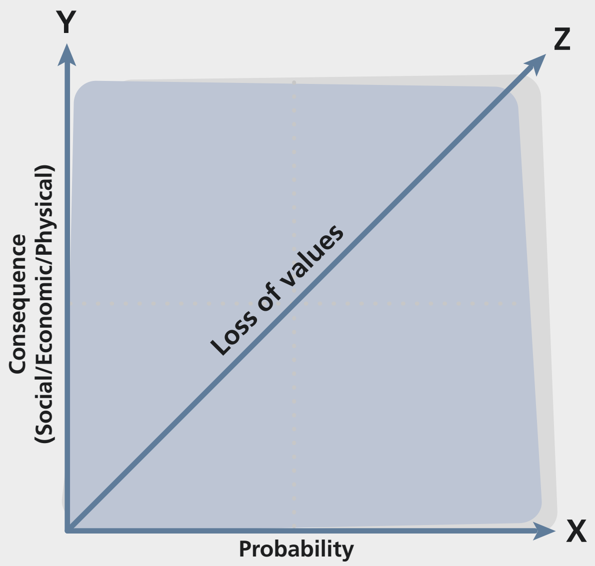

Figure 6. *Assessing the level of risk*

For example, an earthquake affecting a dense urban fabric with rich cultural heritage will represent a scenario with low probability, high physical, social and economic consequences and high loss of value, and therefore a high level of risk; whereas the same earthquake affecting open farm land with no habitation and cultural heritage may represent a scenario of low probability, low physical, social and economic consequences and probably no loss of value, and therefore low level of risk.

To take another example, minor seepage of water from the roof in a significant historic building, due to improper drainage, may cause extensive damage to exquisitely painted ceilings. This would represent a scenario with high probability, with low consequences in physical and economic terms but high consequences for the values represented by the painted ceiling. On the other hand, continual leakage of rainwater through cracks in the roof of an outhouse of little heritage significance, located in an area with a high frequency

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of rainfall, may represent a high probability or high-consequence scenario in physical terms with a not-so-high loss of value.

Various quantitative and qualitative tools can be used to assess the level of risk to heritage sites. One such quantitative tool has been developed for assessing the risk to museum collections (Case Study 9).

CASE STUDY 9

Quantitative expression of risk: the ABC risk assessment scales for museum collections

The probability of disaster and its consequence can also be quantified using mathematical principles. For example, if the probability ***(say 'A')*** *of severe museum fires was 5 museums over a period of 50 years in a country with 2,000 museums, then the probability for each museum is 5 / (50 x 2,000), which means there is 1 chance in 20,000 of fire each year or 1 in 200 every 100 years. The consequence on the museum collections* ***(say 'B')*** *can be quantified in terms of percentage of collection that is affected in a museum, for example, loss of all or most of the collection can be quantified as 100 per cent while a miniscule fraction of loss may be just 0.01 per cent. Similarly, the percentage of value lost in each affected object* ***(say 'C')*** *can be quantified as 100 per cent for total or almost total loss of value in each affected object while miniscule loss of value in each affected object can be 0.01 per cent. According to ABC risk assessment scales, the magnitude of risk to museum collections will thus be the sum total of the three indicators 'A', 'B' and 'C'.*

Source: S. Michalski, 2007, ICCROM-CCI-ICN Reducing Risks to Collections Course, Sibiu, Romania.

The prioritization of risk reduction measures may depend on several factors:

- Although the risk level of a disaster scenario may be quite high, the mitigation measures may need to be optimized if the available or promised resources are limited.
- Prioritization for disaster reduction may sometimes have to wait in the face of the immediate conservation needs of a property, such as repair of a severely damaged structure.
- Prioritization also depends on the costs and benefits associated with both implementation and maintenance stages. This is linked to the availability of human and financial resources.
- Another factor in the prioritization of risk reduction measures is the effect that the proposed measure may have on risks to one heritage component at the cost of reducing the risk to another component, to visitors and staff, or to the environment.

Section 4 *has reviewed what information is needed in order to identify risks (4.1), analysed potential risks (4.2) and seen how they can be reduced by prioritizing them, making use of three general criteria (4.3). The concept of probability and the idea that risk can be expressed quite simply in quantitative terms were introduced.*

Section 5 *reviews the measures that can be adopted to prevent disaster risks or at least to mitigate their impact. Again, a number of case studies illustrate what can be done.*

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5 How can you prevent disaster risks or mitigate their impact?

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5.1 What measures can you adopt to prevent or mitigate disaster risks?

Disaster risks can be prevented or mitigated by:

- preventing hazards such as fires and theft; or
- mitigating the impact of hazards such as earthquakes and flooding; or
- reducing the vulnerability of the property and its environs; or
- training the staff in self-protection strategies.

The prevention and mitigation measures require coordination among various staff members and departments responsible for managing the property as well as contact with outside agencies and experts in relevant fields.

Specific equipment might be required to prevent or reduce the impact of hazards on the property. The cost-effectiveness of this equipment needs to be assessed on the basis of various factors such as available resources and staffing.

Different measures, techniques and strategies for mitigating disaster risks to heritage sites are illustrated here by case studies. These include:

- Urban and regional planning measures in and around a property, which address disaster risks to the property itself and its immediate environs. The need to integrate heritage within existing urban or regional plans and specific planning projects has already been emphasized (Section 2.2) as part of the discussion on the relationship of a DRM plan to other management plans. A good example of this linkage is provided by the regional projects that were designed to avoid flooding of the Historic City of Ayutthaya (Thailand), following the 1995 disaster (Case Study 10; see also Case Study 14 for another response to flooding of a heritage area, involving planning measures at the urban scale).

- Strategic decisions based on detailed studies such as the impacts of climate change and of changes in the ecosystem. This may involve the strategic restoration of a previous ecosystem (Case Study 11).

- Various tools may be used by site managers to mitigate disaster risks in protected areas. In the Galápagos Islands (Ecuador) the management of invasive species through eradication and the imposition of strict controls is crucial to the mitigation of the risk of endemic species loss (Case Study 12).

- Analysis of the flood damage in summer 2002 suggested that restoration of the floodplain ecosystem that was once much more extensive would aid in flood mitigation of the Danube region in South-Eastern Europe (Case Study 11).

- Successful mitigation measures were taken in the face of a predicted El Niño event and possibly accelerated erosion of the earth-construction remains at Peru's Chan Chan Archaeological Zone (Case Study 16).

- Mitigation measures can also include changes to the management of the property and definition of buffer zones.

- Technical measures for protecting the site from the impact of specific natural disasters. The type of measures would depend on the nature of the property and the main disaster risk to which it is exposed. In the case of Venice, which is exposed to regular flooding, a sophisticated technological solution has led in turn to ecosystem regeneration (Case Study 13).

Proposed measures should depend on the nature of the risk while taking into account their potential impact on the values of the property. It is paramount that the proposed intervention should have minimal impact on the values, authenticity and integrity of the property (see Section 5.2 and Case Study 17 on Kobe, Japan).

Planned measures, moreover, should not be seen in isolation but would need to be integrated with other existing planning frameworks. In the case of Grimma (Germany), a technical solution to prevent flooding of the city had to be revised to take account of much broader concerns of planning and public reaction (Case Study 14).

- Disaster risks can also be mitigated to a great extent through effective monitoring systems. Thus the risk of glacial lake outburst floods in Sagarmatha National Park (Nepal) has been reduced by monitoring glacial lakes and by introducing early warning systems (Case Study 15).

CASE STUDY 10

Integrating heritage in urban and regional planning: risk preparedness for the Historic City of Ayutthaya (Thailand)

Over ten ancient towns and several archaeological sites and monuments were flooded due to incessant heavy rainfall during several weeks in 1995. Many historic sites were damaged, and some buildings collapsed. The main cause of increasing flood intensity in historic areas of Ayutthaya was the lack of effective land-use control, causing many natural floodways and retention areas to be destroyed and developed as functional urban areas. In fact, traditional flood prevention systems using water gates and dykes had been effective in Ayutthaya for centuries until they suffered deterioration and destruction in recent years. As a preventive measure for such devastating floods in the future, several projects were formulated at regional level. These included construction of dams and reservoirs, grass plantation along the banks of major rivers, floodwater retention projects, dredging of waterways and removal of water weeds. Revitalization of ancient city moats, walls and gateways was proposed to prevent future floods. Site plans were also prepared for monuments in lower areas outside the city to be protected by dams and drainage systems.

Source: K. Ronarit, 1997, *Risk Preparedness for Cultural Properties: a Case Study on the Old Cities of Bangkok and Ayutthaya*, Kobe/Tokyo International Symposium on Risk Preparedness for Cultural Properties.

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CASE STUDY 11

Flood mitigation through ecosystem restoration: the Danube in south-eastern Europe

In Europe, floods are the most common type of natural disaster, threatening lives and livelihoods and incurring great cost. In summer 2002, 100 people lost their lives through flooding of the Danube. The estimated cost of the flooding was €10 billion in Germany, €3 billion in Austria and €2 billion in the Czech Republic. In 2005 many villages in Romania and Bulgaria were destroyed by flash floods along the Danube. In 2006 up to 30,000 people were displaced in the Danube Basin and at least ten people died, and millions of hectares of agricultural land were flooded, destroying crops. The overall damage was estimated at over half a billion euros.

Studies of satellite images and geographical information systems concluded that the direct cause of flooding was rapid snow melt and heavy rains. However, the restriction of the floods to former floodplains demonstrated that the underlying causes of the disaster were poor planning and investment, allowing industry, agriculture and property to be located on the high-risk Danube floodplain. More than 80 per cent of the former natural floodplain in the Danube Basin has been lost in the last 150 years due to such measures. The Danube Delta World Heritage site is one of the few remaining areas along the lower and middle Danube which still contains large natural floodplain ecosystem complexes capable of mitigating the flood risk. Flood research and models suggest that if natural processes were restored in the most affected areas, the water level would be 40 cm lower during flooding events.

Recent studies based on climate models predict that intensity and frequency of flooding will increase in the future. While climate change is difficult to address directly, mitigation through ecological restoration of floodplains, including reconnecting side channels and widening of the riverbed upstream of settlements, would reduce flood risks by restoring ecological functions. These measures would provide additional ecosystem services including provision of wood, reed, fish, drinking water, nutrient reduction and storage. A network of existing and new protected areas including Srebarna Nature Reserve World Heritage site (Bulgaria), Ramsar Sites, Biosphere Reserves and National and Nature Parks is being developed to help the restoration and protection of the Danube floodplain.

Site managers have a variety of tools available to increase the role of their protected areas in flood mitigation. Materials are available from various international programmes and conventions such as the Ramsar Convention's Wetlands Risk Assessment Framework, and the World Meteorological Organization's Disaster Risk Reduction Programme.

Sources: European Environment Agency, 2005, *EEA Briefing – Climate Change and River Flooding in Europe* (http://www.eea.europa.eu/publications/briefing_2005_1).
Ramsar Convention Secretariat, 2007, *Ramsar Handbooks for the Wise Use of Wetlands*, 3rd edn, Gland, Switzerland (http://www.ramsar.org/cda/en/ramsar-pubs-handbooks-ramsar-toolkit-21323/main/ramsar/1-30-33%5E21323_4000_0__).
S. Stolton, N. Dudley and J. Randall, 2008, *Natural Security. Protected Areas and Hazard Mitigation*, Gland, Switzerland, Research Project by WWF and Equilibrium, pp. 69–73.
http://assets.panda.org/downloads/natural_security_final.pdf?bcsi_scan_EC783A0C3C997A81=1
http://www.wmo.int/

CASE STUDY 12

Mitigation through ecosystem recovery: invasive species eradication in the Galápagos Islands (Ecuador)

Introduced species facilitated by lack of effective control and quarantine measures threaten the endemic species of the Galápagos Islands World Heritage site. By 1900, 112 introduced species had already been identified and by 2007 the number had risen to 1,321. In 2006, a survey showed that the approximately 500 native plant species, of which about 180 are endemic, were outnumbered by the 748 introduced plants. More than half of the 180 species of endemic plants in the Galápagos are now threatened, according to the IUCN Red List of Threatened Species. Invasive and introduced species may lead to the extinction of native plants. Overgrazing from goats can remove entire ecosystems from islands, as well as prevent regeneration after disturbance. Grazing is believed to be responsible for one plant extinction on Santiago Island, and has a knock-on effect on other species. • • •

CASE STUDY 12

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Initial attempts to manage invasive species failed due to lack of monitoring and lack of systematic planning. On Santiago Island a pig eradication programme took thirty years and over 18,000 pigs were removed in all, the last one in November 2000. The programme has allowed turtle, tortoise, nesting birds and many plant species to recover. It also took thirty years to eradicate goats from the Island of Pinta, where they were introduced in 1950 and had devastated native vegetation by the 1970s. The initial programme from 1971–82 removed 41,000 goats but the lack of monitoring and regular visits meant that the island was twice wrongly declared free of the animals. During the successful 1999–2003 programme over 56,000 goats were removed.
In response to the severity of the threat to the natural heritage of the Galápagos from feral animals, the Charles Darwin Foundation (a conservation NGO) has carried out extensive research. A Global Environment Facility (GEF)-funded Invasive Species Project, including the goat eradication component Project Isabella, was jointly conceived between the Galápagos National Parks Service and the Charles Darwin Foundation. At a cost of more than US$18 million, goats and donkeys were removed through an intensive eradication programme. The effectiveness of the project was greatly aided by the use of a geographical information system (GIS). This database aided the project management and monitoring during the project and in the analysis of results.
Prevention of introductions is the first and most cost-effective method of addressing risk from invasive species. Had procedures been in place decades ago to prevent introduction of invasive species, the widespread loss of native species and cost of eradication in the Galápagos could have been avoided. Identifying and blocking pathways for entry of any species, rather than species-based prevention, is the most efficient way to concentrate efforts. For the Galápagos the main entry points are aircraft and ships (tourist and cargo). The Global Invasive Species Programme identifies three major possibilities to prevent further invasions:

- *interception based on regulations enforced with inspections and fees;*
- *treatment of material suspected to be contaminated with non-indigenous species;*
- *prohibition of particular commodities in accordance with international regulations. There is also a need to assess the risk of deliberate introduction of non-indigenous species.*

With increasing entry points to the Galápagos and rising visitation and immigration rates, the role of the government in enforcing prevention and management policies is key. Although protocols and policies have been adopted, implementation is hampered by low capacity and training on the importance of invasive introduction risk reduction activities.

Sources: http://www.hear.org/galapagos/invasives/
Charles Darwin Foundation (http://www.darwinfoundation.org/english/pages/interna.php?txtCodiInfo=34).
Project Isabella Atlas (http://www.galapagos.org/ et http://www.darwinfoundation.org/english/_upload/isabela_atlas.pdf).
http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2002516
R. Wittenberg and M.J.W. Cock, 2001, *Invasive Alien Species: A Toolkit of Best Prevention and Management Practices*, Global Invasive Species Programme (www.gisp.org).

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CASE STUDY 13

Mitigation through flood control and environmental regeneration: Venice (Italy)

Following the disastrous flooding of 4 November 1966, Italy launched an action plan to save Venice by developing and approving special laws for the city, making sizeable sums and resources available, setting up special procedures and instruments for the historic city and its lagoon. The government commissioned Consorzio Venezia Nuova to find a definitive solution to the serious problem of increasingly frequent high tides in the Venice Lagoon Basin. The solution (called MOSE) adopted to counter exceptional flooding is the outcome of a lengthy process, which called for research, experimentation, the construction of mathematical and physical models and careful monitoring of various aspects of the project. This system, in case of exceptionally high tides, will allow the temporary closure by a number of mobile floodgates of the three entrances that link Venice Lagoon to the Adriatic. Three floodgates will be attached to the sea floor at the three entrances of the lagoon. They are called mobile because under normal conditions, they remain filled with water and rest on the seabed in a special casing. A system of hinges attaches the floodgates to these structures, and when tide levels above 110 cm are expected (which happens about seven times a year), compressed air is pumped into the floodgates, emptying them of water. This causes them to rise to the surface and block the inflowing tide. The responsibility of Consorzio Venezia Nuova has been extended to cover a vast range of consolidation work to defend the shores, islands and inhabited zones, and to undertake the morphological restoration and regeneration of significant parts of the lagoon territory, and its protection against pollution. The quantity and quality of this complex range of projects, supported by a modern and sophisticated information service, including a data bank on the transformation of the lagoon environment, have led to the creation of the most important programme of environmental protection, recovery and management ever undertaken in Italy.

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Source: Quaderni Trimestrali, 2002, *Safeguarding Venice and its Lagoon – Atlas of Works*, Ministry of Infrastructures and Transport, Venice Water Authority.

CASE STUDY 14

Integrating flood protection measures with historic urban area planning: Grimma (Germany)

Grimma, a small historic city situated on a terrace in the Mulde River valley in Germany, has an unusually well-preserved setting in the river landscape, with a largely intact medieval city wall still bordering the river bank. The city was one of the worst affected of the many places in Saxony that were flooded in August 2002. Comprehensive flood protection concepts for all the bigger rivers in Saxony and their catchment areas were prepared by the Dam Authority and form the basis for planning in Grimma. An initial, technically oriented proposal for Grimma was promptly rejected by both the city council and the permit authority. The citizens were confronted with the prospect of being blocked off from the river by a monolithic concrete wall stretching 1,200 m and rising about 3 m. It was obvious that realization of this proposal would inevitably involve severe and irreversible damage, not only to the river landscape but also to the functional and aesthetic qualities of the city, particularly the historic fabric and the visual experience of the architectural heritage.

As a result it was agreed that flood protection in historic urban areas must be seen as part of a complex planning process that needs to be integrated with other related activities, such as town planning and urban design, historic preservation, environmental protection and design, local economy and infrastructure, recreation and tourism. The following guiding principles were adopted for positioning the flood protection measures:

- *No protective wall would be planned in front of public buildings; instead their own exterior walls would be structurally retrofitted to meet flood protection requirements. Shutters would be installed to seal windows and doors in case of flooding.*
- *For historic buildings in private ownership, where integration of the protective wall into the building was not possible for legal reasons, the flood wall would be placed directly in front and adapted like a facing.*
- *In the open spaces between buildings, the flood wall would be clearly set back.*
- *A special solution had to be developed for the city wall in order to harmoniously integrate the new flood wall in the historic waterfront ensemble.*

Source: T. Will, 2008, Integrating technical flood protection and heritage conservation planning for Grimma, Saxony, in H. Meir and T. Will (eds), *Heritage at Risk: Cultural Heritage and Natural Disasters*, ICOMOS.

CASE STUDY 15

Mitigation through monitoring and early warning systems: glacial lake outburst floods in Sagarmatha National Park (Nepal)

Global climate change, both natural and anthropogenic, causes the melting of most mountain glaciers around the world. Glacier melting leads to the formation and rapid expansion of glacial lakes. The moraine banks of such lakes are made of loose deposits that may collapse when the lakes fill up or when avalanches fall into the lakes – leading to sudden and violent flooding in the downstream valleys. Any floods of this sort, referred to as glacial lake outburst floods (GLOFs), can have disastrous consequences for the population and biodiversity of the entire downstream region.

In the eastern Himalayan region, more than fifteen major GLOFs have been recorded since 1995. In the Khumbu region of Sagarmatha National Park (Nepal), three major GLOFs occurred in 1977, 1985 and 1998. The 1977 flood destroyed park facilities and a tourist lodge located along the riverbeds. The 1985 flood killed at least twenty people, washed away houses, cultivated land and livestock, and completely destroyed a hydropower station, trails and bridges along its 90 km downstream impact zone.

An effective monitoring and early warning system, embedded in an appropriate risk preparedness strategy, can greatly reduce the loss of life and property caused by GLOFs downstream of potentially dangerous glacial lakes. A 2002 inventory of glaciers and glacial lakes by ICIMOD and UNEP identified twenty of the 2,323 glacial lakes in Nepal as potentially dangerous. The methods of the World Glacier Monitoring Service provide state-of-the-art guidance for effective monitoring of glaciers and glacial lakes. Appropriate monitoring and early warning systems include the use of remote-sensing tools, overflight reconnaissance with small-format cameras, and telecommunication and radio broadcasting systems integrated with on-site installed hydrometeorological and geophysical instruments.

In many instances, sudden and violent flooding may also be prevented by artificially draining potentially dangerous glacial lakes. Such a strategy has been implemented at the Tsho Rolpa Lake in the western part of Sagarmatha National Park. The lake was storing approximately 90–100 million m^3 water held back by a 150 m tall moraine. A breach in this moraine would have caused at least a third of the lake to flood the valley. This threat led to collaborative action by the Government of Nepal with international partners. The 1998–2002 GLOF management project drained the lake, lowering its water level by 3 m, and installed early warning systems in villages downstream.

The lowering of the water level reduced the risk of flooding and associated loss of life and property by 20 per cent. However, complete GLOF prevention at this lake would require further draining, perhaps as much as 17 m.

Sources: Case Studies on Climate Change and World Heritage, 2007, UNESCO World Heritage Centre/UK Department of Culture, Media and Sport.
International Centre for Integrated Mountain Development (ICIMOD) (http://www.icimod.org/).
ICIMOD Publications on Climate Change and Responses (http://books.icimod.org/index.php/search/subject/2).
ICIMOD / UNEP. *Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburst Floods Monitoring and Early Warning Systems in the Hindu Kush-Himalayan Region Nepal*. United Nations Environment Programme (http://www.rrcap.unep.org/glofnepal/guide/movie.html).
World Glacier Monitoring Service (http://www.geo.unizh.ch/wgms/).

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CASE STUDY 16

Mitigation in the face of a potential El Niño event and climate change: Chan Chan Archaeological Zone (Peru)

The vast and fragile site of Chan Chan in Peru was added to the List of World Heritage in Danger in 1986, the same year that it was inscribed on the World Heritage List. Its earthen structures are particularly vulnerable and thus quickly damaged by natural erosion as they become exposed to the environment, and therefore require continuous conservation efforts and substantial ancillary measures. Besides erosion, intense precipitation is damaging the base of the earthen structures, leading to greater humidity in the lower parts of the buildings, an increase in salt contamination of the structures and the growth of vegetation such as reeds. This phenomenon is due to the combined effect of changes in the irrigation technology for extensive mono-cultures in the area and the reduction of the use of water as the local population now obtains freshwater from a new system. Climate change poses an additional source of stress on this site and intense precipitations during the 1997–98 events have also significantly contributed to the increase in groundwater level.

In September 1997, an emergency assistance fund was allocated to implement immediate measures to protect the most significant and vulnerable parts of Chan Chan against the devastating impacts of the El Niño event that was projected to occur in 1998. Consequently, the impacts on the site were relatively modest, which shows that the protective measures were effective. Long-term adaptation is also under way, with the reinforcement and stabilization of foundations and structures for the main buildings and the urban heritage surrounding the Huachaque of the Tschudi Palace. These works are carried out combining the use of traditional materials and skills with modern engineering techniques.

© UNESCO / Jim Williams

Source: Case Studies on Climate Change and World Heritage, 2007, UNESCO World Heritage Centre/UK Department of Culture, Media and Sport.

5.2 How can you make sure that risk prevention and mitigation measures do not have an unintended impact on the heritage values of your property?

The risk prevention and mitigation measures should ideally have no impact on the heritage values, authenticity and integrity of a cultural or natural property. However, strengthening or retrofitting might be necessary if the property is highly vulnerable to hazards such as earthquakes or cyclones. For example, the various approaches to interventions that were adopted in the aftermath of the earthquake in Kobe (Japan) in 1993 took into account the need to avoid, wherever possible, any impact on the cultural values of affected cultural heritage properties (Case Study 17).

Measures such as installing hydrants or water pressure mechanisms, widening narrow streets in historic urban areas (or dirt tracks in natural sites) to accommodate emergency vehicles can have a detrimental effect on the outstanding universal value of a heritage property.

Moreover, emergency activities such as flood control, fire prevention, and humanitarian relief efforts can lead to resettlement areas being selected at the expense of protected areas, for example within national parks. Site managers should ensure their involvement or availability for consultation on strategic decisions during the emergency response period of a catastrophic event. The location of camps for displaced peoples is critical as they can expose a protected area to greatly increased pressure on resources, as happened in Virunga National Park (Democratic Republic of the Congo).

Among risk reduction activities, caution is needed before applying fire-retardant chemicals to historic structures if the potential reaction of the building materials and paintings, for example, is not known during extreme heat conditions in the case of fire.

It is important to consider, furthermore, that the various stakeholders may perceive impacts differently. For example, reduced tourism would be seen as a negative economic impact by some but could also inadvertently lead to the recovery of water supplies, because fewer tourists would mean reduced water consumption. On the other hand, reduced tourism might also lead to increased poaching as people involved in the tourism industry seek alternative income-generating activities to those lost through the decline in tourism.

Reviews to prevent any unintended impact of risk-reduction activities should be incorporated throughout the planning cycle.

CASE STUDY **17**

Principles for repair and restoration of damaged cultural properties: Kobe (Japan) following the 1993 earthquake

When repairing and restoring cultural properties following an earthquake, accurate identification of their state of damage and appropriate retrofitting measures for improving their seismic resistance as well as retaining their heritage values are essential considerations. Following the great Hanshin-Awaji earthquake in 1993, a special committee was constituted to examine the repair policies for cultural properties, which required large-scale repairs and complex seismic retrofitting measures. The committee members comprised architectural historians, specialists in structural studies and repair engineers. The person in charge of cultural assets in the administration managed the committee. The topics discussed by the committee included:

- *analysis of earthquake damage to buildings;*
- *evaluation of the seismic resistance of cultural properties according to the results of structural diagnosis;*
- *the structural reinforcement needed when seismic resistance is found to be insufficient;*
- *examination of proposals on retrofitting methods incorporating new techniques designed so that the values of the cultural property are not damaged, using wherever possible non-destructive testing.*

The cultural properties were divided into those that could be visited by the public and those where entry was prohibited. The committee determined the approaches for retrofitting in the following order of priority:

(1) Additions using traditional techniques and traditional materials, e.g. reinforcement of roofs with palm tree rope.

(2) Additions using traditional techniques and those derived from them, and traditional and modern materials, e.g. reinforcement by carbon-fibre sheet.

(3) Additions using modern techniques and modern materials, e.g. inserting an iron frame in the structure for load sharing.

(4) Replacements using modern techniques and modern materials, e.g. through base isolation of the structure.

Source: Y. Murakami, 2006, *Risk Management of Cultural Assets. Based on the Experience of the Great Hanshin Earthquake.*

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5.3 How can traditional knowledge systems for disaster mitigation help protect your property from disasters? Can you integrate these into the plan?

Traditional knowledge systems for disaster mitigation may take one of several forms:

- *Indigenous management systems:* in Kathmandu valley, Guthi lands are jointly owned by the community for fulfilling various social and religious functions. The returns from these lands provide resources for the maintenance and repair of historic temples, especially after disasters.

- *Indigenous monitoring systems:* in Shirakawa Village (Japan), the community members share responsibility for going around the village daily to inspect any possible risk of fire. While on inspection they call out reminders of the need to be vigilant.

- *Traditional skills and techniques* in building construction and periodic maintenance. Analysis of those constructions that had a higher rate of survival in the Kashmir and Gujarat earthquakes showed how traditional construction techniques often conferred a good earthquake resistance on buildings (Case Study 18).

- *Local ecological relationships and indigenous planning systems* may also contribute to sustainability and thus prevent disasters such as floods. For example, in Majuli Island in Assam (India), a large river island with unique local ecology, the vernacular housing in the area using locally available bamboo and constructed on stilts has evolved as a sensitive response to local factors, notably floods that inundate the island on a regular basis. The light bamboo structure enables easy dismantling and relocation, in the event that the area is affected by floods.

- If such traditional knowledge systems exist, every effort should be made to integrate these into the DRM plan of a heritage property.

CASE STUDY 18

Traditional knowledge systems: earthquake-resistant construction in Kashmir and Gujarat

On close inspection of earthquake-prone regions of Kashmir and Gujarat, we discover several examples of good-quality traditional constructions that survived the devastating earthquakes of 2005 and 2001 respectively. During the Kashmir earthquake, the traditional structures built using local building techniques of Taq *(timber-laced masonry-bearing wall) and* Dhajji Dewari *(complete timber frame with one wythe of masonry forming panels within the frame), in part or in whole, performed much better than many poorly built 'modern' structures. Although there were many cracks in the masonry infill, most of these structures did not collapse, thereby preventing loss of life. Also some vernacular constructions such as wooden log houses, and those employing the use of well-laid masonry with through-stones and well-designed arches, trusses, tongue-and-groove joints and balconies resting on projecting wooden joists performed well in the earthquake. The traditional dwellings of the earthquake-prone Kutch region in Gujarat, the Bhungas, have also withstood the earthquakes, thanks to their circular form, which is very good at resisting lateral earthquake forces. Moreover, wattle and daub constructions, especially where wood is used as reinforcement for the wall, have proved to be very effective. Many traditional structures in Gujarat built prior to the 1950s had floor joists extending through the rubble stone walls to support the balconies. These types of structures were more successful in stabilizing the walls than those where joists terminated in pockets and performed much better during the 2001 quake.*

Sources: R. Jigyasu, 2002, Reducing disaster vulnerability through local knowledge and capacity, Dr.Eng. thesis, Trondheim, Norwegian University of Science and Technology.

6 How do you prepare for and respond to emergencies?

Section 5 *answered questions about reducing disaster risk or mitigating the impact of disasters. Several case studies showed that disaster risk can be reduced or mitigated. The importance was stressed of adopting and implementing measures that, as far as possible, will not diminish the heritage values of the property. Moreover, there may exist local traditional knowledge of disaster vulnerability that can be built into a DRM plan.*

Section 6 *is concerned with the response phase of the DRM cycle (Figure 1, and refer also to the plan structure in Figure 2), after the hazard event has occurred. It answers questions about the risks that may be encountered immediately following the disaster (6.1) and the roles and responsibilities of the emergency response team (6.2). Examples are given, by means of case studies, of emergency response actions at properties (6.3) and of how a property itself can contribute to an emergency response (6.4).*

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6.1 What risks might be encountered during the first 72 hours after the disaster?

An emergency period normally lasts for around 72 hours after the hazard event such as an earthquake and flooding. The emergency may itself create new kinds of risk:

- Theft of collapsed or damaged fragments or movable objects in the property.
- Flooding may cause contamination through pollution and mould growth.
- Risks arising from the surrounding environment or habitat.
- Insensitive actions by relief agencies or by volunteers (due to lack of awareness), such as pulling down damaged structures of heritage value or destroying the indigenous vegetation in the name of 'life safety'. During fire control, additional damage to the heritage property may be caused by the water used for extinguishing the fire.
- Risk of making inappropriate damage assessment of heritage property due to a lack of prior knowledge or experience.
- Confusion due to lack of coordination and preparedness.

The emergency protection measures undertaken during the crucial first 72 hours following the Friuli earthquake of 1976 in Italy managed to save buildings that might otherwise have been demolished and replaced, and also allowed them to withstand a major aftershock four months later (Case Study 19).

CASE STUDY 19

Saving structures of heritage value: emergency protection following the 1976 earthquake in Friuli (Italy)

Before it was damaged during the 1976 Friuli earthquake, the main street in the historic town of Gemona was narrow and twisting. Set between the cathedral and the Palazzo Comunale, the street was flanked by a covered arcade on both sides. Along one side, the buildings were aligned in one plane facing the street with continuous elevation.
The two end buildings suffered considerable damage from the earthquake and, as their upper storeys rested on arches, the condition in which they remained was alarming. The earthquake provoked the collapse of a good portion of the street elevation and the displacement of the end column. Demolition

CASE STUDY 19

was considered. However, after convincing the local authorities that there was a way to protect the street, using salvaged wooden beams with the help of engineers, the displaced end corner was shored up, thus saving the building from demolition. Emergency measures aimed at filling the gaps in the wall and the supporting arches with brick masonry. Closing the openings in the bearing wall increased the area of load transmission. A second measure was to improve and enlarge the preliminary wood shoring at the end of the displaced corner. Finally, bracing between the damaged structure and the buildings across the street created continuity of support between the city blocks and reduced the number of 'end buildings' or gaps within the fabric of the city.

The street was left in this condition until, four months later, a major aftershock hit the area, causing large amounts of damage and destruction. The emergency measures protected the damaged structures from the second seismic shock.

Source: D. del Cid, 1990, *Emergency Protection to Damaged Structures.*

6.2 What should be the roles and responsibilities of the emergency response team members in your property?

- The emergency response team should consist of members or groups who together cover the following responsibilities:
  - coordinator;
  - safety and security;
  - administration and finance;
  - spokesperson for the media;
  - cultural heritage (to include building and maintenance, and salvage of collections or fragments);
  - natural heritage (to include evacuation, community liaison, national disaster relief liaison, relocation of injured or rare animals, restoration and reintroduction of vegetation cover and wildlife).

- The team should be well aware of the roles and responsibilities shared by each member and group and undertake regular drill and simulation exercises to test their operational effectiveness. There should be a provision for a back-up in case a member is not able to perform their function for unavoidable reasons. The value of a clear command structure established as part of a contingency response plan was demonstrated when the World Heritage site of Dorset and East Devon Coast (United Kingdom) was exposed to a potential environmental catastrophe (Case Study 21). The site manager played an important role in the environmental advisory group as part of the coordinated response that was already in place prior to the incident.

- This team should have strong links with the emergency response systems of the larger area in which the property is located. These would comprise police, health services, fire services and the municipality or local government and its planning departments. Initiating these links may in turn encourage the emergency services to undertake special measures for heritage properties. The initiatives of the City Fire Department in Kyoto (Case Study 20) and the US National Park Service are exemplary in this regard.

- The team should establish links with the local community and volunteers by raising awareness through the media, both before and during the emergency.

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CASE STUDY 20

Preventive measures for heritage sites taken by municipal services: Kyoto City Fire Department (Japan)

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Kyoto City has more than 2,000 cultural assets spanning 1,200 years of history. Seventeen of these have been given World Heritage status as the Historic Monuments of Ancient Kyoto. Fires due to carelessness and arson have resulted in the loss of many cultural assets in the past. Establishing fire prevention measures is therefore very important for preserving these vital assets.

The Civil Rescue System for Cultural Assets was set up by the Kyoto City Fire Department so that custodians of these assets, local residents, and related organizations such as the Fire Department and Volunteer Fire Corps are able to collaborate to protect cultural assets from fire.

The activities of the department include:

- *Installation in cultural heritage sites of state-of-the art equipment and systems for fire prevention and control such as alarms, fire extinguishers, indoor and outdoor fire hydrants, water guns and lightning conductors.*
- *On-site inspections by the fire officers.*
- *Erection of notice boards prohibiting open-air fires and smoking.*

Fire drills are organized by the department to ensure that people respond promptly and appropriately in an emergency, whether by putting out a fire at its onset, removing cultural objects, or leading people to safety. The residents living near the cultural assets participate in the training to create a local cultural asset residents' rescue system. The firefighters voluntarily provide guidance to the local residents to enhance their disaster fighting capabilities. In order to make fire prevention facilities readily available during emergency situations, the custodians of the cultural assets voluntarily carry out periodic inspection as well as maintenance and control.

Source: Flyer, 2007, Kyoto City Fire Department, Kyoto, Japan.

CASE STUDY 21

Coordinated emergency response: Dorset and East Devon Coast (United Kingdom)

Successful emergency response requires a timely and efficient coordinated response. In the event of a ship in difficulty at sea, effective intervention at an early stage can prevent severe consequences.

In January 2007, the container ship MSC Napoli was beached off the Dorset and East Devon coast to prevent an environmental catastrophe. If left to drift in one of the world's busiest shipping channels, the ship and its cargo could have caused additional accidents or sunk with the loss of the full cargo and a large tonnage of fuel oil. The national Coastal Pollution Clearance Plan was used to respond to the impact on the shore. The Salvage Control Unit of the UK Maritime and Coastguard Agency assessed the beaching and monitored the MSC Napoli, directing the response operation when cargo was unexpectedly released. An established generic emergency planning response was adapted to outline the multi-agency working arrangements and deal with pollution from the vessel.

A command structure was detailed in the Dorset response contingency plan that included the following roles: Overall Incident Commander, On Shore Strategic Co-ordinating Group, On Shore Dorset (Tactical Response located in the Dorset Emergency Centre), On Shore Devon, Salvage Control Unit, Marine Response Centre, Incident Environment Group (environmental advice), and Control Room (incident notification and callout). Those involved in the emergency response were aided by the response arrangements set out in the

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CASE STUDY 21

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UK national contingency plans of the Maritime and Coastguard Agenda, and at the local level in the County Emergency Plans and Coastal Oil and Chemical Pollution Clearance Plans maintained by Dorset and Devon County Councils. A specific response strategy was developed focused on public safety, limiting access to polluted shorelines, controlling unauthorized removal of property washed ashore, mobilizing 'spotters' to track pollutants and containers, and collecting and collating pollution and debris information into GIS. During the emergency response the Dorset and East Devon Coast World Heritage site was represented on the environmental advisory group established to advise on all aspects of incident response. In communication with the clean-up crews, the site manager provided advice on appropriate clean up techniques, access and vehicle use, waste disposal and storage to avoid environmental damage. Rangers from the property acted as 'spotters' along the shore, helping to track pollution, ship debris and cargo, and clean up oiled birds.

The successful and smooth response to the incident was made possible by the experience and training of those involved. The emergency plan is subject to a regular exercise in real time to practise the first hours of an incident and be familiar with the plan, communication processes and documentation of decisions which can be important for later insurance claims. Individual organizations provide specific training to their site staff, for example in handling oiled birds. Involvement in the Local Resilience Forum and experience gained through emergency planning activities meant that plans and protocols could be quickly adapted, thus saving the World Heritage property and marine and coastal ecosystem from significant damage.

Planning and preparation is key to success in responding to an emergency. Events happen quickly and systems need to be in place to take effective decisions and get the response happening on the ground. Coordinated communication is essential, along with a clear and consistent message to the public. A site manager will not be able to respond to a major incident alone and should be part of a coordinated response. It is important to find out if plans already exist because otherwise the protected area staff may not be involved and the values of the property may not be taken into account in an emergency response.

Sources: http://www.cabinetoffice.gov.uk/ukresilience.aspx
http://www.devon.gov.uk/multi_agency_debrief_v5.0.pdf

6.3 What can you do to improve emergency preparedness in your property?

- Develop a plan and procedures for evacuating people by answering the following questions:
  - Will you aim to move people out of the property or collect them in one place within the site (this depends on the nature of the property and its location)?
  - Which is the shortest exit route for pedestrians (one that has the least potential impact on the values of the property)?
  - What movement patterns do you envisage for emergency vehicles such as a fire engine or ambulance?
  - How will you balance evacuation needs with minimizing the risk of theft (of cultural items) during the emergency? (Opening too many access points may provide opportunities for thieves.)
  - How will you ensure the security of people and heritage properties during emergency response?
- Install general emergency equipment, e.g. emergency alarm systems, specific equipment for flood, fire prevention and mitigation, but only after formulating a comprehensive strategy based on the main risks, the location of the property, and available resources and expertise. The Environmental Water Supply System in Kyoto (EWSS) is an inspiring example of how this can be achieved (Case Study 22).

CASE STUDY 22

Preventing post-earthquake fire: Environmental Water Supply System in Kyoto (Japan)

Post-earthquake fire caused serious damage after the Great Hanshin Awaji earthquake of 1993. This was largely due to breakdown of a modern electricity-driven infrastructure, which led to a lack of water for firefighting. Based on this experience, the Environmental Water Supply System (EWSS) has been developed for Kyoto by harnessing various kinds of water resources for maintaining the water supply at any time, and in adequate quantity to enable firefighting.
The EWSS development plan is evaluated on the basis of:
(1) identification of possible sources of water supply and their location;
(2) estimation of reserved amount of water based on the existing water system and the development measures;
(3) calculation of the reserved amount of water against the recommended amount.
The requirements of water and necessary fire extinction systems are calculated on the basis of the scale of fire. For a small fire, water stored in tubs, ponds or a river would suffice for use by the citizens. However, fires at the scale of a house or neighbourhood area would require large amounts of water for a longer period of firefighting, using hydrants and water sources such as wells, ponds or rivers.
The Sannei-zaka Historical Preservation District in the Ancient Kyoto World Heritage site was selected as the pilot case study area. The EWSS system at this site uses an existing natural water source from a small dam at an elevation of 80 m with natural gravity for water pressure. User-friendly hydrants and sprinkler nozzles are placed at strategic positions in the district to deliver usable firefighting water for the citizens. Some cisterns have also been added as back-up to this system. The concept of EWSS effectively contributes towards a sustainable environment.

Source: K. Toki and T. Okubo, 2005, *Protection of Wooden Cultural Heritage from Earthquake Disaster*, Proceedings of Meetings on Cultural Heritage Risk Management, World Conference on Disaster Reduction, Rits-DMUCH, Kyoto, pp. 94–102.

- Consider setting up alarm systems, special security cordons and coordination between the site staff and security.
- Prepare maps of the property indicating specific features such as utility mains, fire exits, fire extinguishers, etc.
- Communicate the emergency plan and procedures to visitors, staff and local residents by easily readable handbooks, manuals, drawings and signage, and by organizing awareness-raising activities such as seminars and exhibitions.

The initiatives of the City Government of Vigan (Philippines) illustrate the range of activities that can be undertaken through proactive efforts involving both municipal services and the public (Case Study 23). The management plan for Cousin Island Special Reserve in the Seychelles also demonstrates a systematic approach to emergency preparedness, recovery and response and was successfully put to the test in a cyclone in 2002 (Case Study 24).

CASE STUDY 23

Emergency preparedness initiatives: City Government in the Historic Town of Vigan (Philippines)

The Historic Town of Vigan was inscribed on the World Heritage List in 1999 for its unique cultural and historical significance as an exceptionally intact and well-preserved example of a European trading town in East and South-East Asia. However, the town is located in a region highly prone to earthquakes and volcanoes, and its historic buildings are highly vulnerable to fires.
The City Government has undertaken several initiatives to improve the emergency preparedness for such natural disasters. An Emergency Response Handbook for the Historic District has been prepared under the administration of the mayor. The town has a well equipped Fire Department and firefighters conduct round-the-clock monitoring patrols, especially at night and during festivals. The local community is involved in emergency preparedness through the City Fire Volunteer Brigade.
Several activities are conducted as part of Vigan's annual observance of the National Disaster Consciousness Month in July. These include prioritizing emergency response measures in the various offices of the City

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CASE STUDY 23

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Hall, retraining the City Fire Volunteer Brigade, crowd control and fire drill at the City Hall, installation of signage at tsunami safe places and warning sirens. In 2007, the City Government also handed over new fire suits to the personnel of the Bureau of Fire Protection.

Source: Official Website of Vigan City (www.vigancity.gov.ph), 2007, final presentation by Glen Concepcion, city disaster action officer and city environment and natural resources officer, City of Vigan, and Eric Quadra, architect, LGU Vigan, at the International Training Course on Disaster Risk Management of Cultural Heritage, Rits-DMUCH, Kyoto.

CASE STUDY 24

Risk awareness and training as part of management plan: natural heritage of Cousin Island (Seychelles)

The management of Cousin Island Special Reserve in the Republic of Seychelles has included disaster mitigation as part of its management plan since 1999, including restoration of native vegetation and prevention of invasive species. The programme for emergency planning, preparedness and response has included the establishment of contingency plans to prevent disasters that could impact the Marine Protected Area management system by following a strict boat maintenance protocol and removing potential hazards and obsolete materials. Emergency meeting points have been established and emergency helicopter landing sites are maintained.

Since designation in 1968 and management by Bird Life International and more recently by Nature Seychelles, the values of Cousin Island have been greatly restored, with thick native forest covering the entire island. This mitigates against erosion, landslides and fires. Risk awareness and management on the island include maintaining boats and engines in top condition and keeping replacement parts, removing potential hazards, trimming trees near trails and infrastructure, fire-proofing fuel stores with bunding and siting buildings beyond the high-water mark.

Cousin Island is also covered by various forms of insurance, including third-party liability, staff disability or death, and damage to buildings, the hulls of boats and mooring buoys. A small fund has also been established to deal with emergency situations resulting from events such as cyclones. In 2002, the fund was used to help repair infrastructure and rehabilitate the ecosystems.

In addition, staff receive training in first aid, firefighting and safety at sea. A health and safety manual is readily accessible, and all staff carry mobile telephones. A designated helicopter landing pad is available for emergency evacuations, as well as special tools for helicopter-related accidents.

Sources: Nirmal Jivan Shah, Chief Executive, Nature Seychelles, Center for Environment and Education, Roche Caiman, Mahe, Seychelles (nature@seychelles.net).
http://www.natureseychelles.org
UNEP World Conservation Monitoring Centre (www.unep-wcmc.org).

© Nature Seychelles

The success of management plans such as that for Cousin Island depends on their design but especially on their being implemented. If, for whatever reasons, a DRM plan cannot be implemented, a high level of risk can continue with no mitigation measures being taken. The Historic Sanctuary of Machu Picchu in Peru provides an example of a Disaster Prevention and Mitigation Plan that has so far failed to be implemented. Among a number of factors inhibiting its implementation is the lack of local awareness of the high-risk situation (Case Study 25).

CASE STUDY 25

Having a plan is not enough: lack of risk reduction in the Historic Sanctuary of Machu Picchu (Peru)

© UNESCO / Francesco Bandarin

The economic and social impact of disasters is well documented and such impacts can be closely dependent on effective management of a protected area, particularly when it attracts large numbers of visitors. The Historic Sanctuary of Machu Picchu earns the highest revenue in Peru (WCMC, 2005), and was visited by some 1.8 million tourists in 2007. However, the World Heritage property, the local population, and visitors are threatened by landslides, disease, building failure and fire. With such high visitor numbers a natural hazard has the potential to cause loss of life, and a negative impact not only on the local economy and management of the World Heritage site. Despite the identification of risks and repeated warnings from experts since at least 1989, no systematic disaster risk reduction strategy was in place in Machu Picchu in 2008.

Due to the site's topographical and climatic characteristics, landslides are a risk in the citadel, along the rail line, on the vehicle sector and in the sector of Machu Picchu Village. Accelerated glacial regression since 1998 has further increased the occurrence and risk of landslides. Given the high population density in the area, rapidly increasing, and the high visitor and day labourer rates, the risk of loss of life and property from landslides is high.

The World Heritage Committee, on the basis of missions carried out by UNESCO, IUCN and ICOMOS and information received, has repeatedly expressed its concerns over the lack of implementation of a Natural Disaster Mitigation Plan. Several factors have been preventing the implementation of risk reduction measures:

- *Low risk awareness among the local population, who have little experience of managing risk.*
- *The National Institute for Natural Resources has released a Disaster Prevention and Mitigation Plan for the Machu Picchu Town Centre, and has drawn up evacuation, diffusion and drill maps; but application is limited by little awareness of the plan; scant drills; lack of awareness of the risk especially by tourists and workers; vendors and tourist service areas blocking the escape routes; and so on.*
- *There is no allocation for the Disaster Prevention and Mitigation Plan in the official Management Plan budget for the World Heritage site.*
- *The existing Risk Preparedness Plan has not been used to prevent uncontrolled construction in Machu Picchu Village and new roads and bridges have been built in a geologically unstable area that is subject to landslides.*

Protected area managers should ensure that budgets include sufficient funds to implement Disaster Prevention and Mitigation Plans. Additional factors that can prevent effective risk reduction include weaknesses in the governance system such as lack of integrated planning, EIA studies and risk mapping.

Sources: UNESCO / IUCN, 2007, World Heritage Monitoring Mission report to Machu Picchu (http://whc.unesco.org/archive/2007/).
UNEP World Conservation Monitoring Centre (www.unep-wcmc.org).

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Ensure that signage for emergency evacuation is legible and placed at strategic locations. It should show the location of extinguishers, hydrants, first-aid boxes, etc. using universally recognized symbols.

- For emergency actions to save or salvage heritage components, fragments or complete collections in the property, train a team in salvage, immediate storage and treatment, depending on the nature of the fragments or collection. Good documentation and safekeeping at various locations is critical for careful inventorying and identification of objects during the salvage operation.

- Create a directory of contacts that should be easily accessible for unexpected emergencies. The directory should be regularly reviewed and updated.

6.4 How can your property contribute positively to the emergency response?

A heritage property can contribute positively to emergency efforts in a variety of ways:

- Designated areas for emergency evacuation within the property can also be used for providing temporary shelter, if the nature of the property allows and such activities do not damage the outstanding universal value of the property. For example, Kiyomizudera, Nijo Castle and other temple sites within the dense urban fabric of Kyoto can be important areas for temporary refuge in case of disasters caused by earthquake or fire. The same is true of Lal Bagh Fort Complex within Dhaka city in Bangladesh.

- Traditional knowledge systems for emergency warning or response may exist in the area where the property is located. For example, the Andaman Islands tribes had the indigenous knowledge that when the sea recedes, they should also recede, and this knowledge saved their lives during the Indian Ocean tsunami. In the Kathmandu valley, the temple bells on the roof of Pagoda temples are rung in warning in the event of an earthquake.

- Existing social networks in the community or among religious bodies can be used for creating effective teams of volunteers that can contribute towards emergency response. For example, in the Kiyomizudera temple complex in Kyoto, the network of local communities living around the site has been effectively utilized to create a disaster response team of volunteers.

As the site manager you should therefore identify the ways in which your site can contribute to disaster risk reduction and integrate these into your management plan and into the overall DRM plan for the area. This will strengthen your position within the community and support possible requests for funding conservation activities.

Section 6*, concerned with the response phase of the DRM cycle, has reviewed the risks that may be encountered immediately following a disaster (Section 6.1) and the roles and responsibilities of the emergency response team (6.2). Several case studies have shown how site managers can undertake emergency response actions (6.3) and how the property itself can contribute to an emergency response (6.4).*

Section 7 *considers the Recovery phase of the DRM cycle (Figure 1; see also Figure 2).*

7 How do you recover and rehabilitate your property after a disaster?

__Section 6__ has reviewed what actions a site manager should take in the Response phase of the DRM cycle (Figure 1). __Section 7__ covers the following phase, Recovery, which asks questions about new risks that might arise following a disaster (7.1) and how to assess damage to the property (7.2). It then asks how the sustainability of long-term recovery can be ensured (7.3) and how heritage sites themselves can play a larger role in DRM (7.4).

7.1 What new risks might your property be exposed to after a disaster?

The following kinds of risks may be a consequence of a disaster:

General
- Damage to the property's outstanding universal value during emergency response activities.
- Damage or pressure caused by displaced peoples, particularly regarding camps of displaced peoples, their associated infrastructure and their waste and energy requirements.
- Encroachment.
- Pressure of development and illegal or uncontrolled development.

For people
- Injury, mortality or displacement of staff that can reduce capacity for security, monitoring and enforcement.
- Loss of livelihood sources linked to the property.

For cultural sites
- Looting and theft.
- Enhanced rate of deterioration of damaged wood or stone.
- Risk of the loss of authenticity or of falsification through reconstruction.
- Water damage from firefighting.

For natural sites (and some cultural landscapes)
- Outstanding universal value and integrity degraded through habitat loss and poaching.
- Pollution from waterborne debris and contaminated watercourses.
- Encroachment.
- Pressure of development and illegal or uncontrolled development.

For existing management systems
- Site level office buildings and equipments may be damaged.
- Site level staff may be affected.

Risks relating to the type of hazard
- Hurricanes and tornadoes can lead to storm surge, which can cause flooding.
- Earthquakes may cause a tsunami, fire and landslides.

Many of the longer-term impacts of a hazard, such as debris fields, obstructed watercourses, or large areas of damaged historic structures, may persist for months or even years after the event. The recovery and rehabilitation of larger natural and cultural sites will therefore require resources well beyond those of the local World Heritage property, necessitating integration with the state or national incident command system for recovery from large-scale disasters.

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7.2 What are the essential questions when assessing damage to your property?

If the property is affected by a major disaster, you should ask the following questions:
- How many people were present at the time of the event?
- Which components of the property and its surroundings should you inspect for damage? (e.g. historic building, landscape element, archaeological site, etc.)
- Which aspect of each component should you inspect? (i.e. structural stability, material damage, loss of authenticity or integrity, environmental setting, etc.)
- What tools should you use and how do you inspect the various components of your site? (i.e. formats for recording, documentation and inspection).
- Who will be responsible for inspection?
- What emergency actions should you consider for the cultural property to prevent further damage (such as scaffolding, enclosing certain areas, disconnecting gas and electricity supply, prohibiting transit).
- What short-term recovery activities should you undertake and in what order of priority?

It is important to follow a systematic process of damage assessment, taking into account the local context and the resources available. Thus, a strict methodology was developed for costing the war damage to historic buildings in Croatia, based on three different methods depending on the information available (Case Study 26). Similarly, damage recording sheets were developed by the Republic of Montenegro for movable and immovable cultural property (Feilden, 1987, pp. 81–6).

The team assessing the damages to the property must be able to give orders for carrying out these actions. This would be helpful in saving lives as well as heritage components of the property.

CASE STUDY 26

Methodology for damage assessment: post-war reconstruction of Vukovar (Croatia)

The listing and assessment of war-inflicted damage on monuments located in Vukovar's historic urban complex was performed under Section 5 of the War Damage Assessment Act. As materials, structures and construction techniques of monuments hardly correspond to those described by the 'Standard Calculation', a special typology of historic building elements was elaborated under a special clause, for the needs of listing and assessing war-inflicted damage on these monuments. The Act envisages three costing methods to be applied to the listing, assessment and calculation of war-inflicted damage on monuments:
- *Bill of quantities; where the necessary documentation of the historic buildings is available.*
- *Overall assessment method; where it is not possible to apply a bill of quantities either due to lack of documentation or difficulty in recognizing original building elements. The method consists of establishing the aggregate floor area and the appropriate current building cost per unit of gross floor area for each monument.*
- *Building elements method: by applying this method, damage caused to individual building elements and their respective shares in total building costs are assessed.*

Thus calculated, war damage amounts were then in each individual case added to the real cost incurred by the preventive technical protection and urgent preventive measures undertaken.

Source: Vukovar Reconstruction Challenge, 1997, Republic of Croatia, Ministry of Development and Reconstruction, Zagreb.

7.3 What measures will help ensure that the long-term recovery process is sustainable?

After the disaster phase is over, long-term measures need to be formulated to ensure that the property is rehabilitated at the earliest and is protected from future disasters. Lessons learned from the disaster should help in reviewing existing risk management systems. The following aspects need to be reviewed or be put in place for effective recovery:

- Links with the social and economic rehabilitation of the property and its surrounding area. For example, the number of visitors to Bam Citadel (Islamic Republic of Iran) following the 2003 earthquake did not diminish, and so a number of measures were taken early on to facilitate their visits (Case Study 27).

CASE STUDY 27

Visitor-friendly measures during post-earthquake recovery: Bam 2003 (Islamic Republic of Iran)

© UNESCO / Francesco Bandarin

A disastrous earthquake on 26 December 2003 caused severe damage to the Citadel (Arg) and other historic buildings in the city of Bam. After the earthquake, the rescue and restoration of the rich cultural heritage of Bam needed a comprehensive management plan. Therefore various studies and practical interventions were carried out, of which the most important related to the experience of crisis management.

The planning phase during the crisis lasted six months, starting immediately after the earthquake. One of the actions initiated during this phase was to establish a visitor passage (pathway). This was already taken into consideration in the early days after the earthquake and later acquired a renewed importance after the debris from the bazaar had been removed and signs to show the boundaries and roads had been fixed.

The earthquake did not reduce the number of visitors. In fact, their number gradually increased. The particular condition of the citadel after the earthquake attracted a number of enthusiasts and experts. Therefore, a temporary wooden passageway for visitors was constructed through the debris. This structure was a great help in visitor safety and provided access for experts to the various parts of the citadel. Guides were also deputed to control and guide the visitors.

Moreover, blocking the street in front of the citadel and turning it into a pedestrian urban centre was one of the actions taken for the convenience of visitors. Besides making a park in this area, a space was also allocated for the exhibition of ceramic shards discovered during the removal of the debris, so that visitors could be well informed of the archaeological activities and phases of documentation of the archaeological finds in the citadel.

Source: A. Vatandoust, E.M. Taleqani and M. Nejati, 2008, Risk management for the recovery project of Bam's cultural heritage, in H. Meir and T. Will (eds), *Heritage at Risk: Cultural Heritage and Natural Disasters*, ICOMOS.

- Approaches to restoration, reconstruction and rehabilitation of the property following the disaster and how they link to issues such as identity and utility of the property. Debate over the reconstruction of Bryggen in Norway following the 1955 fire, for example, brought out constraints but also opportunities that had not previously existed (Case Study 28).
- Review of cultural heritage legislation and policy, and disaster management if necessary.
- Review of site management systems if necessary.
- Assessment of human resources available or needed, e.g. volunteers.

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• Stakeholder involvement and community participation. In the case of Manas Wildlife Sanctuary (India), the local Bodo community has effectively participated in post-conflict recovery efforts which may contribute also to avoidance of future conflict (Case Study 29).

Regular discussions with stakeholders and the local community are important for keeping these groups involved during recovery and rehabilitation and for their understanding the importance of restoring the lost cultural or natural heritage values of the World Heritage property.

• *Educational and awareness-raising activities:* following the Indian Ocean tsunami, the tropical rainforests of Sumatra were under threat of deforestation to meet the need for timber to undertake massive reconstruction activities, emphasizing the need for awareness-raising among local populations (Case Study 30).
• Introduction of a monitoring system and process.

CASE STUDY **28**

Options for post-fire reconstruction: the case of Bryggen in Bergen (Norway)

The disastrous fire in 1955 totally destroyed half of the then preserved area of Bryggen, a primarily residential area, which is inscribed on the World Heritage List. The discussion on reconstruction dates to 1976–77, when the question was reopened on the future of this site. The possibility of reconstruction was evaluated on the basis of documentation of the burnt-down area, which were mainly the measured drawings. Their assessement was based on their degree of completeness, accuracy, degree of mutual verification between two or more sets of drawings and conditions of preservation at the time of measuring. The amount of daylight that could be brought in and the views from the buildings were also considered as influencing factors. For example, it was found that rebuilding a neighbouring yard to the former height would reinstate the former poor daylight situation and so create problems for the use of preserved buildings. Limitations in town plan and neighbourhood were also considered. For example, some of the limitations laid down in the town plan were dispensable. The prescribed building line along the harbour was based on outdated plans for an underground bus terminal, and could be adjusted to the former frontline. Building regulations gave clear restrictions in terms of fire security on the use of wood in the new buildings. According to the earlier standards, there had to be an 8 m open-air gap or fireproof panels between buildings. However, if the wood in the reconstructed building was covered by fireproof panels or laminated, more ground area could be achieved, which could help in supplying escape routes. The buildings in the site also had foundation problems. The building of cellars was very expensive due to buoyancy and construction problems below sea level. Therefore piles were considered as the only realistic method for the foundations. Reconstruction thus provided an opportunity not only to improve the risk preparedness of the site but also to make changes to suit contemporary needs that would not otherwise have been possible.

Source: H.J. Hansteen, 1992, International Symposium on the Fire Protection of Historic Buildings. Central Office of Historic Monuments and Sites, Norway; Norwegian Institute of Technology; ICOMOS International Wood Committee Norway, Tapir Publishers.

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CASE STUDY 29

Involving local communities in post-conflict recovery: Manas Wildlife Sanctuary (India)

Dealing with insurgency has been a significant feature in the management of Manas Wildlife Reserve in Assam (India) during the period from 1986 to 1993. Infrastructure necessary for management, patrols and research were destroyed including the range headquarters, offices and anti-poaching camps, roads and bridges. Periodic fighting continued until 2000. In 2003 the Bodo Territorial Council was established and accorded semi-autonomous powers, leading to improved relations between the World Heritage site and the surrounding Bodo communities.

During this period, biodiversity loss occurred through encroachment, overgrazing, poaching and logging. Rhinos are now extinct, tiger population status is unknown but depleted, and buffalo are largely semi-domesticated through cross-breeding with domestic cattle. Although the park infrastructure suffered considerable damage, the habitat in the inaccessible parts of the Sanctuary is largely intact.

Policies for recovery have been essentially based on the involvement of the Bodo people in the management of the region and through the leadership of the Bodo Territorial Council. Former poachers have become guards, tourism initiatives have been developed and the potential benefits of Manas and its wildlife for improved economic development through tourism revenue are acknowledged by local people. The national initiative IRV2020 has funded anti-poaching camps which are staffed with forest personnel and ninety rotating volunteers from the local Bodo community, some of whom are ex-poachers motivated by tourism initiatives and awareness of the increased revenue these could bring. The young volunteers also receive an allowance and food. The Bodo community owns a small eco-friendly tourism camp run by the Manas Maozigendri Ecotourism Society. Home Stays with local Bodo families is another initiative targeting the adventure traveller. The Bodo Territorial Council is playing an important role in restoring the Manas Wildlife Sanctuary through promotion of tourism as an industry for the 45,000 resident villagers around the property.

The Bodo Territorial Council is also taking a strong positive lead in the protection of the Manas Wildlife Sanctuary and is currently providing most of the funding for the management of the property. This significant and positive change to the status of the property should allow recovery of the degraded wildlife populations and forests over the next few years if sufficient additional support and training is obtained.

To prevent a return to the problems experienced in the past, the factors that led to the initial situation need to be understood and avoided in the future. Maintaining social stability and reducing poverty through local initiatives are currently helpful, but more formalized budget allocation with federal and state funding would provide much-needed training for capacity-building, education and raising awareness of the benefits of World Heritage status to the Bodo people and thus ensuring a more sustainable peaceful future for the property and its biodiversity.

Sources: UNESCO World Heritage Committee, 1992 (http://whc.unesco.org/archive/repcom92.htm#manas).
UNESCO / IUCN, 2008, Monitoring Mission Report (http://whc.unesco.org/en/list/338/documents/).
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http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2002516

CASE STUDY 30

Deforestation as a secondary risk: post-tsunami rainforest in Sumatra (Indonesia)

Protected areas can mitigate the impact of a disaster and are often more resilient than modified ecosystems are to natural hazards; however, they also suffer from secondary risks. When communities and infrastructure are devastated by a sudden event, resources within a protected area can provide much-needed fuel, food and materials for reconstruction. World Heritage managers should be aware of their role and the measures that can be taken to support local communities without degrading the values and integrity of their World Heritage site.

The tsunami that hit South-East Asia on 26 December 2004 did not directly affect the ecosystem of the Gunung Leuser National Park (GLNP), part of the Tropical Rainforest Heritage of Sumatra; however, the

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CASE STUDY 30

human resources and infrastructure of the national park and the nature conservation agency responsible for the management of conservation areas adjacent to the GLNP were heavily impacted. A wedge of coastline and existing infrastructure up to 6 km inland was devastated. The Nature Conservation Agency Aceh (BKSDA-A) Office in Banda Aceh, the provincial capital of Nanggroe Aceh Darussalam (NAD), and several GLNP resort offices along the western coast of Aceh were destroyed. The capacity to protect and manage the property was seriously affected as many victims worked for government and conservation NGOs, including more than 150 staff in the forestry agencies. The destruction of housing and infrastructure of local communities was estimated to require 8.5 million m3 of timber to build 123,000 houses. This placed great pressure on local and national governments to allow logging within the property. Illegal logging was widespread due to the extreme needs of the local communities, compounded by the reduced capacity to protect the property. In Aceh, increased deforestation degraded the GLNP and the surrounding forests, causing further risk to vulnerable communities through increased flash floods and landslides.

WWF Indonesia helped to raise awareness of the extent of forest destruction after the tsunami. Through the efforts of the Environment Minister, plans to exploit the GLNP were rejected and alternative solutions for reconstruction were sought through international assistance. The Government of Spain supported a two-year UNESCO / PHKA project aiming to mitigate post-tsunami environmental threats to the national park and adjacent conservation areas.

Resisting the pressure to exploit protected areas during the recovery phase of a disaster requires protected area managers to raise awareness among local communities, businesses and politicians and to work closely with aid agencies and NGOs. Education, training and awareness-raising should be ongoing so that emergency response includes the advice of the property management (see also Case Study 21 on the Dorset and East Devon Coast).

Sources: UNESCO / IUCN, 2006, TRH Sumatra Monitoring Mission Report (http://whc.unesco.org/en/list/1167/documents/).
Flora and Fauna International, Rapid Response Facility (http://www.fauna-flora.org/rrf.php)
WWF Indonesia (www.wwf.or.id/).
Leuser Foundation (http://www.leuserfoundation.org/).

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7.4 How can heritage property play a more proactive role in post-disaster recovery and rehabilitation?

Heritage property can play a more proactive role in recovery and rehabilitation by:

- using traditional skills and capacities for post-disaster rehabilitation.
- providing evidence of the local way of life, technologies and sources of livelihood that should be used when undertaking post-disaster reconstruction. In this respect, much can be learned from past mistakes (Case Study 31).
- recognizing that cultural and natural heritage as a source of identity can contribute to the psychological recovery of disaster victims.
- using local coping mechanisms through traditional social networks to promote recovery.

CASE STUDY 31

Impact of reconstruction following Dhamar earthquake (Yemen)

Following the Dhamar earthquake in 1982, the Yemeni Government emphasized the tender (contractor-built) approach to reconstruction by relocating villages, rather than the self-help or repair approaches. The cultural dimension of reconstruction was overlooked, which in many cases led to total rejection of the new settlements by local people. Residents did not think of these settlements as permanent homes, as they failed to offer the advantages of their original village. In some cases, new settlements within an acceptable distance were actually competing with the old ones, as they were neither close enough to merge with the original village, nor far enough away to establish a new centre. Another physical factor seen to have a marked effect on acceptance of the new settlements was their distance from agricultural land.
Moreover, the architecture of the new houses was urban and had no link with the local lifestyle.
A prototype house layout produced by the Executive Office was later adopted by all types of contractors. The unit was repeated in its thousands by different contractors on different sites, using the same technology of reinforced concrete.
As a result, those houses that were inhabited had been substantially altered, extended or changed in some way, or in a number of cases used for functions other than accommodation (storage or animal byres). Also most of the subsequent additions to houses did not have earthquake-safe features because of the inability to follow the introduced technology.

Source: S. Barakat, 1993, *Rebuilding and Resettlement, 9 Years Later.* A case study of the contractor built reconstruction in Yemen, following the 1982 Dhamar earthquake, York, UK, Institute of Advanced Architectural Studies, University of York. Post-War Reconstruction and Development Unit Working Paper No. 2.

➤ Contents

8 How to implement, reassess and reappraise the DRM plan

Contents

8.1 How do you implement and monitor the DRM plan for your property?

An action plan is needed to implement the DRM plan and then to monitor it. Appropriate implementation and monitoring mechanisms form part of the DRM plan.

- The action plan should consist of the following:
  - various activities or projects;
  - time-frame for their implementation;
  - financial resources required;
  - existing and additional human resources;
  - identification of agency(ies) responsible for implementation.

- Periodic review based on the effectiveness of the plan after implementation and in the light of the experience of an emergency, if any has happened.

8.2 How do you train and build local capacity for implementing and monitoring the plan?

- Undertake training and capacity-building on the use of emergency equipment such as fire extinguishers, and emergency simulations in cooperation with external agencies such as fire services.

- Organize regular emergency simulation drills, awareness-raising activities, short publications for visitors, etc. It is crucial to perform simulation drills periodically. A simulation exercise at the archaeological site of Pompeii (Italy) attracted some fifty volunteers to be trained in the event of an emergency at the site or in local museums (Case Study 32).

Involving volunteers in emergencies requires linking them to regular maintenance programmes and simulation exercises.

CASE STUDY 32

Training through simulation exercises: salvaging cultural heritage in Pompeii (Italy)

The Archaeological Areas of Pompei, Herculaneum and Torre Annunziata, near Naples (southern Italy), is a UNESCO World Heritage site. The Vesuvius volcanic eruption in AD 79 covered the city with ash and therefore preserved almost the entire Roman city. However, the site is still exposed to many risks, such as volcanic eruptions, earthquakes and the ever-present risk of fire.
An artefacts emergency plan was therefore developed by the chief archaeologist, Prof. Guzzo, with the support of a consultant and a team of local volunteers. The assistance of volunteers was deemed necessary due to the large number of artefacts in storage and the lack of in-house human resources.
Volunteers can be really helpful only if they are suitably trained. Therefore a training course was set up in 2007 and suitable candidates were found through a major public relations push. Eventually over fifty volunteers, many from the local university, took part in a three-day training course, with practical demonstrations carried out by the archaeologists from the Ministry of Cultural Heritage and Activities.
The topics illustrated during the training course included the techniques of calling to action and dressing for emergency situations, arriving on site and moving around, handling delicate artefacts such as pottery, statues, frescoes, iron, glass and bronze objects, classifying artefacts during salvage, setting up initial space for cleaning and packing salvaged objects pending further professional restoration.

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CASE STUDY 32

A full-scale drill in the coordinated presence of the security guards, fire officers, archaeologists, first-aid crew and the full team of trained volunteers was carried out with favourable results. Thereafter, a regular simulation drill was planned at six-month intervals. The simulation drill was repeated in Herculaneum, Oplontis and the Boscoreale Museum, with different scenarios (fire, explosive device, and so on, with and without visitors present) in order to improve the basic skills of the personnel involved.

Source: A. Biasiotti, UNESCO Consultant on Security for Cultural Heritage, 2007.

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Contents

Appendix I

Glossary of relevant disaster management terms

Climate change: a change in 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 (United Nations Framework Convention on Climate Change; http://unfccc.int/).

Disaster: A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceeds the ability of the affected community or society to cope using its own resources (www.unisdr.org).

Emergency: An unforeseen combination of circumstances or the resulting state that calls for immediate action (Merriam Webster Online Dictionary, www.m-w.com).

Hazard: Any phenomenon, substance or situation, which has the potential to cause disruption or damage to infrastructure and services, people, their property and their environment (Abarquez and Murshed, 2004).

Mitigation: Taking action in the timeframe before a disaster to lessen post-event damage to lives and property. In risk management, many hazards such as earthquakes cannot be reduced, but the risk from that hazard can be reduced, or mitigated, for example by constructing earthquake-resistant buildings, or shelves that prevent objects from sliding off. The former is structural mitigation, the latter is non-structural.

Prevention: Measures taken to reduce the likelihood of losses. Ideally, these measures would seek to reduce losses to zero, but this often is not possible. Key question: How much prevention do you need to undertake?

Recovery: The process of returning the institution to normal operations, which may also involve the repair and restoration of the building or site.

Response: The reaction to an incident or emergency to assess the damage or impact to the site and its components, and actions taken to prevent people and the property from suffering further damage.

Risk: The chance of something happening that will have an impact upon objectives. (Emergency Management Australia, 2000).

Vulnerability: The susceptibility and resilience of the community and environment to hazards. 'Resilience' relates to 'existing controls' and the capacity to reduce or sustain harm. 'Susceptibility' relates to 'exposure' (Emergency Management Australia, 2000).

World Heritage property: World Heritage properties are those defined in Articles 1 and 2 of the World Heritage Convention and inscribed on the World Heritage List on the basis of their outstanding universal value, which is fulfilled through meeting one or more of criteria (i)–(x) in the *Operational Guidelines for the Implementation of the World Heritage Convention* (UNESCO / WHC, 2008*a*).

Contents

Typology of hazards

1. Meteorological

a. storm
   i. high precipitation
   ii. strong wind
   iii. cyclone/ hurricane/ typhoon
   iv. tornado/hail storm
   v. ice storm
   vi. dust storm
   vii. wave action (at sea / lake)
b. fire induced by lightning / static, spontaneous coal /peat combustion
c. drought
d. heatwave
e. high sea-surface temperature

It is also important to be aware of the effect of climate cycles such as the El Niño Southern Oscillation and North Atlantic Oscillation, and the effect of other cycles on predictable variations in risk of certain events such as drought, storm frequency, increased rainfall, etc.

2. Hydrological

a. flood
   i. precipitation flood – inadequate drainage or infiltration
   ii. flash flood
   iii. river or lake flood
   iv. mass movement dam
   v. storm surge
b. tsunami

3. Geological / geomorphological

a. volcanic
b. seismic
c. mass movement (land and sea)
d. erosion (river bank / coast line / reef)

4. Biological

a. epidemics (human, animal, or plant and human-animal transferable diseases)
b. pest infestations
c. algal blooms
d. rapidly spreading weeds or nuisance plants
e. coral bleaching event

5. Astrophysical

a. space weather
b. meteorite impact

6. Human-induced

a. fire (land clearance, arson, accident, drainage of peat soils)
b. pollution (health, e.g. food poisoning, disease)
   i. nuclear/ radioactive accident
   ii. waste mass movement (unstable spoil heap)
   iii. air pollution toxic fire or explosion or leak

Typology of hazards

- iv. water pollution failure or leak / spill → wildlife, plant mortality, disease
  1. toxic
  2. radioactive / nuclear
  3. organic waste
  4. sediment
- c. Violence- and conflict-induced human and wildlife mortality and ecosystem destruction
  - i. disease
    1. rapid-acting: Ebola fever, H5N1, SARS, cholera, rabies
    2. gradual capacity loss and social disintegration → HIV/AIDS
  - ii. human wildlife / conflict
    1. poaching, wildlife massacres, species extinction → pest outbreaks
    2. wildlife stampedes, predator attacks
  - iii. large-scale population dislocation or relocation
    1. rapid loss of vegetation cover → flood, mass movement, human/wildlife conflict
    2. soil or water contamination → disease, pest outbreak
    3. heavy hunting/ poaching → increased human-wildlife conflict or pest outbreak
  - iv. illegal activities and violence, e.g. illegal drug trade
  - v. warfare
    1. explosives (nuclear or other)
    2. biological warfare agents
    3. firearm use
    4. landmines
- d. Gas flaring
- e. Infrastructure failure
  - i. water pollution (algal blooms, coral bleaching, pest infestation, disease epidemic)
  - ii. dam or levee failure, flood
  - iii. coastal protection (wall, artificial beach) failure flood and erosion
  - iv. mass movement (e.g. waste slumps)
- f. Mining-induced
  - i. seismic activity and mass movement
  - ii. volcanic activity and mud volcano
  - iii. mass movement
  - iv. climate change and rainfall variation, e.g. mountain-top mining

7. Climate change

- a. sea-level rise
- b. melting permafrost
- c. rainfall pattern change
- d. increased storm severity or frequency
- e. desertification

Relevant charters and recommendations

- Convention concerning the Protection of the World Cultural and Natural Heritage, UNESCO, 1972. **http://whc.unesco.org/archive/convention-en.pdf**
- Final Recommendations of the International Course on Preventive Measures for the Protection of Cultural Property in Earthquake Prone Regions, Skopje, Yugoslavia, 1985. (Stovel, ICCROM, 1998)
- Conclusions and Recommendations of the International Workshop on Structural and Functional Rehabilitation of Housing in Historic Buildings in Seismic Regions, Mexico City, 1986. (Stovel, ICCROM, 1998)
- Council of Europe, Committee of Ministers, Recommendation No. R(93)9 of the Committee of Ministers to Member States on the Protection of the Architectural Heritage against Natural Disasters, adopted by the Committee of Ministers on 23 November 1993 at the 503rd Meeting of the Ministers' Deputies. (ICOMOS Heritage at Risk, H@R, 2008)
- Declaration of Quebec, Ist National Summit on Heritage and Risk Preparedness, Quebec City, Canada, 1996. (Stovel, ICCROM, 1998)
- The Kobe/Tokyo Declaration on Risk Preparedness for Cultural Heritage, Kobe/Tokyo International Symposium on Risk Preparedness for Cultural Properties, 1997.
- Radenci Declaration, Blue Shield Seminar on the Protection of Cultural Heritage in Emergencies and Exceptional Situations, Radenci, Slovenia, 12–16 November 1998. **http://www.ifla.org/VI/4/admin/emergcy.htm**
- Declaration of Assisi by ICOMOS Scientific Committee for the Analysis and Restoration of Structures of Architectural Heritage, 1998. (Stovel, ICCROM, 1998)
- Torino Declaration. Resolutions of the First Blue Shield International Meeting, Torino, Italy, 2004. **http://www.ifla.org/VI/4/admin/torino-declaration2004.pdf**
- Kyoto Declaration 2005 on the Protection of Cultural Properties, Historic Areas and their Settings from Loss in Disasters (adopted at the Kyoto International Symposium 2005 'Towards the Protection of Cultural Properties and Historic Urban Areas from Disaster' held at Kyoto Kaikan on 16 January 2005); **http://www.international.icomos.org/xian2005/kyoto-declaration.pdf**
- Recommendations of the UNESCO/ICCROM/Agency for Cultural Affairs of Japan – Thematic Meeting on Cultural Heritage Risk Management, World Conference on Disaster Reduction, Kobe, 2005. **http://australia.icomos.org/wp-content/uploads/Japan-recommendations.pdf**
- UNESCO / WHC. 2006. Strategy Document for Reducing Risks from Disasters at World Heritage Properties. World Heritage Committee, 30th Session, Vilnius, Lithuania, 8–16 July 2006. **http://whc.unesco.org/download.cfm?id_document=6525**
- Declaration on the Impact of Climate Change on Cultural Heritage, International Workshop on Impact of Climate Change on Cultural Heritage, New Delhi (India), 22 May 2007. (ICOMOS News, June 2008)

International organizations and research institutions

Contents

A. International organizations concerned with the cultural and natural sectors

- ***International Centre for the Study of the Preservation and Restoration of Cultural Property* (ICCROM)** is an intergovernmental organization dedicated to the conservation of cultural heritage. ICCROM aims at improving the quality of conservation practice as well as raising awareness about the importance of preserving cultural heritage. It contributes to preserving cultural heritage through five main areas of activity: training, information, research, cooperation and advocacy. For details visit **http://www.iccrom.org**. ICCROM, in cooperation with ICOMOS and the UNESCO World Heritage Centre, published Risk Preparedness: A Management Manual for World Cultural Heritage (Stovel, 1998). Furthermore, with assistance from the World Heritage Centre, ICCROM developed a set of training materials which have been tested in a number of countries. Risk management components have also been incorporated into various training programmes (King and Wijesuriya, 2008).

- ***International Committee of the Blue Shield (ICBS):*** The Blue Shield is the cultural equivalent of the Red Cross. It is the symbol specified in the 1954 Hague Convention for marking cultural sites to give them protection from attack in the event of armed conflict. It is also the name of an international committee set up in 1996 to work to protect the world's cultural heritage threatened by wars and natural disasters. The ICBS covers museums and archives, historic sites and libraries, bringing together the knowledge, experience and international networks of the five expert organizations dealing with cultural heritage. For details visit **http://www.ifla.org/blueshield.htm**

- ***International Council on Monuments and Sites* (ICOMOS)** is an association of professionals throughout the world that works for the conservation and protection of cultural heritage places. It is the only global non-government organization of this kind, which is dedicated to promoting the application of theory, methodology, and scientific techniques to the conservation of the architectural and archaeological heritage. For details contact; **http://www.icomos.org**. ICOMOS members and committees have been developing activities, publications and cooperation to enhance prevention or adapting broad conservation principles to the reality of heritage sites located in risk areas (Bumbaru, 2008).

- ***International Council on Museums* (ICOM)** is devoted to the promotion and development of museums and the museum profession at an international level. ICOM is a non-governmental organization with around 21,000 members in 146 countries, many of which have World Heritage sites with museums. **http://www.icom.org**

- ***International Union for Conservation of Nature* (IUCN)** helps the world to find pragmatic solutions to the most pressing environment and development challenges. It supports scientific research, manages field projects all over the world and brings governments, non-governmental organizations, United Nations agencies, companies and local communities together to develop and implement policy, laws and best practice. For details visit **http://www.iucn.org**

International organizations and research institutions

- ***UNEP World Conservation Monitoring Centre*** **(UNEP-WCMC)** is a collaboration between the United Nations Environment Programme, the world's foremost intergovernmental environmental organization, and WCMC 2000, a UK-based charity.
  http://www.unep-wcmc.org

Regional organizations

There are several regional organizations, both inter-governmental as well as non-governmental, which can provide their expertise for the protection of cultural and natural heritage from disasters and also recovering from these. The ***Asian Disaster Preparedness Centre*** **(ADPC; http://www.adpc.net/)** based in Bangkok and the ***Asian Disaster Reduction Centre*** **(ADRC; http://www.adrc.asia/)** in Kobe are two such organizations actively working in the area of disaster management. ***Cultural Heritage without Borders*** **(CHwB; http://www.chwb.org/bih)** is a Swedish non-governmental organization that lends international support to cultural heritage at risk of being destroyed whether as a result of natural disasters, war or neglect because of poverty or political and social conditions. It has been very active in emergency rescue and recovery of cultural heritage damaged due to war in South-East Europe.

- ***Academic and research institutions:*** Various institutions are engaged in research and training in this area or related disciplines. One such institution is the Research Center for Disaster Mitigation of Urban Cultural Heritage at Ritsumeikan University, Kyoto, which has started a UNESCO Chair Programme on Cultural Heritage Disaster Risk Management. For details visit **http://www.rits-dmuch.jp/en/unesco.html**

B. International organizations concerned with the disaster management sector

- ***Food and Agriculture Organization of the United Nations.*** **http://www.fao.org**

- Humanitarian agencies and NGOs with emergency support roles in the region
  (e.g. ***Médecins Sans Frontières, Flora and Fauna International***)
  (Rapid Response Facility).

- ***United Nations Environment Programme Post-conflict and Disaster Branch.***
  http://www.unep.org/conflictsanddisasters/

- Where relevant, international and United Nation agencies such as ***UN Peacekeeping forces,*** **UNHCR** and others involved in refugee management.

- ***World Health Organization for epidemics.***
  http://www.who.int/csr/en/

- ***World Meteorological Organization.*** **http://www.wmo.int**

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Epidemic and Pandemic Alert and Response, World Health Organization.
http://www.who.int/csr/en/

Global Outbreak Alert and Response Network, World Health Organization.
http://www.who.int/csr/outbreaknetwork/en/

Humanitarian Early Warning Service, Inter-Agency Standing Committee developed by the World Food Programme. http://www.hewsweb.org/

Rapid Response Facility, Flora and Fauna International. http://www.fauna-flora.org/rrf.php

Severe Weather Information Centre, World Meteorological Organization.
http://severe.worldweather.wmo.int/

United Nations International Strategy for Disaster Reduction. http://www.unisdr.org

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