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# POTENTIAL ADVERSE EFFECTS OF CLIMATE CHANGE ON HISTORIC HERITAGE

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Climate change potentially has serious implications for the management of historic heritage places and the historic landscapes in New Zealand. There has been considerable research and policy work done in New Zealand by the Ministry for the Environment and other agencies over more than ten years on the effects of climate change. The implications for agriculture, forestry, fisheries, coastal land, human health and so forth have all been explored. Very little work to date, however, has made much reference to the potential threats to historic heritage places. The threats to historic heritage include not only the direct impacts but also the indirect impacts such as increased pressure on the landscape from displacement of other activities and from changes in public policy, for example, increased emphasis on renewable energy.

This paper highlights some of the thinking that has gone on internationally about the range of threats to historic heritage, identifies one particular threat as putting large numbers of New Zealand archaeological sites at risk, and suggests some preliminary steps in policy development for historic heritage. While these threats are a matter for the whole archaeological community, this paper, particularly its policy prescriptions, are based on the Department of Conservation policy development.

## **What are the threats to historic heritage?**

Overseas the impact of climate change on historic heritage has been the focus of a series of reports. English Heritage commissioned research into projected climate changes in the UK (Cassar 2005). The potential effect of climate change on world heritage sites, including archaeological sites and historic settlements and cities, has also been subject of a number of reports (UNESCO World Heritage Centre 2006, 2007). Much of this literature is relevant, in part, to the New Zealand situation.

At a general level, direct impacts of climate change on historic heritage (English Heritage 2006) may include:

- The effect of rising sea levels, which will cause coastal erosion and endanger places at and near the coast such as structures, buildings and archaeological sites;
- More frequent and severe flooding, which may damage some historic buildings and create difficulties in obtaining insurance, which may make others uneconomic to occupy and maintain;
- Changes in hydrology, which may put buried archaeological remains at risk;
- Alteration of agricultural practices resulting from changes in crop or stock viability, which could pose a risk to some archaeological landscapes and buried archaeological sites;
- The increase in the frequency of extreme weather, or a change in its geographical distribution, which could pose an increased risk of damage to historic places.

Many of the specific risks associated with climate change identified above and discussed by Cassar (2005) also come into play in New Zealand conditions, although with some re-ordering of the level of threat from various elements. Flooding is a major risk in the United Kingdom as many historic towns and villages are in river valleys. The risk of increased soil erosion and mass movement is considerably more prominent here than in the UK because this is a rugged country and a high energy environment. The potential destructiveness of heavy rain falling within a relatively short period of time, for example, has been well understood here for decades. It is likely, however, that the major single risk to archaeological sites in New Zealand is from coastal erosion and the direct and indirect changes that this causes. This is discussed further below.

Cassar notes (2005: 1) that “climate change often highlights long standing preservation issues, rather than discovering new problems.” What needs to be addressed is “how to streamline current monitoring, management and maintenance practices to improve the stability of the historic environment, no matter how weak or strong is the impact of climate change.” This is a key conclusion. Ramsey (2006: 142), reviewing the impact of climate change on the New Zealand coast, notes that “the effects of climate change will not create new coastal hazards, but will, at many locations, exacerbate existing coastal erosion or inundation problems.” The threats already exist and will only increase as climate change intensifies. As Chitty (2007), in relation to the United Kingdom, notes “it is the sheer scale and speed at which changes may take place that will be the biggest challenge.” As the incidence of destructive

events increases, the preparedness of institutions will become a significant issue in managing climate change (Few et al. 2007).

The approach taken in reports produced for the UNESCO World Heritage Centre (2007, 2007b) is a similar one. Likely impacts of climate change on historic heritage are identified and possible management responses listed. One report contains “principal climate change risks and impacts on cultural heritage” and “an eight step approach to guide vulnerability assessments.” Brian Egloff, a member of the International Committee for Archaeological Heritage Management (ICAHM), notes in an unpublished paper (2007) that for the most part, the available literature deals with the likely impacts in a very generalized fashion. In many cases this reflects the inadequate state of inventory and monitoring and the uncertainties in relation to the likely impacts.

Egloff (2007) concludes that “maintenance and monitoring, and identification of vulnerabilities and threats are seen as one of the more urgent responses to climate change with a need to immediately commission baseline studies.” Much of the New Zealand coastline has not been surveyed for historic heritage places to the standard required to serve as a baseline for monitoring change. In addition to a system of baseline survey and recording, the response needs to incorporate identification of high risk areas, and strategies to recover information through excavation from those places where loss is imminent.

The biggest area of uncertainty is management and resources. As already noted, Cassar (2005) has stressed the need to streamline current monitoring, management, and maintenance practices to cope with the extra strain that may be put on them. Issues related to institutional preparedness are increasingly being highlighted (Chapman 2006; Few et al. 2007). There is a need for efficient processes for making decisions, prioritising work and allocating resources. In terms of conservation, there will be concurrent significant demands for funding to address issues relating to both natural and historic heritage, as well as visitor facilities such as tracks, bridges and buildings.

Not everyone is convinced that the changes will be manageable. If global warming reaches levels that would cause the ice sheets to disintegrate the change could be rapid and unstoppable and result in a catastrophic sea level rise of several metres (Hansen 2007). This would preclude any effective response to minimising or mitigating the damage.

### *Coastal erosion*

Coastal erosion has particularly serious implications for archaeological sites and is probably the single biggest risk in the New Zealand context. Parts

of the coast have long been a focus for occupation. Middens, in particular, tend to occur on soft shores close to shellfish resources. A GIS study indicates that 62% of North Island middens are within 500 m of the coast, 75% are within 1 km of coast, 90% are within 3 km of coast, and 94% are within 5 km of coast (All figures are at least  $\pm 100$  m). For the purposes of this count ( $n = 15225$ ), midden was any site with a midden component, e.g., pa with pits and midden. There are significant regional variations.

Coastal erosion has been an issue for archaeological sites for many years. Hamel (1978) was commissioned by New Zealand Historic Places Trust to report on the nature, extent, and risk of damage to archaeological sites on the Otago coast from both natural and human causes. She concluded that, at that time, coastal erosion was the main threat to sites. Easdale and Jacomb (1982) surveyed archaeological sites at 27 beaches on Coromandel Peninsula in 1981–82 with more mixed results as residential development had also had a dramatic impact on the many sites there. This survey has been followed up recently with a re-survey of some areas and sites. This is, then, an issue that has been around for a long time. Many of the implications are well understood, which is not to say that the will and resources have existed to tackle the problems.

Ministry for the Environment has issued *Planning for climate change: effects on coastal margins* (2001) and *Coastal hazards and climate change: a guidance manual for local government in New Zealand* (2004) and these provide a summary of the potential impacts, some of which have obvious implications for management of historic heritage places. This summary makes clear that risk is not just from erosion

### **What are the potential impacts on New Zealand's coastal areas?**

In general terms, accelerating sea-level rise around New Zealand may result in:

- increased coastal erosion in some areas. Parts of the coastline that have historically been eroding may experience increased erosion trends; other areas that may have been relatively stable may begin to erode;
- permanent high-tide inundation of very low-lying margins that may at present experience only episodic inundation;
- episodic sea flooding of higher coastal and estuarine margins;
- salinisation of adjacent rivers and streams and landward intrusion of saline groundwater;
- drainage problems in adjacent low-lying areas, especially where gravity is relied on;

- increasing ‘coastal squeeze’, where shorelines are held and constrained by structures such as seawalls and stopbanks, resulting in a reduction of intertidal area and loss of beach; and
- increased rates and frequency of episodic wave run-up and overtopping of both natural and man-made coastal defences.

Other aspects of climate change will also affect many of the other physical drivers that shape coastal margins and ecosystems, such as winds, waves, storms, sediment supply, and sea temperature. For example:

- increase in storm rainfall intensities may lead to increased or more frequent lowland river flooding and impacts on water quality from increased sediment loads to estuaries, although sediment availability will depend on catchment land-use and construction practices;
- change the way sediment is distributed along a coastline through changing longshore transport patterns and re-aligning of beaches;
- altered hydrological soil processes (e.g., greater extremes of drought versus intense rainfall), that may exacerbate erosion and landslips on unconsolidated coastal cliffs;
- changes in wind, ocean currents and waves may alter coastal sediment movement and coastal upwelling of cooler nutrient-rich ocean waters that is important for coastal productivity, including fisheries; and
- aquatic ecosystems will be affected by rising temperatures (air and water), potential loss of habitat from constraining stopbanks in some areas, while in other areas will be impacted by possible increases in sediment loads entering estuaries during storms.

The magnitude of the impacts on coastal margins will differ between regions and even between localities within regions, depending on the localised impacts of climate change on the physical drivers that shape the coast, the natural coastal characteristics and the influence of man-made coastal developments (Ministry for the Environment 2004).

The report recommends “long-term monitoring of the effects of coastal hazards should be undertaken to improve our understanding, and ensure that response options are effective and sustainable. Monitoring techniques need not be expensive (e.g., a regular photographic record), but in high-risk situations, robust monitoring programmes that will provide useful information for future assessments of coastal hazards and response options should be considered” (Ministry for the Environment 2004: 11). Understanding of coastal hazards has improved considerably over recent years but this knowledge is only slowly reflected in planning, with older and inadequate mitigation measures continuing to be used just because they have gained a high level of acceptance.

Recording and monitoring of historic heritage places in the coastal zone have received renewed attention recently in New Zealand (e.g., Jacomb and Walter 2005) and such surveys are a well-established tool in other places, such as Scotland (e.g., Dawson 2003). Ideally, the results of survey should be considered against historic changes in coastal morphology, and use predictive models to gain a better understanding of what has already been lost. Gibb's (1978) study of historical rates of erosion and accretion provides a national picture of the distribution of shorelines that are advancing or retreating but the data is now two to three decades old. Of particular importance for historic heritage places is the response of different coastline types to coastal hazards. The types of coast most susceptible to change are open-coast sand beaches and estuaries. Some types of archaeological site, such as middens, occur more frequently on the types of coast most vulnerable to change.

There is no lack of best practice guidelines for managing the effects of coastal erosion on historic heritage. What is needed is to prioritise this amongst the other risks to historic heritage places, and also to ensure that historic heritage is taken into account by decision-makers, who may be juggling a raft of different considerations.

### **Some other risks**

While coastal erosion has been identified here as a major risk, numerous other potential changes will also impact on historic heritage. Floods, such as 1981 and 2007 events at Kerikeri, sometimes threaten important historic buildings and sites. The damage to historic heritage from flooding has been limited to date and manageable. But the frequency of such events is increasing. The February 2004 event in the Wanganui–Manawatu area inundated farmland and buildings and damaged structures and two marae that were in the way. In July 2004 there was extensive flooding of farmland in the eastern Bay of Plenty. Flood waters also spilled into Whakatane. The Matata event of June 2005 is another in the series of such incidents in recent years.

Heat waves and fire risk, for example, are virtually certain to increase in intensity and frequency (NIWA 2007). The increased fire threat in the north and east of the North Island, and northeast South Island, has obvious risks to historic heritage, particularly wooden buildings and structures. These risks will need to be assessed and resources prioritised.

Of considerable concern are the indirect impacts, as these are often overlooked. English Heritage (2006) have identified the following issues which arise from our responses to the changes rather than the changes themselves:

- The traditional emphasis on seawalls to prevent coastal erosion has slowly given way to a greater emphasis on working or living with

Nature as far as practicable and this poses a risk to archaeology, buildings, and landscapes.

- New flood defences can cause major archaeological damage along waterways affecting archaeology, buildings, and landscapes.
- The architectural integrity of some historic buildings could be damaged by the need to provide new and more effective rainwater disposal systems or other changes.
- Poorly designed or inappropriate energy-saving measures may detract from the historic character and fabric of buildings. Proposals to replace historic buildings with more energy-efficient could result in serious losses.

Developments designed to generate renewable energy, like any other infrastructure developments, can have a variety of impacts (English Heritage 2006). It is important to evaluate these impacts on a case-by-case basis. The construction of new renewable energy infrastructure, including wind farms, may have a direct archaeological impact. Wind farms (like any other prominent developments) need to be carefully sited to avoid compromising significant landscapes or the visual setting of important sites or buildings where the integrity of that setting is an important part of their significance. A number of proposed wind farms have been through a process of assessment for their effect on historic heritage in New Zealand. The introduction of new biomass crops (like other changes in agricultural practice) may pose a risk to archaeological remains by altering agricultural practices and increasing the pressure on arable land. Cumulative changes may radically change the appearance of historically significant landscapes.

Another indirect risk is an increased emphasis on re-vegetation. Under the Kyoto Protocol one approach to reducing climate change is the creation of new forests that extract the greenhouse gas carbon dioxide from the atmosphere and store it as carbon in vegetation and soils. Establishing new indigenous forests can improve conservation, recreation and environmental outcomes on public conservation land. In some cases, however, establishing new forests may not be sensible or acceptable: e.g. where doing so will have significant adverse effects on highly-valued historic heritage, including historic landscapes.

There are a huge variety of potential indirect impacts arising from increased pressure on the landscape, for example, from displacement of land use by changes at the coast. Changes in public policy, for example increased emphasis on efficient use of energy will also affect outcomes. Car use is currently relatively cheap and this has a major influence on land use. It is difficult to see this continuing.

## The policy response

The New Zealand Historic Places Trust is the lead agency for the effects of climate change on historic heritage but other agencies also have a stake in this. The Department of Conservation manages large numbers of historic structures, buildings and archaeological sites. This makes it a key player in climate change as it relates to historic heritage, as well as natural heritage. Historic heritage is affected by climate change and needs to be included specifically in any policy development. The need for good monitoring systems is a key conclusion drawn from a review of the literature. Beyond that, measures to physically protect significant historic places must be developed or, if that is not feasible, the places recorded or investigated before they are destroyed

Based on English Heritage's approach, the Department needs to ensure that, at a minimum, it will:

- Work with others (e.g., HPT) on policies and practices to cope with new circumstances;
- Promote research into the risks posed by climate change to historic structures, buildings and sites;
- Work with others to ensure that significant historic sites that are at risk as a direct result of climate change are protected or, if that is not feasible, recorded;
- Ensure that appropriate emergency response procedures are in place, proportionate to the risk, to mitigate the impact of extreme weather on historic structures, buildings, and sites;
- Ensure that there are robust systems in place for recording and monitoring change to historic heritage places and landscapes and with more urgency accorded to baseline surveys; and
- Ensure that there are good processes for making decisions, prioritising work, and allocating resources.

This paper was written to highlight the issue of climate change and its implications for historic heritage. Limited work is currently under way to get some figures for the relative risk to archaeological sites from the different threats. It is appropriate to end with Cassar's (2005) conclusion, noted above, that "climate change often highlights long standing preservation issues, rather than discovering new problems." But the speed and scale of the changes may cripple any attempts to mitigate or manage them.

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