The Urgent Need to Redefine the Meaning of Sustainability in a Climate-Changed World

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Abstract
In the future, when climate change will force a radical rethink of the concept of ecological sustainability, tourism researchers will be forced to consider how sustainability of natural resources and the sustainability of the tourism industry are linked, with the latter having a high degree of dependency on the former. This paper seeks to draw both aspects of sustainability together and consider how the sustainability of protected areas and the tourism industry will be affected by climate change in the near to long-term future. In this paper, considerations about biological sustainability are limited to protected areas that are used as a key selling point by tourism destinations.

Introduction
From an ecological perspective, sustainability describes the ability of ecosystems to maintain ecological processes, productivity, functions and biodiversity into the future (Krebs 2008). In practical terms, sustainability describes the ability to use resources in a manner that can be continued indefinitely in the future (Murphy and Price 2005). The ability of the global system to grow sustainability into the future was first questioned by Danella and Dennis Meadows in their book "Limits to Growth" published in 1972. In a forceful reminder of the pivotal role of sustainability in future human welfare, Krebs (2008: 128), an eminent ecologist, observed, "…like all populations, human populations are subject to the rule that critical resources limit population growth sooner or later. The carrying capacity of Earth for humans may have already been exceeded, and the transition from a growing human population to a stable one is one of the most important problems of the century." If this is the reality, and there is every indication that human carrying capacity in a global sense is at or has exceeded global human sustainability, how should the global tourism industry respond? This question will become even more critical as global climate change begins to affect ecosystems on a global scale.

From a global perspective, sustainability occurs when the consumption of resources equals the rate that resources are replaced. The evidence points to a global community that is consuming resources at a rate that exceeds nature's ability to replace them (Krebs 2008). Unfortunately, the tourism literature continues to ignore this global dimension in its debate about sustainability. Current debates about sustainability generally assume ecosystem stability and the ability of these systems to retain their biological integrity into the future. This view of nature ignores the fact that biological communities are not restricted by spatial measures, such as park borders, but respond to changes in climate (both natural and human induced) by adaptation, migration or extinction (Prideaux 2009).

Global climate patterns rarely remain constant over the long term and are, in geological terms, constantly changing through a series of short- and long-term cycles that are still not well understood by climatologists (IPCC 2007). Currently, the Earth appears to be facing a human-induced or anthropogenic period of climate change that will lead to global warming. Because of continual changes in global climates biological communities are constantly changing in response. Human-induced climate change is a new factor in this long-term cycle of climate change and will force plant and animal communities to respond at rates that are more rapid than in the past.

In the near future, when climate change will force a radical re-evaluation of the concept of ecological sustainability, tourism researchers will be forced to reconsider the meaning of sustainability in a tourism context given the high degree of dependency of some forms of tourism on natural resources, particularly protected areas. In the recent past, there was an assumption that specific ecosystems can be (are) protected by creating areas with borders that ensure long-term sustainability. This view is naive in that it ignores the reality that climate is rarely stable over the long term. For this reason, protected-area boundaries that are now able to protect the integrity of specific ecosystems may have to be altered over time as climate change affects ecosystem stability. This will be become increasingly difficult as the global population increases and the network of roads, human settlement and farming activity continues to expand in areas surrounding remaining natural areas, including protected areas.

This chapter examines aspects of ecological and tourism sustainability and considers how the sustainability of protected areas and the tourism industry will be affected by climate change in the near to long-term future. In this chapter, considerations about ecological sustainability are limited to protected areas that are used as a key selling point by tourism destinations. This chapter will examine how the Climate Change Impact Model (Prideaux et al 2010) illustrated in **Figure 2** may be used to examine changes in long-term sustainability of the Wet Tropics World Heritage Area (WTWHA) Australia as it begins to be affected by climate change.

The underlying premise of this chapter is that the current concept of sustainability, built on the belief that long-term stability is possible if proper management strategies are implemented, will not be valid in the future and that rather than stability, we are entering a long-term period of instability that will be characterized by large-scale changes in local and global weather patterns, landscapes and sea levels. In periods of rapid change of the nature now beginning to occur, destinations that rely on protected areas as one of their key selling factors have little option but to rapidly adapt to the changes that are now beginning to occur. This is particularly true of nations where wildlife tourism is a key pillar of their appeal to tourists.

Climate Change, Weather and Tourism

The major mechanism through which climate change will impact the tourism industry generally – and protected areas specifically – is weather, described as the pattern of precipitation, temperature, humidity, cloud cover, wind speed and hours of sunlight. There are multiple interactions between weather and tourism. As Becken and Hay

(2007:7) note: “Climate is both a resource for the tourism experience and a risk.” Climate is a key push factor for many visitors who seek favorable weather conditions. In the case of winter sports enthusiasts, snow is a key attraction, while for beach destinations, long hours of warm sunshine are desirable. However, weather is also a risk if the wind is too strong, there is too much rain or the temperature range is beyond desirable limits. In the future, climate change will cause changes to weather patterns that will in turn affect ecosystems and landscapes and the tourism industry they support.

In rainforest areas, for example, if rainfall declines, drying may occur and forest communities may be replaced by grasslands or the composition of the forests may change affecting the distribution of fauna. Other impacts caused by changing weather patterns include fire events that are capable of causing large-scale changes to plant and animal communities and the scenic values they provide.

Figure 1 highlights changes that are predicted to occur in the WTWHA rainforest. This region is World Heritage listed (1988) and extends along the northeast coastal zone of Queensland, encompassing an area of 894,000 hectares. The rainforest contains an almost complete record of the major stages in the evolution of plant life on earth with many rainforest species originating when Australia was still part of the Gondwana super continent. As temperatures increase, species richness and abundance will decline. In some cases, the decline will be a result of changes to local weather patterns that interrupt the growing cycles of plants leaving many animals with a shortage of food. In other cases, temperature-sensitive plants will die out and be replaced by other more temperature-tolerant species.

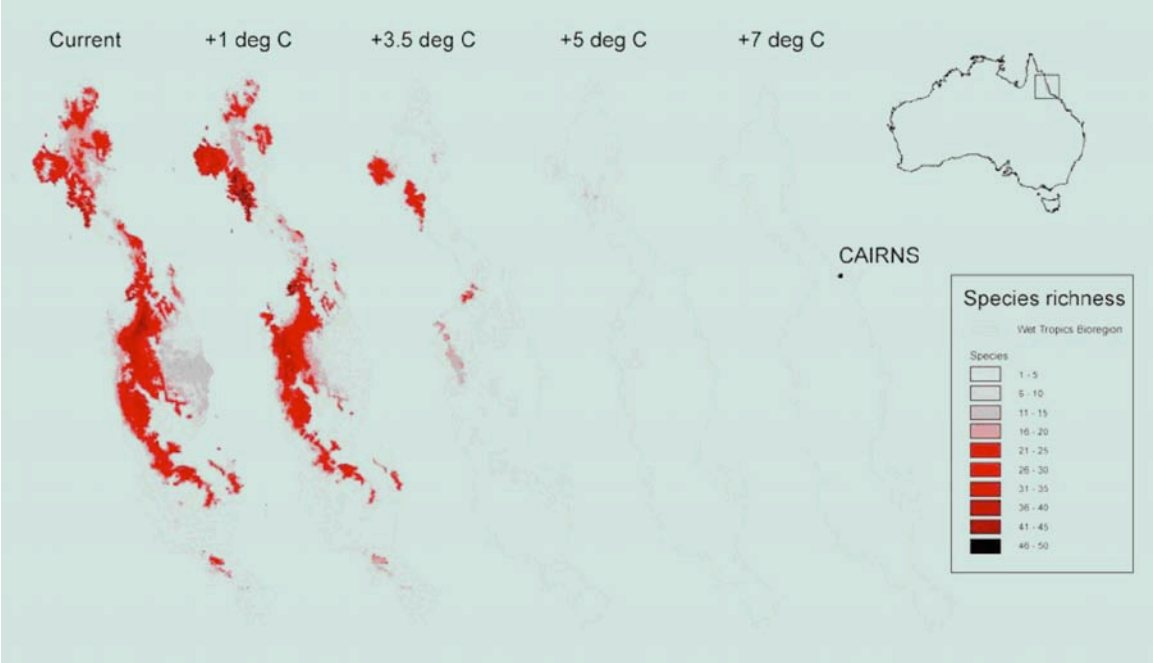

Figure 1. The decline in distribution of species richness of regionally endemic terrestrial vertebrates with increasing temperature. Source: Williams et al (2003).

As **Figure 1** illustrates, the weather element of climate change will cause substantial ecological changes and have a significant impact on the long-term sustainability of the present mix of flora and fauna that constitute the area's ecosystem. Over time, a new modified ecosystem will emerge that will include species that have migrated to the area to fill niches previously occupied by flora and fauna that will become extinct as temperature increases. It is not possible to protect the current ecosystem because there are no migration pathways for forest species to follow and no refuges for animals to escape to. Changing current protected boundaries will have little or no effect. In blunt terms, the rainforest system of the wet tropics as we currently know it is not biologically sustainable in the long term, while the extent of change that occurs will be almost entirely dependent on the effectiveness of global mitigation efforts.

The current concept of sustainability is therefore redundant and a future definition may have to include a willingness to allow the changes that are likely to occur to take place with as little interference as possible so that the new climate-modified ecosystem is given a chance to emerge and become established. Any new definition of ecological sustainability has to recognize that change is an ongoing process. Rather than resisting changes in biological systems caused by climate change through interference with natural processes there is a strong case for allowing change to occur and during this process adapt the way that natural systems are currently used.

For example, if an ecosystem becomes more fragile, the level of use by the tourism industry will need to be adjusted, possibly by reducing visitor numbers and/or restricting access to particularly sensitive areas. This will affect the manner in which protected areas, especially those undergoing change, are used by the tourism industry. Any change

in use, particularly if visitor numbers are reduced, will in turn affect the business sustainability of firms using the resource.

To understand how climate change will impact on the ecosystem, it is necessary to integrate scientific research with social-science research to develop a model that shows how changes in weather affect the landscape-scale protected-area systems that today constitute a significant element of the tourism product in many countries. The starting point for understanding how this process will affect the tourism sector is to investigate how the supply side (defined as landscapes, ambient temperature and scenic views) and the demand side (for tourism experiences) are affected. For example, **Figure 2** illustrates a highly useful science-based tool that can be used as a starting point to future debates on the meaning of sustainability – both ecological and business. In effect, the model is able to give a prediction of how the forest will look from an ecological perspective at varying levels of temperature change.

One of the key factors in future debates about the concept of sustainability must be an understanding of the relationship between the level of global warming and the impact of that warming on the environment. It is not possible to predict how much global temperatures will rise in the remainder of this century because successful political intervention through mitigation may cap temperature increases at some point in the future, or alternatively the failure to achieve global consensus may lead to higher temperatures. Thus, the tourism industry will need to constantly re-evaluate how it uses ecosystems in general and from what philosophical perspective this will occur. In this manner, future sustainability will be a function of the rate of temperature increase; the impact that temperature increases will have on ecosystems measured by changes in abundance and distribution of species; and the sensitivity of the new ecosystems to human use.

The six-stage Climate Change Impact Model (Prideaux e al 2010) illustrated in **Figure 2** is one approach to assessing how the ecosystem and the landscapes it supports will change. The model (Figure 2) is descriptive, designed to identify linkages that might otherwise go unnoticed, and has the capability of being used as an aid in planning. The assumption underlying the model is that changes to weather that are generated by climate change will modify ecosystems, patterns of human settlement, agricultural systems, economic patterns and tourism demand. Conceptually, the model relies on two sets of theory – the concept of consumer-push and destination-pull factors and a standard-economic-demand-and-supply model where a change in supply leads to a change in demand.

This chapter focuses only on the demand and supply for tourism use of protected areas. Various supply-side inputs are required to create a tourist experience that is subsequently marketed to and consumed by tourists. Inputs usually fall into these categories: the natural resource (landscapes, scenic views, flora and fauna and local weather patterns), management of the resource and infrastructure needed to support the tourism sector (e.g. transport networks, accommodation, walking tracks, ranger services and other services). Collectively, these inputs constitute the characteristic product of a protected area.

The consumption of the views and experiences available in the protected area by tourists may be measured as demand, which is a function of how successfully the destination has been marketed and the quality of the experiences available. If the quality of inputs changes as a consequence of ecological changes, the level of demand may change. If climate change has a negative impact, as in the case of the Wet WTWHA, the perceived quality of the protected area will change possibly causing a shift in the level of demand. Also, the sustainability of the protected area measured by the number of visitors that may be sustained on an annual basis may also change affecting the economic sustainability of the tourism sector that relies on the protected area. For example, areas of Africa that experience a severe decline in the abundance of the big-five animals will become less attractive to tourists and suffer a decline in business sustainability.

In **Figure 2,** the first-order impacts of climate change are shown as changes to weather that include temperature (mean yearly average temperature variations based on day and night, and by season), precipitation (rain, snow, fog, clouds, etc.) and wind (including daily wind speeds and wind events, such as wind storms) as well as fire events and changes in sea level. Collectively these impacts cause ecological changes that may include reduced biodiversity, changes in flora and fauna and reduced sustainability and are shown as stage 2 "Biological/Physical" impacts.

The biological and physical impacts may cause visible changes to the natural ecosystem, which in turn may affect tourism demand. For example, a reduction in precipitation that leads to the retreat of rainforests and advance of savannah forest will change the quality of the scenic views. Changes of this nature are illustrated by stage 3 "Changes to the environment." Local changes in weather may also affect the physical resources that define the nature and quality of the environment, which is often the major appeal of protected areas (Scott et al 2007).

Impacts many include significant changes in plant communities, loss of iconic animal species, changes in settlement patterns and changes in agricultural systems. These changes are illustrated in stage 3 and may have a specific impact on aesthetic values and in some cases lead to a reduction in the perceived attractiveness of a specific region (Elsasser and Burki 2002) from a tourism perspective. Changes that are observed in stage 3 are shown as stage 4 "Impacts." In **Figure 2,** the impact on tourism is shown as stage 4a "Tourism impacts." From a tourism perspective, changes in weather may have either positive or negative impacts. In colder areas, for example, increased temperatures may generate increased demand (Scott et al 2007; Richardson and Loomis 2004).

The impacts shown at stage 4a may be either positive or negative as illustrated in stage 5 "Possible tourism outcomes." Positive outcomes may generate increased tourism flow. Negative outcomes may lead to a reduction in demand, falling investment, the need to find alternative markets and even closure of some destinations. Strategies to adapt to climate change impacts are illustrated as stage 6 "Adaptation strategies."

The major feature of the model is its ability to illustrate linkages between the various elements of the physical and human systems operating in protected areas. As

temperatures rise, impacts can be traced from initial biological and physical impacts through to tourism outcomes and adaptation strategies. Changes in the structure of the ecosystem may affect the nature of the tourism experience and the level of enjoyment experienced by visitors. While the model is primarily designed to show linkages and cause-and-effect loops, it also has a capacity to measure the scale of impact.

At each step of the model, it is possible to measure the nature and scale of impacts through a range of cause-and-effect relationships. Science-specific methods may be used in stages 1 and 2 to measure change in temperature, precipitation, wind and fire. These findings may then be used to predict possible and probable changes in stage 2 factors. Commencing from stage 5, social-science research methods, including surveys and the development of scenarios, can be employed to measure the size of potential changes in demand.

After potential outcomes on tourism demand have been identified in stage 5, “Adaptation strategies” (stage 6) can be developed to deal with the changes identified in stage 2. As part of this process, it is necessary to also consider resilience factors.

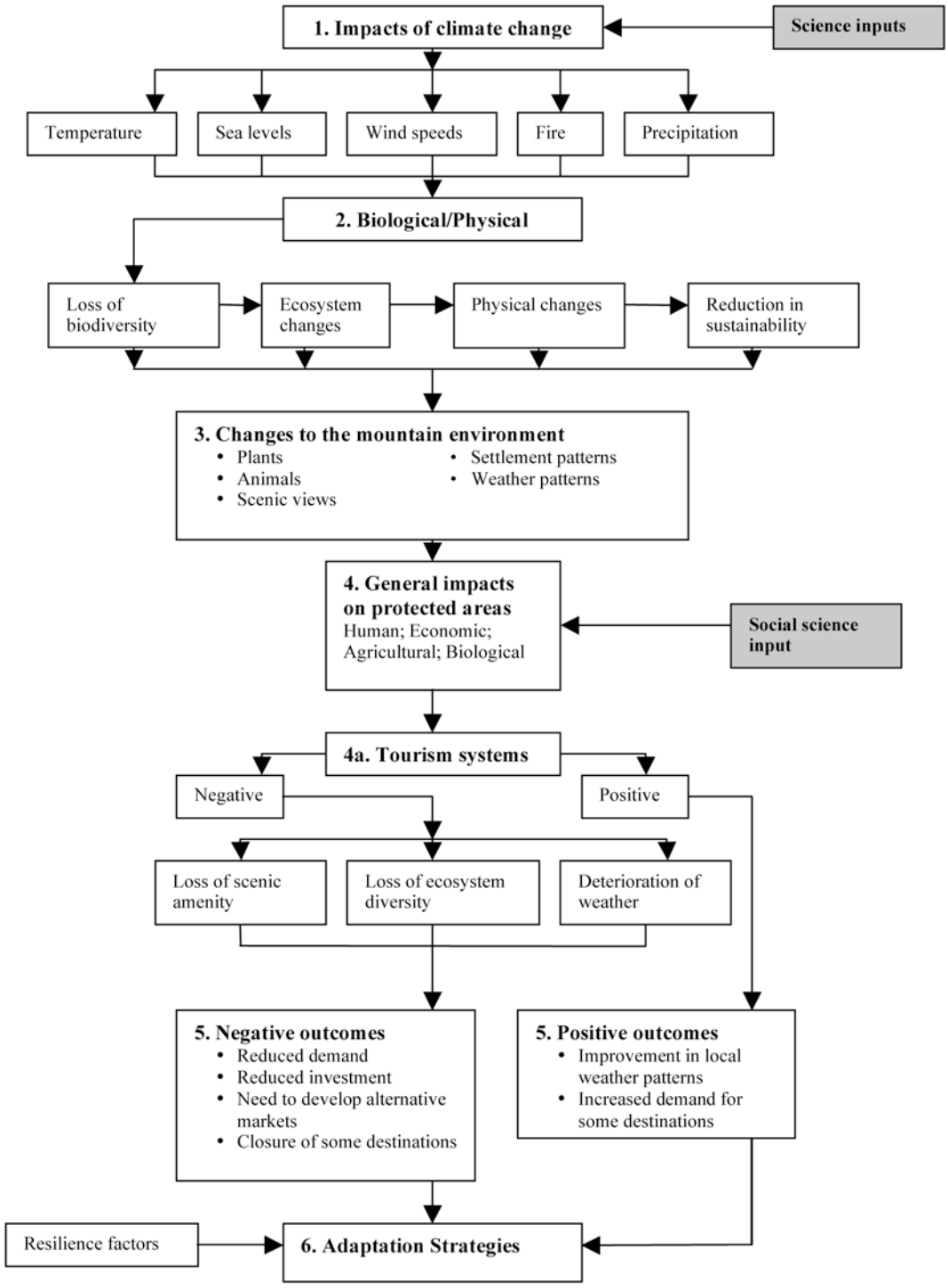

Figure 2. The six-step Climate Change Impact Model applied to protected areas.

Conclusion

The argument presented in this chapter is that our current understanding of sustainability is built on the belief that ecosystems are stable over the long term. Even without human intervention, the global climate system is in a constant state of change. Current views on sustainability are therefore valid only in the short term measured on a time scale that is more likely to be decades rather than centuries in length. As the pace of climate change increases, many ecosystems will undergo change that in most cases cannot be reversed by measures such as restricting tourism use.

In some ecosystems, this may mean a reduction of biodiversity and a significant change in species mix. In other ecosystems, such as some deserts, there is likely to be little noticeable change, at least to the landscape. The major difficulty for most protected-area managers and for destinations that rely on protected areas is the lack of scientific investigation into potential impacts. Without access to data of this nature, managers will find it difficult to make informed decisions on use and management. This will make it difficult to assess the desirable level of tourism use.

Many ecosystems will become vulnerable, and because they are in a state of change, it will be difficult to evaluate how human use will affect the ecological processes that are occurring. Human use may for example speed up undesirable impacts. For these reasons, it will be difficult to determine the extent to which tourists should be allowed to use areas of high biodiversity and fragility.

In the future, adaptation strategies will become critical particularly if global efforts to reduce greenhouse emissions fail or are delayed as now appears to be the case. At the destination level, new adaptation strategies will be required to minimize adverse impacts. These should include a new understanding of sustainability. Before adaptation strategies can be developed, the potential impacts of climate change for each one-degree rise in temperature will need to be identified. This will require greater investment in scientific research, a more effective discussion between scientists, managers and tourism operators, a willingness of the supply side to respond proactively, and acceptance by consumers that they have an important role to play in both mitigation and adaptation. Some areas that are now viewed as being sustainable will be reclassified as fragile, requiring a reduction in tourism numbers that will in turn affect business sustainability.

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