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Wildlife in a changing climate

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edited by
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Cover images, clockwise from left:

The Lemuroid ringtail possum (*Hemibelideus lemuroides*), particularly the white form, may be at the verge of extinction (photo: Mike Trenerry); the population of the 'i'iwi (*Vestiaria coccinea*) is declining (photo: John Kormendy); and the golden toad (*Bufo periglenes*) is considered extinct (photo: Charles H. Smith). All have been affected by climate change.

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Foreword

For the past twenty years climate change has been high on the international agenda. Together with desertification, soil degradation and biodiversity loss, it is widely recognized as the major environmental threat the world is facing. Evidence is increasing that warming and other climate-related changes are happening more quickly than anticipated, and prognoses are becoming worse.

This publication analyses and presents how climate change affects or will likely affect wild animals and their habitats. Although climate change has already been observed and monitored over several decades, there are not many long-term studies on how the phenomenon is affecting wildlife. There is growing evidence, however, that climate change significantly exacerbates other major human-induced pressures such as encroachment, deforestation, forest degradation, land-use change, pollution and overexploitation of wildlife resources. Case studies are presented in this book that describe some of the body of evidence, in some instances, and provide projections of likely scenarios, in others.

An emphasis of this paper is on tropical terrestrial ecosystems. Subtropical, temperate and boreal regions, as well as coastal areas and inland waters, are covered to a lesser degree. These climatic zones and ecosystems are interconnected in many ways, and in particular for animals, there are no strict boundaries between them.

The publication not only highlights climate-induced changes and their likely consequences, but it also provides useful and up-to-date information on how these could be addressed by skilful measures of adaptive management. The findings and suggested measures explore current knowledge and propose a way forward. As climate change is ongoing, there is a need for more concerted research to inform policy and improved monitoring of its implementation. The increased knowledge would allow to better address this urgent issue and further improve climate policy.

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1. Summary

The world already faces a biodiversity extinction crisis, and it is likely to be made worse by climate change. This paper examines the likely ecosystem and landscape changes that will occur in forests, mountains, wetlands, coastal areas, savannahs, grasslands and steppes. Impacts include changes in physical conditions, weather patterns and ecosystem functioning. As a consequence, terrestrial, freshwater and marine wildlife will be severely affected unless we manage to cope with climate changes through decisive planning and action. The main focus is on tropical terrestrial wildlife and its habitats, but other fauna, ecosystems and geographical regions are covered as well.

The impacts of climate change will include permanent changes in physical conditions, such as snow cover, permafrost and sea level along with increases in both the irregularity and severity of extreme weather events like droughts, floods and storms, which will lead to changes in ecosystems and ecosystem functioning. Degraded ecosystems are expected to be less resistant to climate change than intact ones.

This paper explores several main consequences for wildlife, including:

- *Ecosystem changes*: These include geographical and altitudinal shifts, changes in seasonality and rates of disturbance, changes in species composition and a rapid increase in invasive species.
- *Species interactions*: Impacts on wildlife species include changes in species distribution, abundance and interactions, for example through shifting phenology and mistiming.
- *Human–wildlife conflicts*: These are likely to increase as humans and wild species compete for the same dwindling resources.
- *Wildland fires*: Increased drought, the drying out of previously wet forests as well as human interference and pressure are leading to more frequent and disastrous fires in ecosystems that are poorly adapted to such events.
- *Health and diseases*: Wildlife, humans and livestock will be affected by the emergence and increased spread of pathogens, geographically and across species boundaries, due to climate, landscape and ecosystem changes.

Also considered are a number of responses to climate change:

- *Maintaining current ecosystems*: This is crucial, particularly where ecosystems are reasonably intact and therefore likely to withstand climate change. A strong and effective network of protected areas is a critical element in this strategy.
- *Adaptive management*: Protection alone will not be enough, however, as ecosystems change around us. Wildlife biologists are now considering new approaches and more radical steps, including the relocation of protected

areas, perhaps on a temporary basis, to allow migration to suitable conditions; translocation of species that have lost optimal ecological conditions; artificial feeding of wildlife in times of emergency; and modification of habitats. All of these approaches are accompanied by risks and costs and will require that strong safeguards are in place to be successful.

- *Restoring ecosystems*: Restoration will also be needed, particularly in ecosystems that are important for climate change resilience but are already badly degraded. These include mangroves, inland waters, forests, savannahs and grasslands.
- *Landscape approaches*: Actions taken in isolation are likely to fail, making integrated approaches vital. Examples of fire, invasive species and disease and pest management are included in the paper to allow consideration of how such integration might be applied in practice.

Addressing wildlife management among the multiple other concerns resulting from climate change will be challenging. Developing and communicating information on the value of wild species and ecosystems to humanity will be an important strategy in building political momentum for conservation, alongside ethical considerations. Developing, managing and retaining an effective system of protected areas is critical for success. The concept of "mainstreaming" biodiversity conservation needs to be applied consistently and carefully. Finally, as we embark on a period of great uncertainty, further research and careful monitoring are needed to ensure that adaptive management and other new approaches can succeed in responding to existing and newly emerging climate pressures.

2. Introduction

The world is undergoing an extinction crisis – the most rapid loss of biodiversity in the planet's history – and this loss is likely to accelerate as the climate changes. The impact of climate change on wildlife is already notable at local, regional and global levels. The direct impact on species that humans make use of or with which we compete, affects human communities in a very immediate way: the loss of biodiversity is our loss as well. Arguably, we also have an ethical responsibility to address the rapid increase in the rate of global species extinction that has been caused by our own actions.

Climate change is expected to become one of the major drivers of extinction in this century as a result of changes in the breeding times of species and shifts in distributions caused by the variation in temperatures and precipitation regimes. It has been estimated that 20–30 percent of plant and animal species will be at higher risk of extinction due to global warming and that a significant proportion of endemic species may become extinct by 2050 as a consequence. Some taxa are more susceptible than others. For example, 566 of 799 warm-water reef-forming coral species are at risk of becoming endangered because of the increasing climate change, as are about 35 percent of birds and 52 percent of amphibians. Moreover, the impact will likely be more severe on species that are already at risk of extinction: 70–80 percent of red-listed birds, amphibians and corals are considered susceptible to the effects of climate change (Vié, Hilton-Taylor and Stuart, 2008).

When climate change disrupts ecosystems that provide global services, the implications are even more serious. With regard to rainfall generation, the potential impact on food security is huge because weather systems that water crops in the temperate world can be traced back to evapotranspiration in the three main tropical forest blocks (as demonstrated by precipitation simulations showing rainfall patterns over the course of a year). Average annual temperatures have risen steadily over recent decades and an even higher increase is predicted for the years ahead. This is most pronounced in Africa where current climate models project a mean temperature rise of 3–4 °C across the continent by the end of this century, approximately 1.5 times the global average increase (Kleine, Buck and Eastaugh, 2010; Seppälä, Buck and Katila, 2009).

All global ecosystems are likely to be affected by climate change to a greater or lesser extent. Forests cover approximately one-third of the global land surface. They provide essential services that support human livelihoods and well-being, support the majority of terrestrial biodiversity and store about half of the total carbon contained in land ecosystems, including in the peat of some tropical forest soils. Tropical and subtropical forests contain many biodiversity hotspots. There are still major gaps in knowledge about the impacts of climate change on forests, associated wildlife and people and how adaptation measures can best be tailored to local conditions. The productivity of tropical forests is projected to increase where water is available in sufficient quantity. In drier tropical areas, however, forests are projected to decline (Seppäla, Buck and Katila, 2009). Major impacts are also predicted elsewhere, particularly in polar ecosystems, inland waters, grasslands and in the oceans, where climate-driven acidification is perhaps the most extreme threat of all (Parry *et al.*, 2007).

Even moderate climate change, as projected in both unavoidable and stable scenarios, would put some wildlife at considerable risk; worst-case scenarios would see catastrophic losses. Thomas *et al.* (2004) conclude that "for scenarios of maximum expected climate change, 33 percent (with dispersal) and 58 percent (without dispersal) of species are expected to become extinct. For mid-range climate change scenarios, 19 percent or 45 percent (with or without dispersal) of species are expected to become extinct, and for minimum expected climate change 11 percent or 34 percent of species (again, with or without dispersal) are projected to become extinct." According to the Intergovernmental Panel on Climate Change (IPCC; Parry *et al.*, 2007), roughly 20–30 percent of vascular plants and higher animals on the globe are estimated to be at an increasingly high risk of extinction as temperatures increase by 2–3 °C above pre-industrial levels. The estimates for tropical forests exceed these global averages. It is very likely that even modest losses in biodiversity would cause consequential changes in ecosystem services (Parry *et al.*, 2007; Seppäla, Buck and Katila, 2009).

As average global temperatures rise, the impacts on habitats and species will depend on many factors, including local topography, changes in ocean currents, wind and rainfall patterns and changing albedo. In addition to variations in the rate and extent of temperature increases at different latitudes, there may be changes in the length and severity of seasons, including decreases in temperature in some areas. Rainfall patterns may likewise be affected in terms of overall annual quantity, seasonal distribution of precipitation and year-by-year regularity. Extreme weather events, such as droughts and floods, are expected to occur more often. In particular, droughts are projected to become more frequent and intense in subtropical and southern temperate forests; this will increase the prevalence of fire and predisposition to pests and pathogens (Seppälä, Buck and Katila, 2009).

Natural ecosystems are not only threatened by climate change. Loss and degradation due to human encroachment, agricultural expansion for crop and rangelands, invasive species, over-harvesting and trade in natural resources (including wildlife), epidemic diseases, fires, and pollution still exceed the current impacts of climate change. It is widely recognized that measures to limit such non-climatic human-induced pressures can help reduce the overall vulnerability of ecosystems to climate change.

Non-timber forest resources, such as fuelwood, charcoal, non-wood forest products and wildlife sustain the livelihoods of hundreds of millions of people in forest-dependent communities. Most rural and many urban populations in developing countries rely on woody biomass as their main energy source and depend on wild plant medicines for their healthcare. In many developing countries, bushmeat is an important source of protein, while for coastal communities or those living near freshwater, fish can be a major source of protein. In Central Africa, there is a very large and well-established trade in bushmeat products, which is driven mainly by consumer demand in major cities. Up to 5 million tonnes of bushmeat are believed to be consumed every year in the Congo Basin (Fa *et al.*, 2002; Kleine, Buck and Eastaugh, 2010; Seppäla, Buck and Katila, 2009) in a trade that is recognized as unsustainable and often illegal. Despite their importance to local communities, about 13 million hectares (ha) of the world's forests are lost due to deforestation each year (FAO, 2010a) and further large areas are also degraded.

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