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Bird Species and Climate Change

This document (version 1.0) is based on a report "Bird Species and Climate Change" prepared by Climate Risk Pty Ltd, international specialists in climate change risk management. For the complete report visit **www.climaterisk.net**.

Climate Risk Europe Limited
London: + 44 20 8144 4510
Manchester: + 44 16 1273 2474

Climate Risk Pty Limited (Australia)
Sydney: + 61 2 8003 4514
Brisbane: + 61 7 3102 4513

Authors
Janice Wormworth BSc MA
Dr Karl Mallon BSc PhD + 61 412 257 521

WWF - Australia
GPO Box 528
Sydney, NSW, Australia 2001
Tel: +612 9281 5515
wwf.org.au
www.panda.org/climate

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Bird Species and Climate Change
A Summary of The Global Status Report

This summary outlines the findings of "Birds Species and Climate Change", a report to WWF by Climate Risk Pty Ltd, which provides a global analysis of current and future impacts of climate change on birds. The report reviews more than 200 research reports to assemble a clear and consistent picture of climatic risk to this important animal group, illustrated with numerous examples and case studies.

The report finds that 1) climate change now affects bird species' behaviour, ranges and population dynamics; 2) some bird species are already experiencing strong negative impacts from climate change; and 3) in future, subject to greenhouse gas emissions levels and climatic response, climate change will put large numbers bird species at risk of extinction, with estimates of extinction rates varying from 2 to 72 per cent[1], depending on the region, climate scenario and potential for birds to shift to new habitat.[i]

1 Why does climate change affect birds?

"Climate change affects ecosystems, habitats and species with increasing velocity and continuity."

Bairlein & Hüppop, 2004

Altered temperature, precipitation and moisture, a generally more variable climate, and more extreme weather are hallmarks of climate change that directly affect birds. Highly sensitive to weather[ii], birds are the quintessential "canaries in the coal mine", and are already responding to current levels of climate change.

In future, climate change will also affect birds indirectly by altering their habitats via sea level rise, changes in fire regimes, and changes in vegetation or land use. For example, Europe's Mediterranean coastal wetlands[iii], critical habitat for migratory birds, could be completely destroyed by the 2080s with 1.5 to 4.2˚C of warming[iv].

2 How birds respond to climate change

"Differential changes among species could easily be disruptive to communities, which in turn would most likely alter the structure and functioning of most, if not all, of the world's ecosystems."

Root and Hughes, 2005

Shifts in timing of important life cycle events, and shifts in ranges, are two major ways that birds and their ecological communities are already displaying a strong response to climate change. Importantly, these responses, in turn, pose further threats and risks of their own to birds.[v]

1. I.e., a 2-3 per cent extinction rate for Mexican bird species under a minimum climate scenario assuming bird species are able to disperse to new, climatically suitable space; and a 49-72 per cent extinction rate for birds in Australia's Wet Tropics bioregion under a maximum climate change scenario, again assuming dispersal is possible (from Thomas *et al.,* 2004).

Climate change could make Canada's largest puffin breeding colony unsuitable for the tufted puffin.

2.1 Shifts in timing

The early warning signs of climate change are already evident in shifts in the timing of important seasonal bird behaviours. Many bird species now arrive in spring breeding grounds earlier, and lay eggs earlier, in response to warming. One analysis of 64 studies on birds and other groups found that birds had advanced timing for such spring phenomenon at an average rate of 6.6 days per decade[v]. In Europe, some birds (which normally migrate) have even stopped migrating altogether.[vi]

These timing shifts threaten birds when important life cycle events fall out of step with plants and insects they interact with or depend upon. These effects are expected to "disrupt the structure and functioning of most, if not all, the world's ecosystems."[v] In Canada's northern Hudson Bay, for example, mosquitoes appear and reach peak numbers earlier in the spring -- an effect thought to be linked to ongoing climate change. However, seabirds breeding there have not adjusted their behaviour, and the combination of heat and mosquitoes is causing higher egg loss and greater adult mortality.[vii]

Long-distance migratory birds face elevated climate change risk

Long-distance migratory birds, already in decline in Europe and North America, are removed from food sources at other parts of their migratory path and cannot predict changes there. Some species are therefore unable to advance their arrival date in spring breeding grounds sufficiently to track availability of their prey, i.e. insects, which may peak earlier due to climatic warming. This exposes long-distance migratory birds to a greater climate change threat than resident birds. In the Netherlands, this mismatch has led to declines of up to 90 per cent in some populations of pied flycatchers over the past two decades. These long-distance migratory birds are nesting more quickly after their spring arrival in Europe. However, because their arrival dates are relatively unchanged, they are unable to nest and breed sufficiently quickly to match nestlings' food demands with peak insect supplies, which now occur earlier. [viii]

Climate change could reduce the arctic breeding range of the Siberian crane by 70%. This long-distance migratory bird is already critically endangered

2.2 Shifting and shrinking ranges

"Rapid movement of climatic zones is going to be another stress on wildlife … In effect we are pushing them off the planet."

James Hansen, NASA Goddard Institute for Space Studies, 2006

Significant evidence now shows that birds, and other animals and plants, are shifting their ranges in response to climate change, with bird species shifting pole-ward, or to higher altitudes in tropical mountains.[ix] In future, the extent of such shifts is expected to be considerable; for example, some European birds are expected to undergo range boundary shifts of more than 1,000 km.[x,2] Crucially, range contractions are expected to be more frequent than range expansions.[iii,x,xi]

2.2.1 Direct effect of range shifts

"… species with low adaptability and/or dispersal capability will be caught by the dilemma of climate-forced range change and low likelihood of finding distant habitats to colonize, ultimately resulting in increased extinction rates"

Walther, 2002

Birds' ability to shift to new, climatically suitable ranges may be complicated by landscapes which are fragmented or rendered unsuitable due to human land use. Furthermore, many centres of species richness for birds are currently located in protected areas, from which birds may be forced by climatic changes into unprotected zones.[iii] Island and mountain birds may simply have nowhere to go, as they are confined to increasingly smaller patches of habitat. In addition, even moderate climate change is expected to cause rates of change that will exceed the ability of many plants and animals to migrate or adapt.[xii]

In the USA, future range shifts from unabated global warming are expected to cause a net decrease in neotropical[3] migrant bird species in every region, including a 30 and 29 per cent net decline in the number of bird species in the eastern Midwest and Great Lakes regions respectively.[xiii]

In Europe, the endangered Spanish imperial eagle, currently found mainly in natural reserves and parks, is expected to lose its entire current range.[x] Furthermore, new climatically suitable areas may not provide sufficient undisturbed and protected areas to support it. The Scottish highland habitat of the capercaillie, the world's largest grouse, is expected to shrink 99 per cent, virtually eliminating UK habitat for this bird by 2050 if a high global warming scenario comes to pass.[xiv]

2.2.2 Indirect effects of range shifts

"… well-balanced bird communities as we know them will likely be torn apart. As species move, they may have to deal with different prey, predators and competitors as well as habitats that are less than ideal."

Terry Root, Stanford University Center for Environmental Science and Policy

As they respond to climate change, birds and the species they interact with are unlikely to shift as intact communities, because each species' response will be unique. This means natural communities will be re-organised or "reshuffled". Birds may come into contact with different prey species, predators, parasites and competitors.[v] These indirect effects of climate change are expected to produce further, still stronger changes of their own.[xvi]

2. Under mid-level global warming of 2.5˚C by 2100.
3. Species which breed in North America but migrate south to the neotropics of Central and South America, southern USA and Mexico.

Major contraction predicted for world's most productive duck habitat

In North America, extreme range contractions are predicted for the Prairie Pothole Region of the Northern Great Plains, where 50-80 per cent of the continent's ducks breed. Even with no precipitation changes, approximately 2.5°C of warming would reduce this habitat by two thirds, cutting the zone's duck numbers by almost three quarters.[xv]

The sizeable extent of such reorganizations is illustrated by a study of an entire ecological community in Mexico, including 1,179 bird species, which predicts greater than 40 per cent turnover in some local ecological communities by 2055, as dozens of species disappear or are displaced by invader species, "suggesting that severe ecological perturbations may result."[xvi]

A Hawaiian example illustrates how such re-organisations pose a threat to birds. High elevation forests there form a refuge for eight endangered species of Hawaiian honeycreeper. In future global warming is expected to make higher elevations hospitable to mosquitos carrying avian malaria, an introduced disease deadly to honeycreepers, and thus drive several of these bird species to extinction. [xvii]

3 What is the scale of climate impacts on birds?

"… the low end of the precipitation range brings the population near reproductive failure. Any change in climate that would increase the frequency of extreme dry conditions would likely endanger populations of these species."

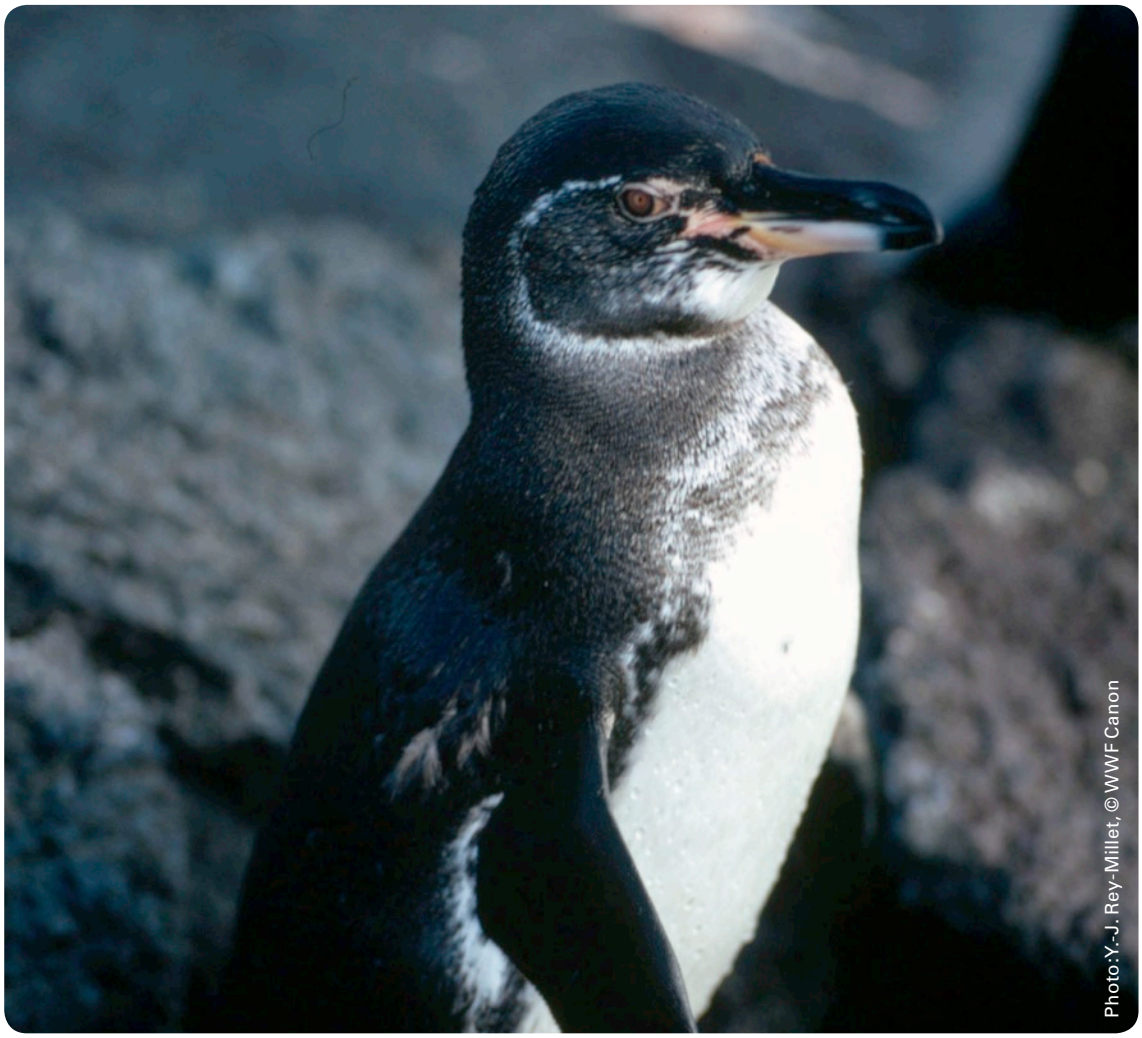
Bolger ***et al.***, 2005

3.1 Climate change threatens bird populations

Local weather and regional climate patterns strongly influence birds' behaviour and survival in both their breeding and non-breeding seasons, and numerous studies link climate change to recent or future declines in bird populations around the globe.

A recent US example highlights the disproportionately large role of climate extremes, to which birds and entire ecosystems are responding particularly rapidly and strongly with climate change. In California, the reproductive success of four arid-land birds declined 97 per cent during a record 2002 drought. With precipitation expected to decrease and become more variable in this region, climate change makes these bird species particularly vulnerable to extinction.[xviii]

In the Galápagos Islands, penguin populations have halved since the early 1970s because the adult penguins become emaciated (sometimes dying) and fail to reproduce during severe El Niño years. More frequent El Niños expected with climate change are predicted to further reduce the already small, restricted populations of these endangered Galápagos penguins and place them on a trajectory toward extinction.[xix] Indeed, this report cites numerous examples of seabirds already showing strong negative responses to climatic change, often in



El Niño events, expected to become more frequent with climate change, result in starvation and reproductive failure of endangered Galápagos penguins

conjunction with major prey shifts in warming ocean waters, highlighting the vulnerability of this bird group to current levels of global warming.

3.2 Climate change threatens birds with extinction

"Extinction rates caused by the complete loss of core environments are likely to be severe, nonlinear, with losses increasing rapidly beyond an increase of 2 °C, and compounded by other climate-related impacts."

Williams ***et al.***, 2003

Extinction is the most severe and final of all climate change consequences for biodiversity. Climate change has already caused the extinction of 70 harlequin frog species[xxi] in Central and South America. In future climate change could threaten bird species even of currently safe conservation status. This extinction threat for birds is still being quantified; however, first-cut estimates for mid-range[4] climate change scenarios indicate greater extinction rates than habitat loss, currently deemed the top threat to biodiversity, and find that climate change is likely to be the greatest threat to many, if not most, ecosystems.[i]

High rates of extinction are expected in north-eastern Australia's Wet Tropics bioregion, where almost three quarters of

4. Global warming of 1.8–2.0 ˚C and CO_2 increases of 500–550 p.p.m.v.

Unprecedented breeding failure of seabirds in the North Sea

In 2004, tens of thousands of long-lived, slow-breeding seabirds nesting in Britain's North Sea coastal breeding colonies failed to raise any young; in some cases starving adult birds ate those chicks that did hatch. This breeding crash has been attributed to food shortages and large-scale changes in North Sea marine ecosystems linked to ocean warming and climate change.[xx]

rainforest birds will become threatened (including 26 species now critically endangered) by mid-range[5] climate change.[xxii] In South Africa, mid-range climate change[6] would result in a 33-40 per cent extinction rate if birds are unable to shift to new habitats of suitable climate.[i]

In Europe, new research also finds a substantial climate change threat to bird diversity[x], with a decline in species richness[7] to 60 per cent of current levels predicted for 426 Europe-breeding birds with 2.5°C of global warming, if birds are unable to shift to new climatically suitable areas.[x]

Worldwide, bird groups particularly vulnerable to climate change include migratory, Arctic, Antarctic, island, wetland, mountain and seabird species. The climate change threat to migratory birds equals the sum of all other human-caused threats combined, with 84 per cent of migratory bird species facing some type of climate change threat.[xxv] Factors that elevate climate change risk to birds include: breeding in arid environments,[xviii] poor dispersal ability, low population numbers or already poor conservation status, restricted or patchy habitat, and limited climatic range. Furthermore, while generalist and invader species may expand their ranges, specialist bird species are expected to continue to decline due to climate change.[x]

4 Conclusion

"Conservationists are entering a new era of conservation, one in which last-ditch stands to save species where they currently exist may not be enough."

Hannah ***et al.***, 2005

Having served as reliable indicators of environmental change for centuries, birds now indicate that global warming has set in motion a powerful chain of effects in ecosystems worldwide. As this report shows, robust evidence demonstrates that climate change is affecting birds' behaviour -- with some migratory birds even failing to migrate at all. Furthermore, new research reveals a trend of escalating impacts that already impairs some birds' ability to reproduce or even survive, findings which indicate that a march toward a major bird extinction may be underway. Looking to the future, the report includes projections of major population declines for many bird species and high rates of extinction in some zones.

However, in the opinion of the authors many current projections of climate impacts, including those of the Intergovernmental Panel on Climate Change, are likely to be

5. 3.6˚C of regional warming.
6. Global warming of 1.8–2.0 ˚C and CO_2 increases of 500–550 p.p.m.v.
7. The number of species within a region.

Australia's golden bowerbird a candidate for extinction

The golden bowerbird, along with many other birds in the Wet Tropics of Australia's northeast, is highly vulnerable to climate change. Its suitable habitat would decrease[8] 63 per cent with less than 1°C of future warming, up to 98 per cent with 2-3°C of warming, and completely disappear with between 3 and 4°C of warming[xxiii], illustrating why this zone's climate scenario has been termed "an impending environmental catastrophe."[xxiv]

underestimates. For example, most analyses have not yet factored in interactions between threats, or the disproportionately large impact of climate extremes, to which birds and entire ecosystems respond particularly rapidly and strongly. As the range of impacts is more fully considered, further research is expected to upgrade estimates of climate change risk to birds.[i,xii, xxvi]

Furthermore, climate change is expected to shift important, species-rich bird communities out of protected areas. If conservation efforts are to meet the climate change threat, a fundamental change in approach to bird conservation is needed to preserve species diversity.

In responding to this report WWF notes that the degree of global warming is the most fundamental variable that will determine future impacts on birds. This depends on 1) the sensitivity of the climate to current and future greenhouse gas concentrations and 2) the extent and speed of greenhouse gas emissions increases or reductions. The impact of climate change on bird species is already evident, and more is inevitable given the unavoidable global warming already "locked in" to the climate system. However, the more extreme scenarios of bird species extinction cited in this report could be prevented by policy that leads to stringent climate protection targets, and reductions in greenhouse emissions sufficient to keep the global mean temperature increase to less than 2.0 °C above pre-industrial levels.

8. Assuming a 10% decrease in rainfall.

Dependent on prey scavenged from sea ice, ivory gulls have already declined 90% over the past two decades in Canada, and face an uncertain future in the warming Arctic

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Climate Risk Europe Limited
London: + 44 20 8144 4510
Manchester: + 44 16 1273 2474

Climate Risk Pty Limited (Australia)
Sydney: + 61 2 8003 4514
Brisbane: + 61 7 3102 4513

Authors
Janice Wormworth BSc MA
Dr Karl Mallon BSc PhD

World Wide Fund for Nature Australia
GPO Box 528
Sydney, NSW, Australia 2001
Tel: +612 9281 5515
wwf.org.au
www.panda.org/climate

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