Climate Change & Species

What does climate change mean for the planet's most iconic animals?

10 case studies A report for Earth Hour and WWF International

Author : Dr Tammie Matson

WWF

60 EARTH HOUR

Dr Tammie Matson: tmatson@wwf.org.au

We thank the following reviewers:

Sue Lieberman, Ray Nias, Wendy Elliott, Liz McLellan, Lesley Hughes, Geoff York, Juan Casavelos, Gilly Llewellyn, Nick Heath, Ove Hoegh-Guldberg, Bivash Pandav, Noah Sitati, Colby Loucks, Sejal Worah & Sybille Klenzendorf .

March 2009

Executive Summary

Could you ever imagine a world where elephants are no longer roaming on the Africa savannah, where orang-utans are only found in captivity or where a polar bear running along ice caps can only be seen in film archives?

Such a world is more likely than you might think.

WWF has commissioned this assessment of the likely impacts that climate change will have on some of the world's best-known species, drawing on the latest scientific literature.

It makes for unsettling reading: ninety five per cent of the Great Barrier Reef corals gone by 2050, seventy five percent of Antarctic's Adelie penguins could disappear by 2050, polar bears wiped out entirely before the end of the century.

Surely this is not a future that any of us can accept. Individuals, companies and governments must do everything in their power to address the issue of climate change and mitigate the impacts on the biodiversity and rich natural habitats upon which we all depend.

Earth Hour is an opportunity for everyone to voice their concern about climate change. On 28 March, more than one billion people around the world are expected to turn out their lights for one hour – Earth Hour – to send a signal to decision-makers that they want to see action on climate change.

It is not too late to stop the tide of extinction, but we must act quickly. With the United Nations negotiations on climate change culminating in Copenhagen this December, 2009 is a critical year for setting the world on a new course – one that safeguards these species and our planet.

Visit **www.panda.org** to learn more about what WWF is doing for the conservation of these species and their habitats, and how you can help.

Visit **www.earthhour.org** to find out how you can take part in Earth Hour and change the future. It's as easy as flicking a switch.

James Leape,
Director General, WWF International.

Table of Contents

For species like orang-utans, tigers and whales, which have been at risk of extinction for decades, due to over-exploitation by humans and habitat loss, climate change threatens to put the final nail in the coffin.

Introduction

The impact of climate change is placing enormous pressure on the earth's most fragile ecosystems pushing many of the earth's animals and plants perilously close to extinction. Scientific modelling and analyses predict it will cause catastrophic losses of species across the planet.

In this century, global warming is expected to be one of the greatest drivers of species extinction, particularly for those species that have already declined due to other human-caused factors.

A recent study published in the journal Nature (2004) projected that at least a quarter of land animals and plants will be driven to extinction by 2050 if greenhouse gas emissions are not drastically reduced. The Intergovernmental Panel on Climate Change's (IPCC's) fourth assessment report Climate Change 2007 predicts an even worse outcome; it states that 20-30% of species are likely to be at high risk of extinction with global warming of 1.5-2.5ºC.

The IPCC report predicts global rises in temperature of 1.1-6.4ºC by the end of the century based on current rates of greenhouse gas emissions. Even if global emissions were to suddenly drop to zero, the earth will be 0.4ºC hotter by 2050 regardless.

Few species will be immune to the effects of global warming, but some are particularly at risk such as those in areas of higher than average warming (polar regions), those that cannot adapt and those whose populations are already too small to cope with rapid changes. A recent report by the International Union for Conservation of Nature (IUCN) suggests that up to 35% of birds, 52% of amphibians and 71% of reef-building corals have traits that are likely to make them particularly susceptible to climate change.

For species like orang-utans, tigers and whales, which have been at risk of extinction for decades, due to over-exploitation by humans and habitat loss, climate change threatens to put the final nail in the coffin. Threats like the widespread loss and fragmentation of habitat, illegal hunting and trade, and uncontrolled, unsustainable human development have already drastically depleted many species' populations worldwide. Six of the seven species of marine turtles are threatened or endangered, and one-third of Australia and New Guinea's kangaroo and wallaby species are at risk of extinction. In combination with the existing threats, global warming will push some species over the edge unless drastic measures are taken now.

Predicting the effects of global warming is not an exact science. It relies on a combination of bioclimatic modelling and ecological knowledge. Bioclimatic modelling allows scientists to predict the potential impacts of climate change on the natural distribution of species. For many species it is unknown how – or if – they will adapt to climate change. Some adapt easily to their environment, while others are have very specific needs. For species like orang-utans in Indonesia or Malaysia and African elephants, food shortages as a result of changed rainfall patterns may be one of the first signs of climate change. In the dwindling Indonesian forests where orang-utans live, the frequency and intensity of flooding and wild fires are predicted to increase in wet and dry seasons respectively, changing the life cycles of their food plants and nesting trees and reducing food supply. Coupled with widespread logging of their habitats and illegal hunting and capture of orang-utans, the combination could be the final blow. In sub-Saharan Africa, extreme weather events such as droughts are predicted to become more frequent and intense. Some climate projections suggest that 20% of the protected areas in which African elephants live may no longer be suitable for them by 2080, including possibly national parks like Kruger.

For other species the effects of climate change are already being felt as their environments respond to global warming. Populations of polar bears and Emperor penguins at the north and south poles respectively are beginning to decline due to the loss of vital sea ice, which is essential for their survival. The loss of sea ice edges, which provide important foraging grounds for many whale species, is reducing the krill populations on which many species rely for food. Other important food sources for whales such as squid may be affected by rising levels of ocean acidity as a result of global warming. Some coral reefs have almost been destroyed by the bleaching events caused by global warming in the latter part of last century, and such events are predicted to grow more severe and frequent in the future.

In Australia, warmer temperatures on Macquarie Island have fostered favourable conditions for non-native feral rabbits and rats, which are destroying the nesting sites of rare Albatross. On some beaches in northern Australia and in Latin America, marine turtles are producing more female hatchlings than male. It suggests global warming is already affecting this species as sex determination for marine turtles is based on nest temperature. In the Sunderbans of India and Bangladesh, which contain the only population of tigers living in mangrove swamps, the sea level is rising rapidly, threatening to engulf the limited amount of tiger habitat that is left on land.

A changing climate will change the geography and in some cases, biology of certain species, so existing measures put in place to conserve them may no longer be enough. For example, higher temperatures may force some species to move outside of protected areas established specifically for them. Climate change will also change human behaviours. Sea level rises and the need for alternative fuel sources will increase competition for land, placing greater pressures on the habitats of some species.
It is not too late to turn the tide of extinction around, but there is no time to waste. If we want to share our future with tigers, turtles and polar bears, urgent action is needed to reduce greenhouse gas emissions globally. Simultaneously, steps must be taken to increase the resilience of ecosystems to climate change by reducing all other threats to species, allowing them to adapt to the changes in their habitats. The future of the world's most charismatic species are in our hands. Inaction is not an option.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour - Earth Hour. WWF's lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.

CASE STUDY 1:

Polar Bears

01

Species, Status & Threats

The polar bear is an icon of the Arctic wilderness and a symbol of the catastrophic impact that global warming is having on the world. The long term survival of polar bears in the wild is now literally ‘on thin ice’. There are approximately 20,000-25,000 polar bears in the wild today, with the majority in Canada (13 out of 19 subpopulations). Six of these subpopulations are declining or showing critical signs of decline.

Both male and female polar bears can live for 25-30 years, primarily preying on ringed and bearded seals. The seasonal movements of polar bears depends on the availability of sea ice. Sea ice is essential for polar bear survival because it acts as a platform for hunting, mating and resting, and reproduction. During spring and early summer, polar bears feed intensively on seals to build up their energy for the long, dark Arctic winter.

Polar bears often travel huge distances throughout the year and the greatest threat to their survival is the loss of their sea ice habitat due to climate change. With increases in air temperatures over the Arctic of up to 5ºC in the last 100 years, the fundamental habitat of this top predator is rapidly disappearing. Between 1979 and 2006, Arctic sea ice decreased by 21%, an area roughly the size of Alaska. In May 2008, the United States Fish & Wildlife Service recognised the future threat from predicted habitat loss, and listed the polar bear as a threatened species on the US Endangered Species Act, due to the probability that “all or a significant proportion of the global population will become endangered in the foreseeable future”.

Polar bears are also threatened by the offshore expansion of industrial activities like oil and gas development and commercial shipping, unsustainable harvest, and the loss of their prey base, seals, as a result of sea ice loss.

The Impact of Climate Change

A recent study by the United States Geological Survey projected that at current levels of sea ice reduction, 42% of summer polar bear habitat will be lost by the middle of the 21st century. The most severe impacts will be in spring and summer, which are the most crucial times for polar bears to secure food and mate in advance of the long winter. Approximately two-thirds of the world’s remaining polar bears could be lost based on these projections of changes in sea ice. Unless drastic steps are taken now to reduce greenhouse gas emissions and ease the impact of warming worldwide, the polar bear could be gone in 75 years.

One of the major impacts of global warming in the Arctic is the thinning and early break up of sea ice. In the Hudson and Baffin Bay areas of Canada, sea ice is breaking up three weeks earlier than in 1979. This gives both male and female polar bears less time in spring to build up their body weight by hunting and feeding. The average body weight of lone adult females fell from 290kg in 1980 to 230kg in 2004. The critical weight at which females appear to no longer be able to reproduce is 189kg. If the reduction in body weight continues at the same rate, females will be unable to reproduce by 2012.

Polar bear cub survival is also negatively affected by the earlier break up of sea ice. With changes in sea ice, important denning areas for pregnant females may no longer be available. Changes in rainfall patterns may cause the roofs of dens to fall in before females and cubs have departed, exposing them to the elements and predators. Denning and feeding areas for females may be separated, with vulnerable cubs unable to survive in the freezing water that divides them.

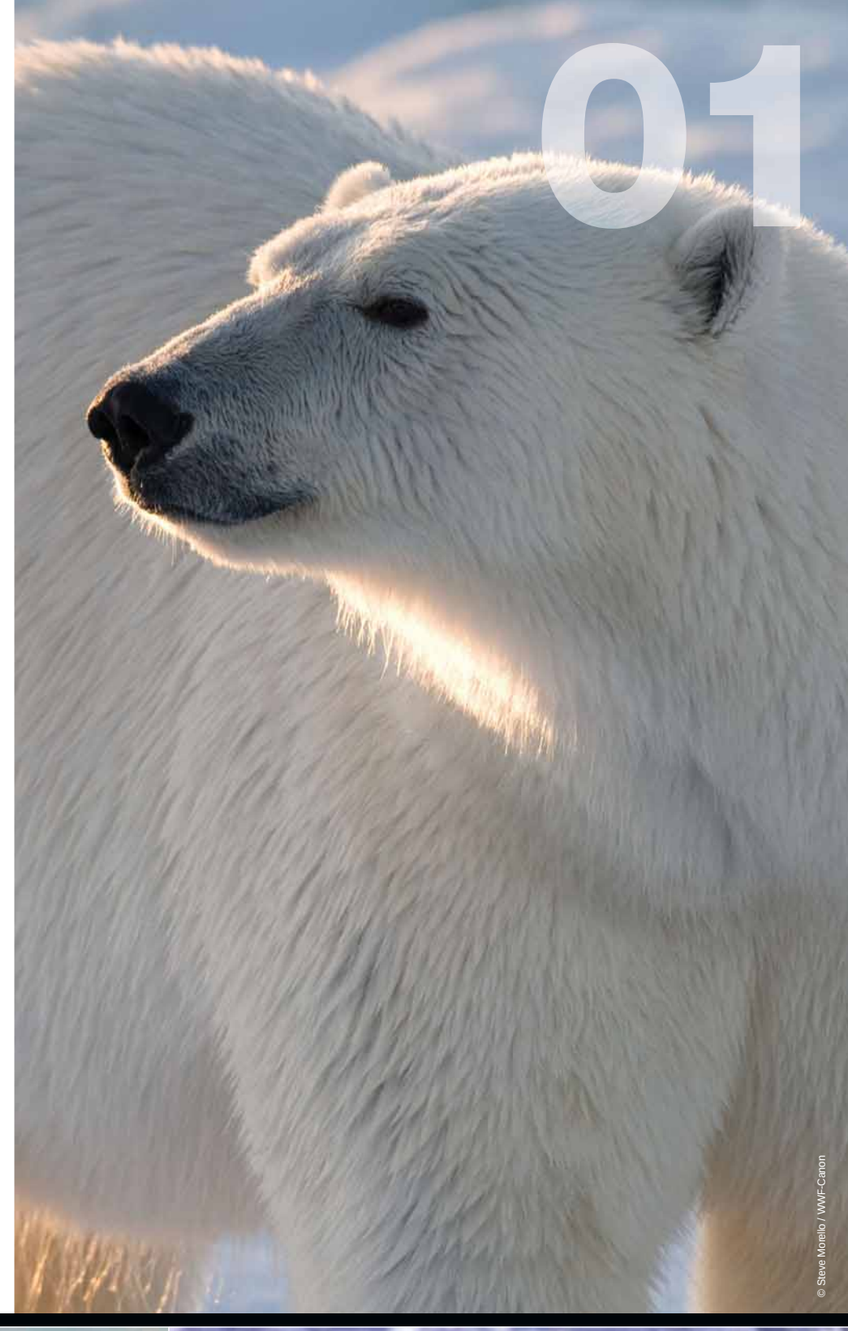
Like polar bears, the life cycle of their main prey species, seals, is heavily dependent on sea ice. As sea ice levels fall, ringed seals will find it harder to reproduce and their populations will almost certainly diminish. Fewer seals means less food for polar bears, and in the Arctic, there are no similarly abundant sources of high calorie prey.

Polar bears are highly specialised and have adapted to their polar environment, making them extremely vulnerable to changes in climate and habitat loss. With dramatic loss of habitat and the effect this has on their physical condition and ability to reproduce, some populations are already declining and more are predicted to follow over time.

What can be done?

Governments, corporations, communities, and individuals have a huge role to play in saving the polar bear from extinction by reducing greenhouse gas emissions while working to reduce all the other threats to polar bears and their Arctic habitat. Polar bears are not simply an Arctic icon, but they truly integrate and represent the health of this critical ecosystem. As a key regulator of the global climate, a living Arctic is important not only to polar bears, but to people worldwide. The plight of this majestic creature is an early warning and call to action for the changes that await us all if we fail to act now in reducing greenhouse gases and creating sustainable communities. WWF is working to increase resilience for the Arctic by protecting critical habitats, promote sustainable use, and reducing the threats from increased human activities across this priority region.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF’s lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.



IMPACT OF CLIMATE CHANGE

- **42% loss of habitat and two-thirds loss of population by mid 21st century**
- **Total extinction within 75 years**

60 EARTH HOUR

WWF

CASE STUDY 2:

Tigers of the Sunderbans

02

Species, Status & Threats

In the last 100 years, tiger numbers have declined by 95% to only an estimated 4,000 remaining in the wild. Three subspecies have become extinct and four have not been seen in the wild for over 25 years. The Bengal tiger is one of five living subspecies of tiger and, with a population of approximately 1,400, it is the most numerous of the subspecies.

Most Bengal tigers are found in the forests and grasslands of India, but they also exist in Bangladesh, Bhutan, Myanmar and Nepal. At the delta of the Ganga and Brahmaputra Rivers, the Sunderbans landscape is the largest mangrove forest in the world and a UNESCO World Heritage site. Straddling two countries, India and Bangladesh, it is the only mangrove forest where tigers are found. Sanskrit for 'beautiful forest', the Sunderbans is home to about 400 tigers, ranging across 10,000 km^2 of ecologically rich swamps and marshes dotted with islands.

Tigers have been hunted for over 1,000 years, and until the 1930s, this was the biggest threat to their survival. Although tigers are now legally protected, they are still hunted for the illegal trade in tiger body parts such as skin and bone, which are prized in traditional medicine and for clothing. Tiger populations have also diminished because of major reductions in their habitat and its fragmentation. Tigers need large areas to survive and many of the remaining pockets of habitat are too small or fragmented to hold viable numbers of tigers and their prey.

Linked to the destruction of their forest habitats, declines in their prey species such as wild ungulates, compound the pressures on the last of the world's tiger populations. Reductions in wild prey and habitat are thought to contribute to increases in conflict between humans and tigers, with tigers being forced out of increasingly smaller and smaller natural habitats and into contact with people and domestic livestock.

The Impact of Climate Change

It is not known yet how all of the world's tiger subspecies will be affected by climate change but it is likely that tigers in the Sunderbans landscape may already feeling its effects through rising sea levels. As sea levels rise, the threat of submergence is a very real threat to the islands of the Sunderbans and this could spell disaster not only for the tigers, but for all of the region's diverse animal and plant life forms, including threatened species like Gangetic sharks, estuarine and marine turtles, and fishing cats. Recent studies suggest that within fifty years more than 70% of the Sunderbans tiger habitat may be lost due to rising seas. If this occurs, the remaining habitat may not be sufficient to maintain a viable tiger population.

The Sunderbans ecosystem is extremely fragile and sensitive to changes in salt levels. Due to sea level rise as a result of global climate change, some mangroves are becoming exposed to salt water, which may lead to drastic and negative changes in plant life over time. If the habitat changes and becomes more open, tigers may be an easier target for poachers. Conflict between humans and tigers also appears to be on the rise in the Sunderbans, with dozens of human deaths due to tiger attacks occurring every year. As tiger habitat diminishes, swallowed up by the sea, tigers could be forced to come into contact with people more often, increasing the likelihood of human-tiger conflict in the future—with tragic consequences for both people and tigers.

What can be done?

WWF is working within 13 priority landscapes, in 11 countries on the recovery of wild tigers, to restore and connect tiger habitats, strengthen anti-poaching efforts, reduce human-tiger conflict, halt the trade in tiger body parts and build the capacity of local people to conserve tigers. In the Sunderbans, conservationists are working to combat the potential impacts of sea level rise on tigers and their habitat by restoring degraded mangrove habitats to compensate for losses due to sea level rises, reducing the dependency of people on the forests, controlling poaching of tiger prey through education and capacity building, and reducing human killings by tigers. WWF is calling on everyone to get involved and reduce greenhouse gas emissions to ensure that the dangerous threshold of 2°C of warming is not reached.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF's lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.

IMPACT OF CLIMATE CHANGE

- More than 70% of habitat lost in 50 years
- Increases in human-tiger conflict

EARTH HOUR

CASE STUDY 3:

Reef-building Corals

Species, Status & Threats

Coral reefs are among the most diverse ecosystems on earth. Colonies of corals consist of many tiny animals called 'polyps', each of which secretes a skeleton of limestone-like material around itself, dividing and growing throughout their lives, building the framework of coral reefs. As well as supporting millions of other species, coral reefs contribute US$30 billion annually to the world's economy (UNEP 2008). The real contribution of reefs to human communities may be even higher; some estimates place their value in terms of ecological and economic services at US$375 billion. This is because coral reefs protect tropical islands, provide income, food and employment through the fishing and tourism industries, as well as numerous flow on benefits to the economies of many countries.

Coral reefs occur in deep, cold water environments (3-14ºC) such as the Norwegian fjords, and in the shallow, warm waters (21-30ºC) of tropical seas, such as around islands of the South Pacific. Cold water coral communities are solitary and live in complete darkness, in highly productive, nutrient-rich waters and rely on dead plant and animal matter and zooplankton to survive. Trawling and sea bottom-dredging are a serious threat to cold water coral reefs.

Warm water corals live symbiotically with tiny algae that photosynthesise and provide the polyp with their daily energy needs. Corals and their symbiotic algae are also highly sensitive to changes in salt levels, sea surface temperatures, UV radiation and nutrient levels. Pollutants from coastal land practices, over-fishing, over-harvesting, and marine-based pollution are major threats to tropical coral reefs. If they are not reduced, these influences alone are predicted to destroy 50% of the Great Barrier Reef in the next 30-50 years.

The Impact of Climate Change

The effects of climate change are already being felt by the world's coral reefs. Coral bleaching is a sign of stress that occurs when the thermal threshold of corals is exceeded and the symbiotic algae (zooxanthellae) on which corals depend are expelled. The death of corals due to bleaching is one of the most devastating effects of global warming so far.

In 1998, 16% of the world's reef-building coral died in a massive coral bleaching event. Almost half of the corals in the West Indian Ocean were heavily affected. In Kenya, the Maldives, Tanzania and the Arabian Gulf, loss of shallow corals reached 95%. It is expected that at current levels of warming the 1998 coral bleaching event will become a regular event in fifty years time. UNEP (2008) suggests that more than 80% of the world's coral reefs may die in a matter of decades as a result of climate change. The impact of this would be not only the devastating loss of the corals, but the elimination of many other species that rely on them for survival, along with significant harm to local communities, , who would suffer great livelihood losses (such as from fishing and ecotourism), along with threats to food supply.

While there are signs of recovery from the 1998 bleaching event in some reefs (e.g. the apparent resilience of some coral populations to bleaching in the Arabian Gulf), recovery has been poor in many other places (e.g. Western Indian Ocean, parts of the Philippines and Indonesia), partly because of ongoing human impacts, such as over-fishing. If we fail to curb climate change and its effects on the world's oceans, it is projected that only 5% of Australia's Great Barrier Reef corals will remain by 2050.

Another severe impact of global warming on coral reefs may result from rising levels of carbon dioxide and the resulting increase in ocean acidity. Corals are already experiencing the impacts of ocean acidification, due to its impact on their ability to form their calcareous skeletons. As the calcium carbonate concentration of sea water drops, so does the ability of reefs to build and regenerate. The Great Barrier Reef is already beginning to experience skeletal weakening due to a steady drop in calcification in the last twenty years. Corals on the Great Barrier Reef are growing at rates that are 15% less than they were prior to 1990.

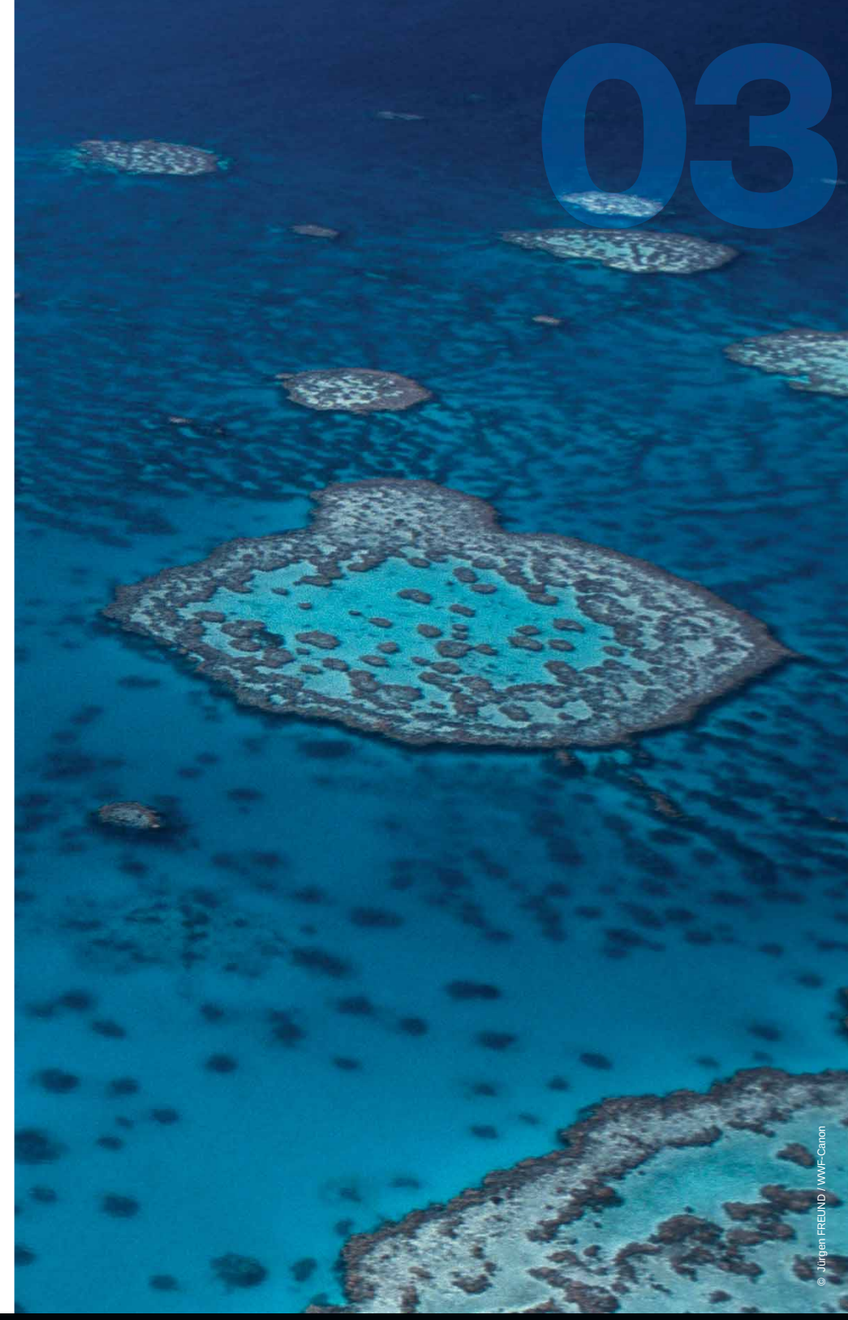
Coral diseases and outbreaks of destructive species like the Crown of Thorns Starfish may increase due to climate change. Pollution and over-fishing of the species that control invasive species could make the problem worse.

What can be done?

It is not too late to save the world's coral reefs, but there is no time to waste because the effects of global warming are already being felt. WWF is working to ensure that warming is kept less than 2ºC above pre-industrial times by calling for massive cuts in CO_2 emissions, while also working in many places across the globe on all the other threats to coral reefs and coral reef species.

To buy time for coral reefs, WWF is working with decision makers to build the ecological resilience of coral reefs through reductions in pollution, improvements in fishing practices and the establishment of comprehensive, adequate and representative marine protected areas networks. WWF convinced the Australian government to invest $375 million in measures to ease pollution, yet over-fishing continues to threaten many reef species. WWF is working to conserve the Coral Sea, which adjoins the Great Barrier Reef, and also the Coral Triangle, which spans Malaysia, Indonesia, the Philippines, Papua New Guinea, the Solomon Islands, Fiji and Northern Australia and is home to 75% of the world's coral species. These bold initiatives will assist coral reefs in surviving climate change while we urgently seek rapid reductions in CO_2 emissions over the next decade.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF's lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.



IMPACT OF CLIMATE CHANGE

- **In 1998, 16% of the world's corals died**
- **Mass coral deaths will happen regularly by 2060**
- **80% of the world's corals may die within decades**

60 EARTH HOUR

WWF

CASE STUDY 4:

Kangaroos

04

Species, Status & Threats

Kangaroos belong to the superfamily *Macropodoidea*, also known as the macropods, meaning ‘long foot’ in Greek. As well as the kangaroos, the macropods include wallabies, pademelons, tree kangaroos and rat kangaroos. Macropods range in size from the tiny musky rat kangaroo, weighing just half a kilogram, to the giant red kangaroo, which can weigh up to 100 kilograms.

At the time of European settlement in Australia there were 83 species of macropods; since then nine have become extinct and 28 are listed as threatened. Some species, like the grey kangaroo, are common, but many of the smaller species, such at the rufous hare wallaby, are at great risk of extinction. The key drivers of decline are the widespread loss of habitat, predation, altered fire regimes, and competition with introduced species like European cats and foxes. Climate change is likely to make many of these threats worse and it is unlikely that most kangaroo species will be able to adapt, either by genetic or geographic change.

Most of the extinctions of macropods have occurred in what is known as the ‘critical weight range’ (35-5,500 grams) because they are most vulnerable to invasive predators. Many of the rock wallabies, rat kangaroos, tree kangaroos and hare wallabies remain at great risk of sharing the same fate as extinct species like the crescent nailtail wallaby and the toolache wallaby.

In New Guinea, eleven of the 12 species of native tree kangaroos are classified as threatened, and four are listed as critically endangered, largely due to human hunting.

The Impact of Climate Change

Climate change in Australia is predicted to result in more extreme weather events such as hotter, longer droughts, more intense floods and more devastating tropical cyclones. The number and intensity of late, hot, dry season fires may increase and the amount of water and its seasonal availability in some regions may change. For macropods, the consequences of these changes are many and varied.

Hotter temperatures, plus less predictable rainfall, could cause waterholes to dry up and pastures to become depleted, causing starvation and dehydration of less mobile macropods. Just 2°C of warming could trigger serious changes to seasonal rainfall patterns to which the life histories of many macropod species are closely tied. Recent bioclimatic modelling projects that the habitat of the antilopine wallaby, which is adapted to wet tropical conditions, may decrease by 89% with 2°C warming, bringing it alarmingly close to extinction. Even for relatively mobile species like the red kangaroo and common wallaroo are predicted to experience significant large-scale range contractions with 2°C of warming.

For threatened species that are already living in much reduced, fragmented habitats, global warming is likely to cause marked declines in populations. Some of these species, like the endangered bridled nailtail wallaby, will be highly vulnerable to climate change. The bridled nailtail wallaby is restricted to a small population in central Queensland but it is unable to move south due to the presence of non-native foxes. Tree kangaroos in far North Queensland are restricted to cool, mountain-top habitats and increasing temperatures may push them further up into the mountains, as well as reducing the overall amount of suitable habitat available to them. Tree kangaroos are also quite susceptible to cyclones because of their heavy reliance on specific home ranges. With more intense cyclones, in New Guinea, the loss of dense foliage could increase their vulnerability to hunters.

Bioclimatic modelling suggests that with just a 0.5°C increase in temperature, the habitats of some species like the banded hare wallaby and the black-footed rock wallaby in Southwest Australia may become climatically unsuitable. These species already have a narrow, restricted distribution and limited room to move, so climatic changes could be catastrophic for their small, fragmented populations.

Increases in the frequency and intensity of fires could spell disaster for Australia’s potoroos, which are dependent on a variety of truffle species for food. Frequent burning has been shown to reduce the diversity of truffles and this could have serious consequences for potoroos.

Foxes and feral cats are partly to blame for the extinctions of 22 Australian mammal species. Extreme events like droughts and floods as a result of climate change are likely to provide favourable conditions for further expansion of non-native, invasive species in Australia and New Guinea. Small Australian mammals like the mountain pygmy possum are at greater risk of being killed by foxes and the growing number of rabbits on Macquarie Island can be attributed to climate change.

What can be done?

Reducing the impact of climate change by cutting emissions is a vital step towards building ecological resilience in Australia and New Guinea’s threatened kangaroos. WWF Australia is working with community groups and decision makers to manage introduced species, protect and connect adequate macropod habitat and build the capacity of Indigenous people to manage fire. In New Guinea, WWF is working to conserve the forests where tree kangaroos live, working with communities to put in place moratoriums on hunting and promoting alternative food sources to native species.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF’s lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.

IMPACT OF CLIMATE CHANGE

- **Up to 89% loss of habitat for some species**
- **Increased vulnerability to non-native predators**

60 EARTH HOUR

WWF

CASE STUDY 5:

Whales & Dolphins

Species, Status & Threats

There are 86 species of whales, dolphins and porpoises worldwide, which make up the group collectively known as cetaceans. Despite decades of legal protection, nine of the 15 great whale species remain threatened with extinction, as are an additional 22 species or subspecies of dolphins and porpoises.

Until the international ban on commercial whaling in 1986, some species were brought to the edge of extinction. Some, such as the North Atlantic Right Whale, and the Antarctic blue whale, have not yet recovered. In the Antarctic alone, more than two million whales were killed by commercial whalers. Today, the international moratorium on whaling has not entirely stopped the killing of whales, with Japan conducting so-called 'scientific whaling', and Norway and Iceland whaling under an 'objection' to the moratorium.

Throughout their geographic range cetaceans continue to face great threats to their survival, including over-hunting, entanglement in fishing gear (bycatch), chemical and noise pollution, habitat loss, ship strikes and overfishing. Tragically, nearly 1,000 cetaceans are killed as bycatch every day, in excess of 300,000 per year. The world's most endangered cetacean, the Yangtze River Dolphin may become the next species to go extinct and indeed may already be gone, largely due to bycatch and degradation of its habitat. In freshwater habitats, river dolphins and porpoises face severe threats to their survival, including pollution, dam building and other human developments in their already heavily fragmented habitats.

The Impact of Climate Change

As the oceans warm, many cetacean species are likely to try and shift to more suitable habitat. Species that have adapted to living in polar conditions may decline, and for many, moving to a new habitat will not be possible. For example, the critically endangered vaquita is restricted to the warm waters at the northern end of the Gulf of California in Mexico, and is unable to move into cooler habitat. River dolphins, with their very limited geographic ranges, are likely to be negatively affected.

Crucial sea ice habitats at the poles are shrinking rapidly as a result of global warming. Since the 1970s, Arctic sea ice has decreased by 14% and projections suggest that by 2040 there will be almost no sea ice in the Arctic basin in summer. A loss of sea ice habitats may be particularly detrimental to Arctic cetaceans that depend on them, like narwhals, beluga whales and bowhead. Changes to sea ice patterns may also increase incidences of 'entrapments', when holes in the ice which form critical breathing holes for cetaceans change location or close up completely. A recent entrapment event in Baffin Bay, Canada led to the death of over 500 narwhals.

Reductions in Arctic sea ice will make some areas accessible for human developments and activities that were not possible before, such as the Northwest Passage. This is likely to increase the impacts of ship strikes, commercial fishing activities and pollution on whales.

In the Antarctic, IPCC models project that sea ice over the Southern Ocean will decline on average by 10-15% by 2042, when they predict 2°C global warming at current emissions levels. In some areas, sea ice loss could be up to 30%. Cetaceans such as the Antarctic minke whale, which are highly dependent on feeding habitats on the sea ice edge, are likely to be impacted. In addition, the reduced sea ice edge is likely to cause crowding for species such as humpback and killer whales and increased competition for food and space with other species, like seals. Crowding may also increase the susceptibility of cetaceans to disease.

In the Antarctic, ocean fronts are particularly important habitats for many species as they contain seasonal feasts of nutrients, phytoplankton and krill. In a warmer climate, these fronts will likely move south, meaning that whales such as humpbacks may have to increase the distances that they migrate. Longer migrations will not only have a higher energy cost for these whales, some of which have already travelled thousands of kilometres, but will also leave them with less time to forage for food.

The loss of sea ice in the Antarctic is predicted to reduce krill populations, which many whales rely on almost exclusively for food. The blue whale may be particularly vulnerable to krill shortages, due to its already fragile status. This species has not recovered from whaling activities of the last century, and currently numbers around 1,700 animals in the Antarctic, compared to an estimated 239,000 before commercial whaling.

With increasing levels of carbon dioxide in the atmosphere, more is absorbed by the oceans, leading to acidification. Whales such as beaked and sperm whales may be particularly affected by climate-induced oceanic acidification because of its influence on their key prey, squid.

What can be done?

As well as reducing emissions to keep global warming below the dangerous 2°C threshold, there are other things we can do to help reduce the impact of global warming on whales. WWF is working with partners to reduce all other threats to cetaceans, including protecting adequate amounts of marine and freshwater habitat, and taking steps to limit all other threats to whales, especially bycatch.
Due to the uncertainty surrounding the impacts of climate change on these species, WWF is working to ensure management of the species most threatened is precautionary, flexible, and adaptable.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF's lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.

IMPACT OF CLIMATE CHANGE

- 14% loss of sea ice habitat since 1970
- Virtually no summer Arctic sea ice by 2040
- Food source losses for critically endangered species

60 EARTH HOUR

WWF

CASE STUDY 6:

Penguins

Species, Status & Threats

Penguins are true flightless birds that inhabit cold climates in the southern hemisphere, as far north as the Galapagos Islands and the subtropical coasts of South Africa, Australia and South America. The vast majority of the world's penguins, however, live around Antarctica and the sub-Antarctic islands. Four species, the Emperor, Adelie, Chinstrap and Gentoo penguins, breed on the Antarctic continent. Of these, Emperor and Adelie penguins are 'ice-obligates' in that they rely on habitat that has pack ice for a significant part of the year.

Of the 19 species of penguins, 11 are threatened with extinction. Penguins are an integral part of the Antarctic food chain. They feed on krill, small crustaceans, squid and fish and provide food for species like killer whales and seals. Penguin chicks and eggs are also eaten by the gull-like skuas. Adult penguins have no natural enemies on land and as a result, they have no natural fear of humans.

The largest and perhaps the hardiest of the penguins is the Emperor penguin, which weighs up to 40 kg and stands up to 1.15 m tall. Emperor penguins breed throughout the long, dark winter, withstanding temperatures as low as minus 49ºC. Like all penguins, they have a thick layer of fat and waterproof plumage to protect them from the freezing temperatures. Female Emperor penguins make epic journeys of up to 200 km across the ice to lay a single egg, before leaving the egg with their mate and returning to the ocean to feed. Thick, land-locked sea ice and cold temperatures are essential for this journey and for the survival of penguin chicks.

Adelie penguins live close to sea ice all their lives, but depend on ice-and snow-free land to breed. This species has very particular requirements for breeding as it depends on having accessible open water within pack ice during winter and early spring to reproduce successfully. As a result, only a very small percentage of the Antarctic continent is suitable for them to breed. This makes them highly susceptible to the effects of climate change.

The Impact of Climate Change

Sea ice covers 6% of the world's oceans and has a major impact on the planet's atmosphere, oceans and polar ecosystems. It is highly sensitive to changes in climate. In the West Antarctic Peninsula, sea ice covers 40% less area than it did 26 years ago. At the poles, the IPCC has found that air temperatures are warming at twice the global rate.

With global warming, pack ice is disappearing from the Antarctic at twice the average global rate of warming. For the two species of ice-dependent penguins the consequences are likely to be devastating. With warming of 2ºC, colonies of 50% of the Antarctic's Emperor penguins and 75% of Adelie penguins are predicted to decline markedly or disappear.

The Emperor penguin is extremely vulnerable to climate change because of its heavy dependence on pack ice. Warmer winter temperatures are leading to thinner ice and some populations of Emperor penguins are already showing signs of decline. Unlike Adelie penguins, which may be able to move to find new nesting sites, Emperor penguins will have difficulty finding suitable sites to raise their young because they depend on having ice of adequate thickness.

Adelie penguins nest on ice-free and snow-free terrain that is close to open water. Higher snowfall as a result of global warming in the Antarctic Peninsula is thought to be making it harder for some colonies of Adelie penguins to make or find their nests. Later snowfall may allow other species that are better adapted to warmer conditions, like Gentoo and Chinstrap penguins, to move in, displacing Adelies from nesting areas, placing further pressure on their populations.

Many penguins are also struggling to find food because as the sea ice shrinks so too does the abundance of their primary prey source, krill. Some Chinstrap penguin colonies have shown population declines of 30-66% over the last 26 years, which is attributed to food scarcity.

Penguins are adapted to the cold, extreme conditions of Antarctica, an environment that is changing rapidly by the day and warming even more rapidly than the global average. With a 2ºC increase in global temperature, and diminishing sea ice in the Antarctic, many penguins now face a serious battle for survival.

What can be done?

WWF is urging governments, corporations and individuals to reach an agreement to make strong reductions in greenhouse gas emissions. The aim is to maintain the temperature below that of the projected 2ºC of warming by 2042 in order to avoid catastrophic consequences for penguins and other Antarctic wildlife. In the Southern Ocean, WWF is working to address all other threats to the Antarctic ecosystem, including the introduction of a network of marine protected areas, covering at least 10% of the Southern Ocean's 20 million km2.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF's lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.

IMPACT OF CLIMATE CHANGE

- **75% population loss of Antarctica's Adelie penguin colonies**
- **Up to 66% population reduction in some colonies since 1983**
- **Increased scarcity of food sources and nesting sites**

EARTH HOUR

CASE STUDY 7:

Marine Turtles

07

Species, Status & Threats

There are seven living species of marine turtles, five of which are listed by the International Union for Conservation of Nature (IUCN) as either endangered or critically endangered. The hawksbill, Kemp's ridley and leatherback marine turtles are recognised as critically endangered.

Female turtles do not breed every year and it takes up to decades for females to reach an age at which they can reproduce. Mating occurs in waters near the shore while nests are laid on tropical, subtropical or warm-temperate beaches. There is minimal parental care but several clutches are laid per nesting season, with up to 50-200 eggs per clutch. Hatchlings usually emerge at night when temperatures are cooler, using the moon and other cues as guides to find the water. Although many young are produced, mortality is high, with many predators taking hatchlings before they even reach the ocean.

Today the chances of a turtle living to a grand old age, or even sexual maturity, are slim. They are harvested for their eggs, shells, skin and body fat for both domestic and international markets (all international commercial trade is illegal, as are domestic trade and harvest in most countries). Hundreds of thousands of marine turtles are killed annually as incidental capture by fisheries (bycatch), by being caught on long line fishing hooks and in trawling nets. Crucial nesting and feeding habitats are being destroyed by uncontrolled coastal development. Lights from roads and buildings near nesting beaches can disorient hatchlings and lead them away from the ocean, resulting in death by dehydration or predation. Feeding grounds are being damaged by over-fishing, sedimentation and reef and seagrass destruction. Invasive predators like foxes, pigs, and dogs prevent turtle offspring from ever having a chance to hatch from their eggs. The threats are massive, compounded by the fact that these highly migratory species have different habitat and other requirements on the land, near the shore, and on the high seas.

The Impact of Climate Change

Marine turtles have been swimming in the world's oceans for over 100 million years and have coped with changing climatic conditions in the past, but never at the scale and rate of change we are seeing today. However, with populations that are already rapidly declining, and most species now perilously close to extinction due to human impacts, climate change could be the last straw.

Fundamentally this is because all stages of marine turtles' life histories are profoundly affected by temperature. The sex of marine turtles is determined by the incubation temperature of eggs hatching within the beach sand. As higher temperatures lead to female hatchlings and lower temperatures lead to more males, warm dark sand produces more females and lighter, cooler sand gives rise to more males. Small increases in temperature due to global warming may skew the sex ratio of hatchlings in favour of females. Many nesting beaches already have a strong female bias.

Extremes of temperature are a significant source of mortality in several marine turtle species. Low hatchling success has been linked to temperatures exceeding the maximum for successful embryonic development, leading to heat stress and embryo mortality or the production of smaller or debilitated hatchlings. Marine turtle eggs usually require incubation temperatures of 25-32°C. Some nesting beaches now have temperatures above 34°C, which is often lethal. Some well-studied marine turtle beaches in the Great Barrier Reef have recorded sand temperatures at nesting depth of up to 36°C during summer.

Higher sea surface temperatures due to climate change have caused a loss of important foraging grounds for marine turtles through coral bleaching and seagrass burning. Increased storm severity may destroy critical nesting beaches, damaging nesting sites and eggs. Increased flooding from storms can lead to loss of critical seagrass and nesting habitats, and has been implicated in reduced growth and breeding rates of green turtles in parts of Queensland. Sea level rises from global warming could further erode turtle nesting beaches. Changes in ocean currents could alter turtles' feeding patterns and migration paths. An increased number of turtles have been recently recorded in the United Kingdom and loggerhead turtles appear to be nesting earlier in the season in response to warming in Florida, USA.

Hawksbills turtles, for example, retain a strong connection to the nest site where they hatched – after breeding, an adult female, 20-25 years after hatching, returns for the first time to the very beach she was hatched on to lay her eggs. If she can survive all the other threats, what awaits today's hawksbill hatchling female 20 years from now when she returns to her natal beach?

What can be done?

WWF is working to reduce all the various threats to marine turtle survival today, to increase the chance of more generations surviving and eventually adapting to changed conditions. Protecting and managing critical nesting beaches is essential, including retaining natural coastal vegetation and beach structure. Reducing mortality from the impacts of bycatch, over-harvesting, illegal trade, and inappropriate coastal development will also help save marine turtles for future generations. Every effort must be made now to reduce greenhouse gas emissions. For threatened species like marine turtles, two degrees is too much.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF's lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.

IMPACT OF CLIMATE CHANGE

- **Skewed gender ratio of hatchlings**
- **Increased rates of hatchling mortality**
- **Loss of food sources and nesting sites**

60 EARTH HOUR

WWF

CASE STUDY 8:

Orang-utans

Species, Status & Threats

Asia's 'red man of the forest' was once widely distributed from southern China, through the Himalayan foothills to the island of Java, Indonesia. Today, less than 80,000 orang-utans survive in the wild, the two species confined to the disappearing forests of the islands of Borneo and Sumatra. In the last ten years, the population of orang-utans has declined by 30-50%. At this rate, Asia's only great ape could be lost from the wild within decades.

Much of the lowland forests in which orang-utans live have been cleared and what is left is disappearing at an unprecedented rate. Almost half of Sumatra's forests have been cleared since 1985. Widespread forest clearing for palm oil, timber, paper and pulp, and the planting of rubber and pulp plantations, combined with fires set to aid clearing, is destroying the last of the orang-utan's habitat. Tragically, because they are slow moving, it is thought that many orang-utans die in the flames of forest fires.

Where orang-utans live is determined by the availability of food, good quality habitat and mates. Orang-utans are closely tied to their environment and their diet includes over a thousand plant species. They are largely frugivorous (fruit-eating), although they also consume leaves, liana (woody vines), bark and small invertebrates. They are arboreal (live in trees) and rely on the forest to provide suitable nesting trees. Orang-utans are slow to reproduce; females produce a single infant only once every 6 to 9 years. As well as being dependent on the forest for their survival, orang-utans also play an important role in the ecological balance of the forests by dispersing seeds.

Another serious threat to orang-utans is illegal hunting and trade. Orang-utans are killed in conflicts with farmers, mainly during forest fires, or captured for the entertainment or pet trade. In Kalimantan, some local tribes hunt orang-utans for subsistence. All international and most domestic trade is illegal, however surveys by TRAFFIC - a joint programme between WWF and IUCN - indicate that around 200-500 orang-utans from Kalimantan are traded annually. Most of these are very young individuals, and given that for each individual animal observed in trade, at least one other has died (its mother) this represents a significant loss to the wild population. The opening up of the forest through logging, oil palm plantations and other roads is allowing easier access for hunters to kill and capture orang-utans.

The Impact of Climate Change

Climate change poses yet another grave threat to the future survival of orang-utans in Indonesia affecting rainfall and fire in wet and dry seasons respectively. With global warming, higher rainfall is projected to occur in the majority of Indonesian islands, which may cause flooding and landslides. By 2025, climate models suggest that annual rainfall will increase by 70%. As well as the direct negative impact on the forest, higher rainfall is anticipated to change the growth patterns and reproductive cycles of the plants which orang-utans eat. This may reduce the amount of food that is available to them. Food limitations are likely to impact the ability of females to reproduce.

Forest fires during the dry season are expected to increase in severity with global warming. This is already having a serious impact on orang-utan populations. In 1997, severe forest fires resulted in 12% of the forest cover being lost in the Indonesian state of Kalimantan. It is believed that 1,000 of the 40,000 orang-utans in the population died as a result. The combination of logging and fires not only destroys their habitat and food sources, it may also affect their movement and foraging patterns.

Ironically, while climate change is predicted to cause further habitat degradation for orang-utans, the production of CO_2 from the forest logging and fires is itself a major contributor to global warming. In Sumatra's Riau province, fires combined with clearing of forests and peat swamps release as much carbon into the atmosphere as 122% of the Netherlands' annual emissions.

It's not just orang-utans that are at risk from climate change; the IPCC states that 50% of Asia's biodiversity is at risk due to global warming. Indonesia's forests also harbour many other species, including Asian elephants, Sumatran rhinoceroses and Malayan sun bears, and 16% of all of the world's reptile and amphibian species.

What can be done?

WWF is working to reduce deforestation in Sumatra and Borneo (both Malaysia and Indonesia), both to benefit orang-utans directly and to reduce carbon emissions from forest loss. WWF is working with decision makers in Indonesia to create effective strategies to adapt to climate change and reduce the nation's overall greenhouse gas emissions. In Danau Sentarum and Betung Kerihun National Park, West Kalimantan, WWF is working to integrate orang-utan conservation with climate change adaptation and mitigation.

WWF works in collaboration with government and others non-government organisations, including TRAFFIC, to stop the illegal trade in orang-utans. The Orang-utan Conservation Strategy and Action Plan, developed in 2007 by the Indonesian government and non-government organisations, including WWF, aims to stabilise orang-utan populations and their habitat by 2017.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF's lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.

IMPACT OF CLIMATE CHANGE

- **Higher death rates from increased forest fire severity**
- **Reductions in habitat and food sources**
- **Food shortages as a result of increased rainfall**

60 EARTH HOUR

WWF

CASE STUDY 9:

African Elephants

Species, Status & Threats

Two sub-species of elephants have been recognised in Africa: the savannah (or bush) elephant and the forest elephant. Elephants play an important keystone role in African ecosystems. In some West African forests, up to 30% of trees may require elephants to disperse and germinate their seeds. They have a great influence on forest and woodland structure, by creating gaps and more open habitats that are suitable for other species.

Elephants once roamed most of the African continent, from the Mediterranean coast to the tip of South Africa. But in the 20th Century the planet's largest living land mammal declined significantly in parts of its geographic range due to legal and illegal hunting for ivory. Major declines in particular have taken place in West and Central Africa, and parts of East Africa. Since the global ban on the ivory trade was agreed in 1989, through the Convention on International Trade in Endangered Species (CITES), African elephants have increased or remained stable in parts of their range, especially in southern and eastern Africa. But many populations, especially in West and Central Africa, remain at great risk. The demand for elephant ivory and meat has continued, driven by unregulated domestic markets in parts of Africa and Asia, and illegal trade. Habitat deterioration and loss, particularly from unsustainable logging practices, continue to threaten many small, fragmented populations, especially for forest elephants of West and Central Africa.

The human population of Africa almost doubled between 1980 and 2005 from 480 to 905 million, increasing competition with elephants for natural resources. With the total population of elephants now between 470,000 and 690,000, human-elephant conflict is on the rise. Approximately 80% of occupied elephant habitat lies outside protected areas.

The Impact of Climate Change

Climate change predictions for the future by the IPCC suggest that Africa is more vulnerable to climate change than any other human-inhabited continent, with major implications for Africa's biodiversity, including elephants. By 2080, the IPCC's fourth assessment report predicts a 5-8% increase in arid and semi-arid lands in Africa. More severe and frequent periods of droughts and floods are likely under global warming scenarios.

Some climate projections suggest that parts of West and southern Africa may experience an increase in drought-tolerant, deciduous trees and grasses at the expense of evergreen trees. Increases in fire frequency due to climate change may influence the habitats of elephants as fires reduce food availability. Changes in vegetation will influence water run off and stream flow, impacting on ecosystem structure and function, affecting wildlife distributions and putting additional pressure on water resources.

Elephants are highly adaptable, but the extent of their capacity to adapt to climate change as their environment changes is unknown. Furthermore, human agriculture and settlements will likely block potential movement into more suitable habitats in many cases. The migrations of elephants are tied to seasonal changes in rainfall and vegetation. Climate change is likely to affect these seasonal movements, but it may also affect overall population distribution. It is possible that climate change may affect the current distributions of a variety of African species, including elephants, in several important conservation areas, including the iconic Kruger National Park. Some climatic models suggest that elephant populations will experience a contraction of suitable range by 2080, moving southwards from their range in central Africa. These models project that 20% of the protected areas in which elephants currently occur may be climatically unsuitable for them by 2080.

Some scientists predict that overall prevalence of elephants may be reduced by global warming (a 14% reduction according to projections by Palmer, 2008). Food and water availability is significantly reduced during severe droughts and this has a major negative effect on elephant mortality, especially of calves, which could mean lower reproductive success among elephant populations.

Africa's human population will also be significantly impacted by climate change because 70% of the population is dependent on rain-fed agriculture.

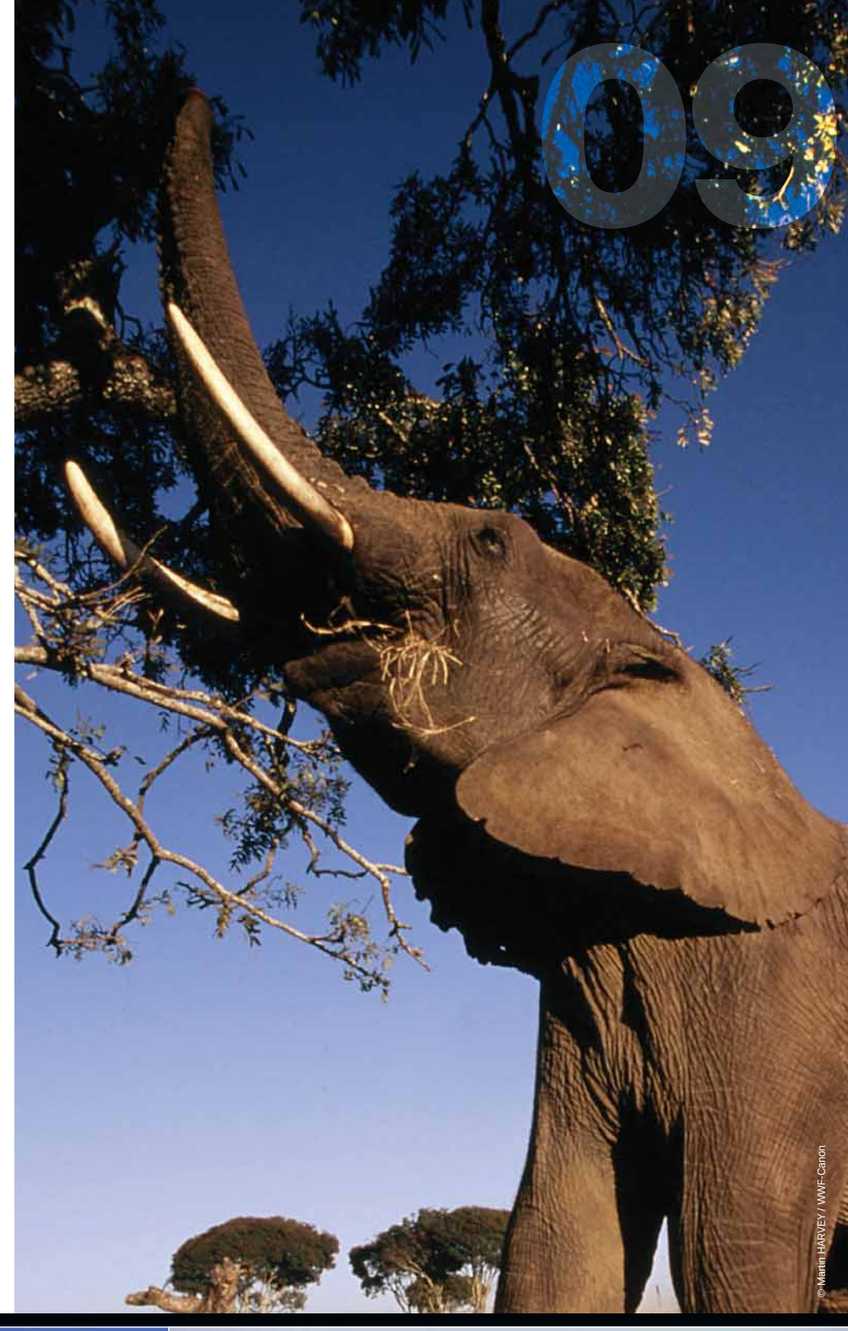
The IPCC predicts that in some African countries rain-fed agriculture will decrease by 50% as early as 2020, exposing millions of people to water stress. Reduced food and water availability under global change scenarios is likely to lead to more competition between people and wildlife, including elephants, for scarce natural resources – particularly land and water. This may result in higher levels of human-elephant conflict, as has been observed in the TransMara of Kenya during drought years or increased poaching for meat.

What can be done?

WWF has field programmes in West, Central, East and Southern Africa. In order for elephant populations to adapt to climate change, they need room to move. Since such a large proportion of elephants live outside formal protected areas, land-use planning that takes into account human and elephant needs, both now and in the future, is absolutely essential.

One mechanism for allowing space in landscapes is Transfrontier Conservation Areas (TFCAs), which provide corridors for elephants to roam across country borders and mechanisms for people to benefit from their presence. WWF is part of international, collaborative efforts to develop TFCAs across Africa, assisting governments and local communities with land use planning designed to accommodate both peoples' and wildlife's needs.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF's lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.



IMPACT OF CLIMATE CHANGE

- **Reductions in food and water sources**
- **20% loss of current protected habitat by 2080**
- **Calf survival reduced by droughts**

60 EARTH HOUR

WWF

CASE STUDY 10:

Albatross

10

Species, Status & Threats

Albatross are majestic, long-lived oceanic birds that travel enormous distances over the world's oceans. They are the largest seabirds, with some species having a wing-span up to 3.5 metres, but also the world's most threatened seabird family. Of the 22 species of albatross worldwide, 18 are threatened, and some, such as the Macquarie Island wandering albatross and the Amsterdam albatross have such small populations that extinction may be imminent.

Albatross spend more than 95% of their time flying across the world's oceans in search of prey, only returning to land to breed. Albatross mate for life and are slow breeders, producing only one egg at a time. In the Southern Ocean nesting usually occurs on small, remote islands such as Macquarie Island, Heard Island, McDonald Island, Campbell Island, the Crozets, Albatross Island, Pedra Branca and the Mewstone.

Albatross were once shot at sea for the amusement of 19th century sailors and their feathers sold. Now albatross are threatened by a whole range of human activities, particularly long-line, squid and driftnet fisheries. Their natural prey is squid and fish, both of which are commonly used as bait in long-line fishing. Incidental bycatch of seabirds in the longline fishing industry is a major threat to albatross as they can be caught on hooks, become entangled, or eat discarded plastic and other marine debris. While the fishing industry has made significant improvements in reducing this threat, illegal, unregulated and unreported fishing remains the cause of thousands of albatross deaths every year.

On Macquarie Island, a crucial breeding site for four threatened albatross species, a new threat has emerged in recent years. Invasive species such as rats are preying on albatross chicks and rabbits are destroying nesting habitats, causing widespread damage to the albatross' habitats and reducing reproductive success.

The Impact of Climate Change

With already reduced populations, climate change is likely to make things even worse for the world's albatross, especially those species with restricted geographic ranges. In fact, birds are a good indicator of climate change as their life cycles often rely on weather and climatic conditions. This is especially true of birds that migrate or that travel long distances while looking for food, such as the albatross. While no one knows for sure what the impact of climate change will be on albatross and how they will adapt, some worrying trends are apparent.

Albatross that breed at a single location are the most at risk from climate change as their populations are not buffered against environmental change. Six of Australia's albatross species breed on only one or two geographically close islands. Albatross are extremely faithful to breeding sites and unlikely to breed elsewhere. At this time there is not enough research to indicate how these species will fare, or how the vegetation of these islands will respond to climate change. It appears that warmer temperatures are already fostering improved conditions for invasive species like rats and rabbits at nesting sites on islands like Macquarie, adding further to pressures on these small populations.

Air temperatures over the Southern Ocean have been increasing steadily since the 1960s, and this has coincided with a decrease in the abundance of the wandering and black-browed albatross. Warmer waters are more nutrient poor than cooler waters and the success of sea bird feeding has been correlated with instances where a high degree of mixing between colder, deeper, nutrient rich water and warmer, nutrient poor surface water occurs. In 2002, there were unusually high sea surface temperatures, associated with reductions in food availability. Many chicks died as a result.

The prevalence of storms is also an important consideration; adults may literally be blown off their nests, or, as happened in November 1994 to a Chatham Island albatross population, and eggs may be damaged or destroyed.

Since 1970, the climate has become warmer and drier at all sites where the northern wandering albatross breeds in New Zealand. This may be stressful for the adults as they rear chicks because they can not leave the nest and risk heat exhaustion. Hot conditions also promote the growth and reproduction of blowflies, which attack and kill chicks. As breeding grounds are adversely affected, for example by storms eroding habitat, albatross may be forced to compete for less space and higher densities could in turn lead to an increase in blowfly attack and parasite outbreaks.

What can be done?

The conservation of albatross requires the co-operation of many countries because of their vast migratory routes. In the face of climate change the best outcome for albatross is to build population resilience by ameliorating all other threats, as well as reducing overall greenhouse gas emissions to ensure that the critical threshold of 2°C warming is not reached.

The Agreement on the Conservation of Albatross and Petrels (ACAP) is an international convention that protects all albatross species. It provides a focus for international cooperation and exchange of information and expertise towards the conservation of these declining seabirds. ACAP's goals include control of non-native animals on breeding islands, implementing measures to reduce bycatch and protecting breeding habitat.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF's lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.


© Rowan Trabbol / WWF-Canon

IMPACT OF CLIMATE CHANGE

- **Increased vulnerability to invasive species**
- **Reduction in breeding sites**
- **Increased instances of hatchling mortality**

60 EARTH HOUR

WWF


© Fritz POLKING / WWF


© James FRANKHAM / WWF-Canon


© Sylvia RUBLI / WWF-Canon

Conclusion

It is almost impossible to imagine a world without penguins, coral reefs, marine turtles and polar bears. Thirty years ago, no one could have imagined a global threat so great that it would threaten life on earth as we know it.

But that is the reality of climate change. It is here and now. The planet is warming, climate patterns and seasons are changing and ecosystems and species are already forced to adapt. Unless we act now, global temperatures will surpass the 2°C dangerous threshold at which many more species will become threatened or perish in less than an average human life span.

Species at the poles are particularly at risk because the rate of warming is much higher than the global average, and because there is no 'colder' habitat for those species to move into as the poles warm. At current rates of temperature increase, by the middle of the 21st Century, almost half of polar bear summer habitats are predicted to be lost. The thinning and earlier break up of sea ice in the Arctic is believed to be reducing the body weights of female polar bears and by 2012 the average body weight may be too low for them to reproduce. With 2°C of warming, thinning sea ice in the Antarctic is predicted to cause the loss of 75% of Emperor penguin colonies and 50% of Adelie penguin colonies. Albatross, the most endangered group of birds worldwide, depend on sub-Antarctic islands in the Southern Ocean to breed and nest and are highly susceptible to climate change. In places like Macquarie Island, warmer temperatures are now fostering improved conditions for rabbits and rats, devastating Albatross' nesting sites.

Marine environments are already showing impacts of climate change, for example in the mass coral bleaching event of 1998 that killed 16% of the world's corals and devastated many more. UNEP (2008) suggests that more than 80% of the world's corals could be extinct in a matter of decades. Marine turtles, which are already at risk of extinction due to numerous threats throughout their geographic range, are showing signs of impacts due to global warming. At some nesting beaches, a female-biased trend is already evident, and if temperatures continue to increase this is likely to cause massive losses of offspring due to heat stress and dehydration – this on top of other threats, including the loss of foraging and nesting habitats due to climate change as well.

Among terrestrial species, changes in rainfall and temperatures are predicted to have severe impacts on their habitats, which in many cases are already limited and extremely degraded. Increases of just 0.5°C are predicted to make the habitats of some of Australia's small mammal species climatically unsuitable, including the black-footed rock wallaby and banded hare wallaby, due to their already highly restricted ranges. A 2°C increase in temperature is predicted to cause the extinction of the Antilopine wallaby, which is adapted to wet, tropical conditions, and other kangaroo and wallaby species are predicted to have less suitable habitat available. With global warming on the two islands where orang-utans remain in Indonesia, rainfall is predicted to increase in the wet season and fires in the dry season, causing significant losses in food for orang-utans. In the Sunderbans of India and Bangladesh, where approximately 400 of the world's dwindling Bengal tiger population live in mangrove swamps, sea levels are rising at 4mm per year. Already, almost a third of tiger habitat has disappeared, including two islands. With a drier, less predictable climate in sub-Saharan Africa, suitable habitat for elephants is predicted to contract and by 2080 they may no longer occur in some of the places they exist today.

WWF is working with communities, governments, other NGOs and companies all around the world to reduce the threats to species and their habitats. But the future of wildlife, like the tigers of the Sunderbans and the polar bears of the Arctic, really depends on a global collective effort. We are all connected to the problem of climate change because we are all energy users. That is why we must all play a part in reducing global greenhouse gas emissions and become part of the solution. If we don't, it won't only be only our species that pays the price – it will also be all of the amazing creatures with whom we share the planet.

2009 is a crucial year for climate change in the lead up to the United Nations Climate Change Conference in Copenhagen, Denmark. Global leaders will be deciding on a new global deal that will replace the Kyoto Protocol and define the approach to dealing with global climate change in the future. You can help by reducing your own carbon footprint and making your voice heard by participating in Earth Hour on 28 March 2009. Visit **www.earthhour.org** to find out how.

At 8.30pm on 28 March 2009, governments, corporations and individuals from all corners of the world will turn off their lights for one hour – Earth Hour. WWF's lights out initiative aims to create a platform upon which the citizens of the world can unite in a single voice and vote for action on climate change. Casting a vote is as easy as flicking a switch.

REFERENCES

General

- Hulme, P. E. 2005. Adapting to climate change: is there scope for ecological management in the face of a global threat? Journal of Applied Ecology 41: 784-794.
- Thomas, C. D. et al. 2004. Extinction risk from climate change. Nature 427: 145-148.
- Saving the world's natural wonders from climate change. WWF briefing paper. 2007. WWF International. Gland, Switzerland.
- Williams, S. E., Shoo, L. P., Isaac, J. L., Hoffman, A. A. & Langham, G. 2008. Towards an integrated framework for assessing the vulnerability of species to climate change. PLOS Biology 6 (12): e325.

www.panda.org

www.panda.org/species

www.iucn.org

http://iucn.org/about/work/programmes/species/about_ssc/

http://www.iucn.org/about/work/initiatives/climate_news/_/climate_change_and_species/index.cfm

http://www.panda.org/about_wwf/what_we_do/climate_change/problems/global_warming/

Polar Bears

- Amstrup, S. C., Marcot, B. G. & Douglas, D. C. 2007. Forecasting the Range-wide status of polar bears at selected times in the 21st century. United States
- Geological Survey Science Strategy to support U. S. Fish & Wildlife Service Polar bear listing decision. U. S. G. S., Virginia, United States.
- Norris, S., Rosentrater, L. & Eid, P. M. 2002. Polar bears at risk: a WWF status report. Gland, Switzerland.
- O'Neill, S. J., Osborn, T. J., Hulme, M., Lorenzoni, I. and Watkinson, A. R. 2008. Using expert knowledge to assess uncertainties in future polar bear populations under climate change. Journal of Applied Ecology 45: 1649-1659.
- Polar bear conservation fact sheet. WWF U. S. October, 2008.
- Serreze, M. C., Holland, M. M. & Stroeve, J. 2007. Perspectives on the Arctic's shrinking sea ice cover. Science 315: 1533.
- Stirling, I. & Derocher, A. 2007. Melting under pressure: the real scoop on climate change and polar bears. The Wildlife Professional. Pp. 24-27 & 43.
- Wiig, O., Aars, J. & Born, E. W. 2008. Effects of climate change on polar bears. Science Progress 91(2): 151-173.
- WWF Polar bear conservation: securing a future for the icon of the north. October, 2008. WWF U. S.

http://www.panda.org/about_wwf/where_we_work/europe/what_we_do/arctic/area/species/polarbear/

http://www.panda.org/about_wwf/where_we_work/europe/what_we_do/arctic/area/

Tigers

- Dinerstein, E. et. al. 2007. The fate of wild tigers. Bioscience 57 (6): 508-514.
- Elliott, W. Solving conflicts between Asian big cats and humans: A portfolio of conservation action. WWF International. Gland, Switzerland.
- Kathiresan, K. & Rajendran, N. 2003. Conservation of mangrove ecosystems in India. Seshaiyana 11 (1): 1-4.
- WWF Tiger fact sheet: Revered around the world, but persecuted throughout its range. 2008. WWF International. Gland, Switzerland.
- Colby Loucks, unpublished data, WWF US

http://www.panda.org/about_wwf/where_we_work/asia_pacific/our_programmes/tiger_programme/wwf_strategy/priority_landscapes/sunderbans/

http://www.panda.org/about_wwf/what_we_do/climate_change/problems/impacts/species/

http://www.panda.org/about_wwf/what_we_do/species/about_species/species_factsheets/tigers/

Reef-building Corals

- Coral reef investigations in Abu Dhabi and Eastern Qatar. Final report January 2005 – December 2007. WWF & Emirates Wildlife Society. Dubai, United Arab Emirates.
- Hoegh-Guldberg, O. & Hoegh-Guldberg, H. 2008. The implications of climate change for Australia's Great Barrier Reef: People and industries at risk. WWF Australia. Brisbane, Queensland.
- Hoegh-Guldberg, O., Mumby, P.J., Hooten, A. J., Steneck, R.S., Greenfield, P., Gomez, E., Harvell D. R, Sale, P.F., Edwards, A.J., Caldeira, K., Knowlton, N., Eakin, C. M., Iglesias-Prieto, R., Muthiga, N., Bradbury, R.H., Dubi, A., and Hatziolos, M. E., (2007) Coral Reefs under Rapid Climate Change and Ocean Acidification. Science 318: 1737-1742
- Nellemann, C. Hain, S. & Alder, J. 2008. In dead water: Merging of climate change with pollution, over-harvest and infestations in the world's fishing grounds. UNEP, Norway.
- Riegl, B. 2003. Climate change and coral reefs: different effects in two high-latitude areas (Arabian Gulf, South Africa). Coral Reefs 22: 433-446.
- Wilkinson, C. 2004. Status of coral reefs of the world. Australian Institute of Marine Science. Townsville, Australia.

http://www.panda.org/about_wwf/where_we_work/asia_pacific/publications/index.cfm?uNewsID=106580

http://wwf.org.au/ourwork/oceans/gbr/

http://www.panda.org/about_wwf/what_we_do/climate_change/problems/impacts/coral_reefs/

Kangaroos

- Low, T. 2008. Climate change and invasive species. A review of interactions (November 2006 Workshop report). Commonwealth of Australia. Canberra, Australia.
- Matson, T. 2008. Australian species and climate change. WWF Australia. Sydney, Australia. Hughes, L. (ed.).
- http://wwf.org.au/publications/australian-species-and-climate-change-report/
- Ritchie, E.G. & Bolitho, E.E. (2008). Australia's Savanna Herbivores: Bioclimatic Distributions and an Assessment of the Potential Impact of Regional Climate Change. Physiol. Biochem. Zool., 81: 880-890.

http://wwf.org.au/ourwork/climatechange/

http://wwf.org.au/publications/kangaroos-and-wallabies-fact-sheet/

Whales & Dolphins

- Cetaceans fact sheet. 2006. WWF International Gland, Switzerland.
- Elliott, W. & Simmonds, M. 2007. Whales in hot water? The impact of a changing climate on whales, dolphins and porpoises: A call for action. WWF International. Gland, Switzerland/ WDCS. Chippenham, United Kingdom.
- Elliott, W. & Tin, T. 2008. Ice breaker: Pushing the boundaries for whales. WWF International. Gland, Switzerland/Fundacion Vida Silvestre Argentina.
- Tynan, C., and Russell, J. 2008. Assessing the impacts of future 2ºC global warming on Southern Ocean cetaceans. International Whaling Commission Scientific Committee paper SC/60/E3.

www.panda.org/species

http://www.panda.org/about_wwf/what_we_do/species/about_species/species_factsheets/cetaceans/

Penguins

- Ainley, D., Russell, J., Jenouvrier, S. 2008. The fate of Antarctic penguins when earth's tropospheric temperature reaches 2º above pre-industrial levels. WWF.
- Antarctic penguins and climate change. Real leaders tackle climate change. 2007. WWF International pamphlet.

http://www.panda.org/index.cfm?uNewsID=119060

http://www.panda.org/about_wwf/where_we_work/asia_pacific/where/thailand/publications/index.cfm?uNewsID=147341

http://www.panda.org/about_wwf/what_we_do/climate_change/problems/global_warming/scientific_proof/ipcc_report/polarregions.cfm

http://www.panda.org/about_wwf/where_we_work/project/projects/index.cfm?uProjectID=AU0083

Marine Turtles

- Broderick, A.C., Godley, B.J., and Hays, G.C. (2001) Metabolic heating and the prediction of sex ratios for green turtles *(Chelonia mydas)*. Physiological and Biochemical Zoology 74: 161-170.
- Case, M. 2008. The impacts of climate change on hawksbill turtles. WWF US.
- Chaloupka, M., Kamezaki, N. & Limpus, C. 2008. Is climate change affecting the population dynamics of the endangered Pacific loggerhead turtle? Journal of Experimental Marine Biology and Ecology 356: 136-143.
- Cronin, L (2001) *Australian Reptiles and Amphibians*. Envirobook, NSW Australia.
- Davenport, J. (1997) Temperature and the life-history strategies of sea turtles. Journal of Thermal Biology 22: 479-488.
- Glen, F. & Mrosovsky, N. (2004) Antigua revisited: the impact of climate change on sand and nest temperatures at a hawksbill turtle *(Eretmochelys imbricata)* nesting beach. Global Change Biology, 10, 2036-2045.
- Glen F, Broderick, A.C., Godley, B.J., and Hays, G.C. (2003) Incubation environment affects phenotype of naturally incubated green turtle hatchlings. J. Mar. Biol. Ass. U.K 83: 1183-1186.
- Hawkes, L.A., Broderick, A.C., Godfreyz, M.H and Godley, B.J. (2007) Investigating the potential impacts of climate change on a marine turtle population. Global Change Biology 13: 1-10.
- Hawkes, L. 2007. Hawksbill turtles and climate change: Developing an approach for adaptation to climate change in the Insular Carribean. WWF & the MacArthur Foundation. Florida, USA.
- Hays, G.C., Broderick, A.C., Glen, F., and Godley, J. (2003) Climate change and sea turtles: a 150-year reconstruction of incubation temperatures at a major marine turtle rookery. Global Change Biology 9: 642-646.
- Hobday AJ, Okey TA, Poloczanska ES, Kunz TJ, Richardson AJ. (2006) CSIRO Marine and Atmospheric Research, report Impacts of Climate Change on Australian Marine Life to the Australian Greenhouse Office, Department of the Environment and Heritage. http://www.greenhouse.gov.au/impacts/publications/marinelife.html
- Hughes L (2000) Biological consequences of global warming: is the signal already apparent? Trends in Ecology and Evolution15: 56–61.
- Kaplan, I.C (2005) A risk assessment for Pacific leatherback turtles (1). Can J Fish Aquat Sci 62: 1710–1719.
- Marine turtles factsheet: Ancient mariners threatened with extinction. 2006. WWF International. Gland, Switzerland.
- United Nations Environment Programme (UNEP) and Secretariat of the Conservation of Migratory Species of Wild Animals (CMS) (2006) Migratory Species and Climate Change: Impacts of a Changing Environment on Wild Animals.
- Weishampel, J.F., Bagley, D.A., and Ehrhart, L.M. (2004) Earlier nesting by loggerhead sea turtles following sea surface warming. Global Change Biology 10: 1424-1427.
- Whiting, S.D., Long, J.L., Hadden, K.M., Lauder, D.K., and Koch, A.U. (2007) Insights into size, seasonality and biology of a nesting population for the Olive Ridley turtle in northern Australia. Wildlife Research 34: 200-210.
- Yntema CL, Mrosovsky N (1982) Critical periods and pivotal temperatures for sexual differentiation in loggerhead turtles. Canadian Journal of Zoology 60: 1012–1016.

http://www.panda.org/species

http://www.panda.org/about_wwf/what_we_do/species/about_species/species_factsheets/marine_turtles/marine_turtles_threats/

http://www.panda.org/about_wwf/where_we_work/latin_america_and_caribbean/our_solutions/marine_turtle_programme/news/?uNewsID=19554

http://www.panda.org/about_wwf/where_we_work/latin_america_and_caribbean/our_solutions/marine_turtle_programme/projects/climate_turtles/

http://www.panda.org/about_wwf/where_we_work/latin_america_and_caribbean/index.cfm?uNewsID=131301

http://www.iucn.org

http://www.iucn-mtsg.org/

Orang-utans

- Case, M., Ardiansyah, F. & Spector, E. 2007. Climate change in Indonesia: Implications for humans and nature. WWF Indonesia & WWF International.
- Nijman, V. 2005. Hanging in the Balance: An Assessment of trade in Orang-utans and Gibbons in Kalimantan, Indonesia. TRAFFIC Southeast Asia.
- Species fact sheet: Orang-utans – victims of logging and fire. 2006. WWF International. Gland, Switzerland.
- Suhud, M. & Saleh, C. 2007. Climate change impacts on orang-utan habitat. WWF Indonesia. Jakarta, Indonesia.

http://www.panda.org/species

http://assets.panda.org/downloads/orangutan_factsheet2006.pdf

http://www.panda.org/about_wwf/where_we_work/asia_pacific/our_solutions/borneo_forests/news/?119600

http://www.panda.org/about_wwf/what_we_do/climate_change/index cfm?uNewsID=147524

African Elephants

- Aga Alo, C., & Wang, G., 2008. Potential future changes of the terrestrial ecosystem based on climate projections by eight general circulation models. Journal of Geophysical Research 113.
- Desanker, P. V. No date given. The impact of climate change on life in Africa. WWF pamphlet. Centre for African Development Solutions, Johannesburg, South Africa, University of Virginia, United States & WWF.
- Dudley, J. P., Criag, G. C., Gibson, D. St. C., Haynes, G., & Klimowicz, J. 2001. Drought mortality of bush elephants in Hwange National Park, Zimbabwe. African Journal of Ecology 39: 187-194.
- Foley, C., Pettorelli, N., & Foley, L., 2008. Severe drought and calf survival in elephants. Biology letters 4: 541-544.
- Hulme, M., Doherty, R., Ngara, T., New, M. & Lister, D. 2000. African climate change: 1900-2100. Climate Research. University of East Anglia, Norwich, United Kingdom.
- Loveridge, A. J., Hunt, J. E., Murindagomo, F., & Macdonald, D. W., 2006. Influence of drought on predation of elephant calves by lions in an African wooded savannah. Journal of Zoology 270: 523-530.
- Lovett, J., Midgley, G. F., & Barnard, P., 2005. Climate change and ecology in Africa. African Journal of Ecology 43: 167-169.
- Palmer, G. 2008. Simulating range shifts of African mammals under predicted climate change: potential conservation and economic consequences. MSc thesis. Durham University. United Kingdom.
- Sitati, N., 2008. Climate change may complicate human-elephant conflict mitigation in the Mara ecosystem. Unpublished WWF report. Nairobi, Kenya.
- Stephenson, P. J., 2007. WWF Species Action Plan: African elephant 2007-2011. WWF International. Gland, Switzerland.
- Thuiller, W., Broennimann, O., Hughes, G., Alkemades, J. R. M., Midgley, G. & Corsi, F. 2006. Vulnerability of African mammals to anthropogenic climate change under conservative land transformation assumptions. Global Change Biology 12: 424-440.
- WWF Species fact sheet: African elephant. 2007. Gland, Switzerland.

http://www.panda.org/species

http://www.panda.org/about_wwf/what_we_do/species/about_species/species_factsheets/elephants/

www.iucn.org

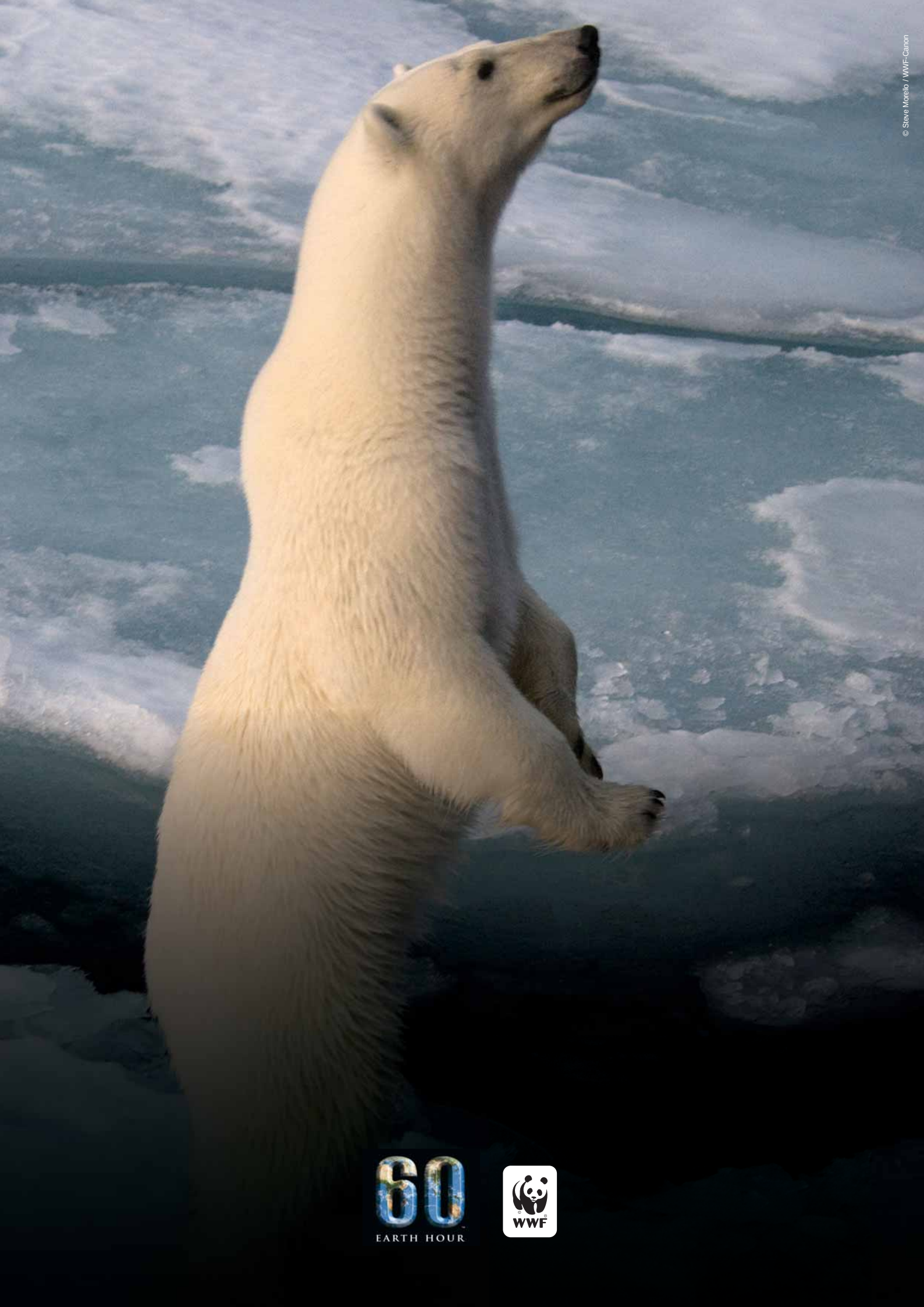
http://iucn.org/about/work/programmes/species/about_ssc/

Albatross

- Agreement on the Conservation of Albatross and Petrels (ACAP) 2004. Official webpage available at http://www.acap.aq/
- Australian Fisheries Management Authority, 2005. Official webpage available at http://www.afma.gov.au/fisheries/industry/default.htm
- Antarctic Division, Australian Government 2005. Official website available at http://www.heardisland.aq/protection/legislation/International_Agreements.html
- Brothers, N. 1991. "Albatross Mortality and Associated Bait Loss in the
- Japanese Longline Fishery in the Southern Ocean". Biological Conservation 55: 255.
- Inchausti, P, et al. 2003. Inter-annual variability in the breeding performance of seabirds in relation to oceanographic anomalies that affect the Crozet and the Kerguelen sectors of the Southern Ocean. Journal of Avian Biology, 34: 170-176.
- Gould, P. et al. 1997. Laysan and black-footed albatross: trophic relationships and driftnet fisheries associations of non-breeding birds. Pages 199-207 in G. Robertson and R. Gales (Eds), "Albatross: Biology and Conservation", Surrey Beatty and Sons Pty Limited.
- Intergovernmental Panel on Climate Change, 2001. Climate Change 2001: Impacts, Adaptation and Vulnerability. http://www.grida.no/climate/ipcc_tar/wg2/229.htm
- Medway, D.G 1997. Human-induced mortality of Southern Ocean albatross at sea in the 19th century: A brief historical review. Pages 189-198 in G. Robertson and R. Gales (Eds), "Albatross: Biology and Conservation", Surrey Beatty and Sons Pty Limited.
- Ministry for the Environment, New Zealand Government 2004. Climate Change Effects and Impacts Assessment: A guidance manual for Local Government in New Zealand. http://www.mfe.govt.nz/publications/climate/effects-impacts-may04/index.html
- Robertson, C.J.R. 1997. Factors influencing the breeding performance of the Northern Royal Albatross. Pages 99-104 in G. Robertson and R. Gales (Eds), "Albatross: Biology and Conservation", Surrey Beatty and Sons Pty Limited.
- Smithers, B.V. et al. 2003. Wedge-tailed shearwaters negatively affected by sea surface temperature variation causing changes in availability of food. Marine and Freshwater Research 54(8): 973.
- Weimerskirch, H. et al. 2003. "Trends in bird and seal populations as indicators of a system shift in the Southern Ocean." Antarctic Science 15: 249.

http://wwf.org.au/publications/australian-species-and-climate-change-report/

http://wwf.org.au/ourwork/species/albatross/


© Steve Morello / WWF-Canon
60
EARTH HOUR
WWF