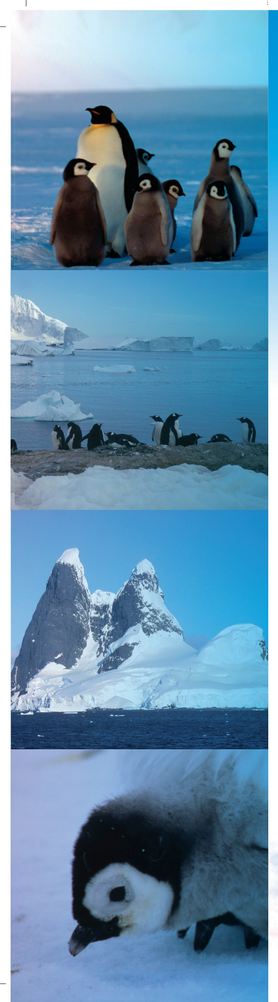

ANTARCTIC PENGUINS and CLIMATE CHANGE

We need to protect Antarctica against climate change for penguin conservation

Real leaders tackle climate change

There is no time to lose, no reason to wait. The solutions exist!

In order to avoid dangerous climate change, WWF calls the world's governments and business leaders to:

- **WITHIN TWO YEARS, INITIATE ACTION THAT TRULY WILL REVERSE CLIMATE CHANGE FACTORS**: Get global negotiations off to a good start in Bali.
- **CUT EMISSIONS:** Industrialized countries need to cut domestic emissions by at least 30% by 2020; the solutions exist today.
- **BRING EMERGING ECONOMIES ON BOARD:** The big developing economies should agree to join hands with rich countries to develop their own climate solutions.

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WWF *for a living planet®*

ANTARCTIC PENGUINS and CLIMATE CHANGE

Unequivocal Change in Antarctica

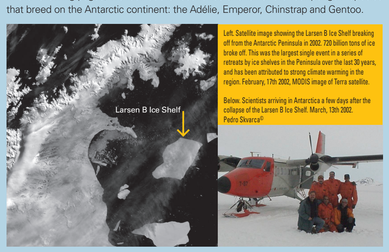
The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) concluded that the Earth's dramatic warming is "unequivocal." This warming is caused by increasing levels of greenhouse gases in the atmosphere which have now reached unprecedented levels. This phenomenon is produced, predominantly, from the burning of fossil fuels, with significant contributions from clearing of forests and intensive farming. Across the globe, the atmosphere and the ocean are warming, and snow and ice are melting, all at accelerating rates. Many plants and animal species have had to adapt, migrate or change the timing of their growth stages in order to avoid extinction. Even penguins at the remote southern end of the Earth have not escaped from these changes.

Though far away from civilization, the polar regions at the northern and southern ends of the planet have been seriously affected by global warming. In fact, they are among the regions warming the fastest. In the southern polar region, the Antarctic Peninsula is warming five times faster than the average rate of Earth's overall warming. The vast Southern Ocean has warmed all the way down to a depth of 3,000 m. Sea ice – ice that forms from sea water and a key feature of polar oceans –covers an area that is 40% less than it did 26 years ago off the West Antarctic Peninsula. Many species that had evolved the capacity to live in the cold, icy and harsh conditions of these polar regions, are now losing their only home.

The penguin is an indisputable icon representing the harsh, wild, yet hauntingly beautiful expanses of Antarctica. All 17 penguin species of the world live in the Southern Hemisphere; none can be found in the Arctic. The populations of the four penguin species that breed on the Antarctic continent are now showing large changes. Other penguin species are declining in the sub-Antarctic regions. For them, food has become scarce owing to industrial fishing in conjunction with climate change. In regions that have so far not seen such fishing, some penguin species are increasing (while others decline) as climate change has improved (reduced) their habitat. What is clear is that these unique, hardy and charismatic creatures are trying to keep up with the large, fast changes that are happening in their environment. Some are happening at unprecedented rates and are severely challenging the penguin's ability to adapt.

Some parts of the Southern Ocean, in particular the Ross Sea shelf which is the largest continental shelf in the Antarctic, remain among the few large marine ecosystems where direct human influences have been minimal. Climate change, compounded by human exploitation activities, will certainly jeopardize the survival of these last pristine marine environments.

In the following pages, we look at the recent rise and fall of the four penguin species that breed on the Antarctic continent: the Adélie, Emperor, Chinstrap and Gentoo.



Left. Satellite image showing the Larsen B Ice Shelf breaking off from the Antarctic Peninsula in 2002. 720 billion tons of ice broke off. This was the largest single event in a series of retreats by ice shelves in the Peninsula over the last 30 years, and has been attributed to strong climate warming in the region. February, 17th 2002, MODIS image of Terra satellite.

Below. Scientists arriving in Antarctica a few days after the collapse of the Larsen B Ice Shelf. March, 13th 2002.
Pedro Skvarca®

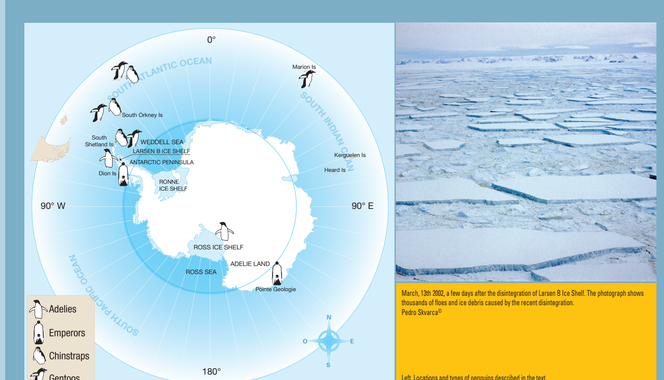
SOMEWHERE TO LIVE, SOMETHING TO EAT: PENGUINS, KRILL AND SEA ICE

Sea ice is the ice that forms on the surface of the ocean when sea water gets cold enough to freeze. At the southernmost areas of the Southern Ocean, sea ice begins to form at the beginning of the austral autumn. As temperatures drop, new ice forms further north and old ice thickens. Near the coast, there are often extensive flat areas of sea ice that are held fast by the land. This so-called fast ice is essential for Emperor Penguins because it provides a stable platform during the eight months needed by parents to attend eggs and chicks.

In contrast, farther away from the coast, sea ice is broken into pieces, with stretches of open water in between. This is referred to as pack ice. During the breeding season, both the Adélie and Emperor Penguins need to commute efficiently from their breeding sites – on land or on fast ice – into the pack ice where their food lives in the ocean beneath. The longer the commute is, the lower the chance that they or their chicks would survive. However, penguins can walk, slowly, over ice but can swim rapidly in open water. Therefore, stretches of open water within the pack ice, maintained by persistent wind or currents, are extremely important to the penguins. It allows them to get to their food faster, giving their chicks a higher chance of survival.

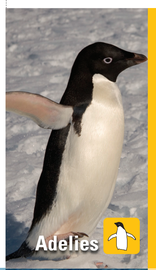
Sea ice is also a home for microscopic algae and other microbes which are at the base of the food chain. These organisms live in sea water in summer, but in autumn, when sea water freezes, living cells are trapped between the newly formed ice crystals. They then miraculously live and thrive within the ice throughout the cold dark winter. When summer comes, the ice melts, the microbial organisms are released into the sea water and they thrive under the constant sun. Through photosynthesis, they flourish, bloom and multiply, putting on an annual feast for many species including the Antarctic krill and larval fish, which are then eaten by the fish, seal, seabird and whale predators of the Southern Ocean.

In the southwest Atlantic sector of the Southern Ocean, in the vicinity of the Antarctic Peninsula, sea ice has been forming later, receding earlier and covering a smaller average area each winter. Here, the populations of krill and fish that normally live around sea ice have also been decreasing. Many scientists believe that the fate of sea ice and its relationship to the food web holds the future of many species in Antarctica.



March, 13th 2002, a few days after the disintegration of Larsen B Ice Shelf. The photograph shows thousands of floes and ice debris caused by the recent disintegration.
Pedro Skvarca®

Left. Locations and types of penguins described in the text.



Adelies

The Adélie Penguin lives on or close to sea ice all its life but only breeds on land without ice. Although Antarctica is big, only 2% of its land is ice-free. Within this limited area, few places are ideal for the Adélies' to breed. An ideal breeding site needs to be surrounded by open water within the pack ice during winter and early spring every year; be accessible from the sea by minimal walking; be on a gentle sloping beach which is free of snow, ice or meltwater; and have a plentiful supply of little pebbles that these penguins use to build their nests.

In recent decades, Adélie Penguins on the Antarctic continent and on the Antarctic Peninsula have seen very different fortunes. In the northwestern coast of the Antarctic Peninsula, where warming has been dramatic, populations of Adélie Penguins have dropped by 65% over the past 25 years. Temperatures here have risen well above freezing for much of the year. There is less sea ice than before. Antarctic krill and silverfish – Adélie Penguins' primary food source during summer – have been decreasing. Warmer temperatures also have allowed the atmosphere to hold more moisture, thus bringing more snow and reducing the land area on which Adélie Penguins can breed. Meanwhile, the open-water cousins of the Adélies - the Chinstrap and Gentoo penguins – have invaded this region as the sea ice disappears. These two species are not affected by the increased snowfall since they breed much later, once any fallen snow has melted. Scientists believe that the Adélie Penguin is likely to lose out if it has to compete with the Chinstrap and Gentoo, which are much more adapted to warmer environments.

In contrast, along the east coast of the Peninsula, and on the coast of the Antarctic continent, populations of Adélie Penguins have been growing. Here, stronger winds have sustained larger stretches of open water near to the colonies. As a result, it has been easier for the Adélie Penguins to access food which has, until now, been in areas with a lot of sea ice. In addition, in the Ross Sea area, one of the Adélie Penguins' competitors, the Minke Whale, has been extensively hunted by humans in recent decades. This has probably left the Adélie Penguin more food, contributing to their population growth.

Emperors

The largest penguin species, the Emperor Penguin, is truly a hardy animal. It is the only one that breeds during the cold, harsh winter, surviving through blizzards, darkness and temperatures as low as -49 C. Every year around late March, adult Emperor Penguins leave the pack ice and may walk up to 200 km over its frozen surface to their breeding sites. In May or June, the females lay one egg and then make the long walk back to open water, eating again for the first time in about two months. In the mean time, the egg is kept on the feet of the father, protected under the layers of feathers and fat of its abdomen. During the next two months, the father fasts while keeping watch until its chick hatches. Miraculously, at that time the mother returns with food. By that time of year (July-August), food can then be obtained more easily because adjacent ocean areas have been swept free of sea ice by strong winds.

The life cycle of this remarkable animal is closely linked to that of sea ice. Cold temperatures and thick, land-locked sea ice provide a safe and stable home during breeding. Around January and February when fast ice is unstable, Emperors molt - when they shed their feathers and grow new ones - standing on the pack ice. During this time they are not waterproof for four weeks and would die if they had to swim.

Two of the northernmost Emperor Penguin populations are located at Pointe Géologie, Adélie Land, and Dion Island located on the Antarctic Peninsula. In this warmer part of Antarctica, both Emperor Penguin populations have declined over recent decades. At Pointe Géologie, the population has declined by 50% over the past 50 years. High mortality occurred during the late 1970s and the population has not recovered since. Breeding areas have suffered dramatic changes. Warmer winter temperatures have led to thinner ice which has then been broken up and swept out to sea by frequently stronger winds. As a result, Emperor eggs and chicks have been blown away before being able to survive on their own.

Out of all the Antarctic bird and mammal species, the Emperor Penguin has become the most vulnerable to the rapidly changing climate. It needs stable, land-locked sea ice on which to breed (it is too clumsy to climb over icy, coastal slopes), but wind-swept, ice-free ocean areas in which to feed. Ironically, climate change has made it easier to feed at the expense of strong thick ice needed for nesting.

Chinstraps

Unlike the Adélie and the Emperor Penguins, Chinstrap Penguins are only found where sea ice is minimal, if indeed present at all. They live at the northern tip of Antarctica – mainly on the Antarctic Peninsula – and on the sub-Antarctic islands (Shetland, Orkney and Sandwich). They breed on land that is free of snow and ice, one month later than the Adélies. Males and females take shifts of three to eight days to incubate their two eggs. One parent guards the nest while the other goes back to the sea to feed.

During breeding, Chinstrap Penguins eat Antarctic krill and lanternfish. Abundant krill is often associated with extensive sea ice, since krill likes to eat the algae that grow underneath the ice. Although it is ideal to have lots of available food, too much sea ice makes it difficult for them to go back and forth while feeding their chicks which remain on land. Some chicks, therefore, may not get enough food to survive since tired adults may abandon them.

Between the 19th century and mid 20th century, humans hunted for fur seals and whales, wiping out their populations in many parts of the Southern Ocean. Industrial fisheries took over in the mid 20th century and have continued to remove enormous numbers of fish from this region. As seals, whales and large fish competed with Chinstrap Penguins over the same food, their disappearance has actually allowed Chinstrap populations to increase.

Despite this increasing trend, a decreasing amount of sea ice in different regions over recent decades has introduced some variations in Chinstrap populations. Along the western Antarctic Peninsula, winters have warmed by 5-6 C over the past 50 years. Sea ice now covers a smaller area and lasts up to three months less. Scientific studies of fossilized bones have shown that Chinstrap and Gentoo penguins began to appear in this region only recently, just as the area started to warm up. With fewer cold years and less sea ice, the region has become more suitable for these open-water penguins, at least temporarily.

On the other hand, some Chinstrap colonies around the South Shetland and South Orkney islands have actually begun to decrease by 30-66% owing to a scarcity of food available, particularly for young penguins. This is most likely due to the reduction in krill abundance associated with the disappearance of sea ice. Furthermore, Humpback Whale populations are also increasing, competing with Chinstraps over food.

Further warming and diminishing sea ice in future years could allow the Chinstrap Penguin to expand into ice-free areas. However, if food becomes less available – because of reduced sea ice, increased industrial fishing or increased whale populations – existing populations may decline.

Gentoos

Gentoo Penguins live further north than any of the three other 'Antarctic' penguin species. They can be found on the Antarctic Peninsula, the surrounding islands, as well as on the sub-Antarctic islands. In these more northern regions, the climate is milder and the summers are longer. Gentoo Penguins breed on land, looking for fish and krill in the open sea near their colonies. They remain around their breeding islands all year. Males and females take turns every few days to incubate their two eggs in the nest, and they never fast during the breeding season.

In recent decades, the number of Gentoo Penguins has, generally, been decreasing almost everywhere. Only where sea ice has recently disappeared along the coast of the northwest Antarctic Peninsula have small numbers of this open-water species been increasing. In areas south of the South Shetlands on the west coast of the Antarctic Peninsula, fewer cold years and less sea ice are making the region increasingly suitable for Gentoos. Like the Chinstrap, Gentoo Penguins prefer open water over sea ice.

In the sub-Antarctic islands and northern parts of the Antarctic, large-scale industrial fishing in ice-free waters has taken food away from penguins. In waters around Kerguelen, Marion, Heard, South Georgia, South Orkney and South Shetland islands, the Gentoo Penguins' food - marbled notothenia, mackerel icefish and other species – has dropped to below 10% of their population before fishing began. Gentoo Penguins are, therefore, forced to eat more krill than before. As krill numbers have also decreased significantly over the past century – linked to a decrease in winter sea ice - Gentoo Penguins have no other alternative than to depend on a declining food species.

In the future, with further warming and less sea ice, Gentoo Penguins may be able to expand to areas that were previously unsuitable. However, if food becomes less available – because of reduced sea ice or increased industrial fishing – existing populations most certainly will decline.

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