

# Climate Change Threatens Penguins

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## Penguins—waddling wonders of the Southern Hemisphere

Penguins (order Sphenisciformes, family Spheniscidae) are flightless seabirds found almost entirely in the Southern Hemisphere. Although their wings have become useless for flight, they have become superbly adapted to swimming and diving. For example, Gentoo penguins can swim up to 35 km per hour—compared with 9 km per hour for the fastest Olympic swimmer. Emperor penguins can dive to depths of more than 520 m to find food—deeper than any other bird. Penguins must return to land or sea ice to rear their young, however, and they are renowned for their feats of endurance as parents. The Emperor penguin raises its chick on top of the frozen Antarctic Ocean amid winter temperatures as low as  $-60^{\circ}\text{C}$  and winds of 195 km per hour. For two months, the male fasts while taking on the sole duty of incubating the egg, which he must balance on top of his feet to protect it from the ice below.



Macaroni Penguin (*Eudyptes chrysolophus*) on Hannah Point, Livingston Island, Antarctic Peninsula, sports colorful crests. Photo: Jerzy Strzeleck

## Penguins are not just found in Antarctica

Although penguins are commonly associated with Antarctica, penguins are found in a variety of habitats in the Southern Hemisphere. Eighteen different penguin species inhabit areas from Antarctica to the Equator. They can be divided into three groups:

- Four penguin species breed in Antarctica and/or the Antarctic islands: the Emperor, Adélie, Chinstrap, and Gentoo penguin.
- Most penguin species breed on islands in the sub-Antarctic waters of the Southern Ocean (a.k.a. Antarctic Ocean), the South Atlantic Ocean, the South Pacific Ocean, and the Southern Indian Ocean: the King, Southern Rockhopper, Northern Rockhopper, Macaroni, and Royal penguin. Several penguin species are found only on the coastlines and islands of Australia and/or New Zealand: the Little Blue, Snares Crested, Erect Crested, Fiordland Crested, and Yellow-eyed penguin.
- The most northerly penguins breed along the more temperate coasts of South America and Africa: the Humboldt, Magellanic, Galápagos, and African penguin.

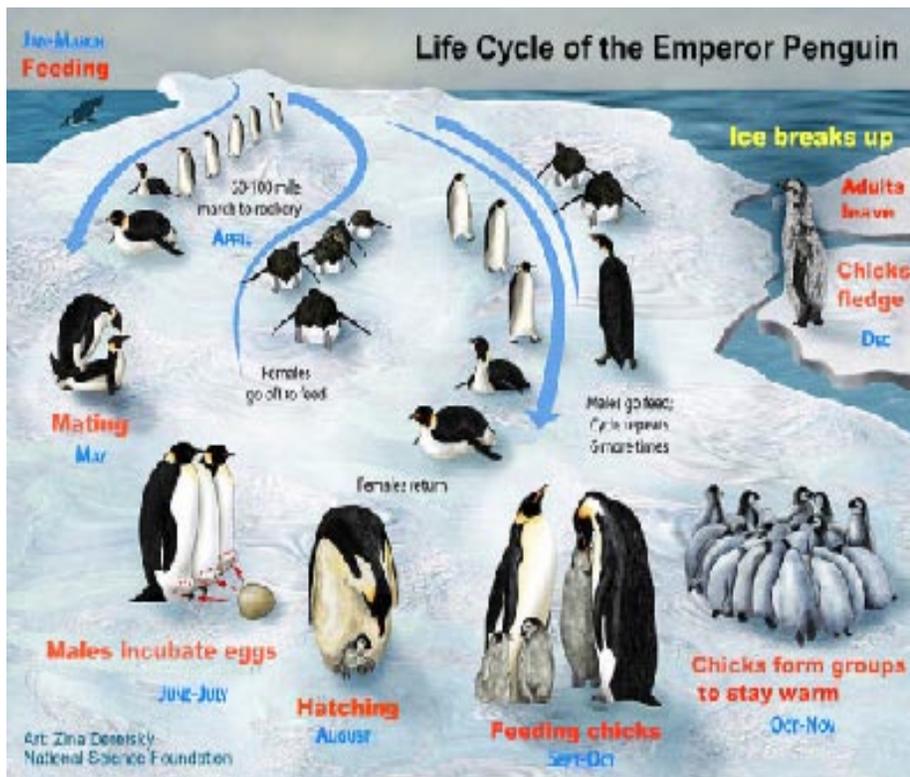
Penguins are a highly threatened group. According to the International Union for Conservation of Nature, the world authority on the status of threatened species:

- 11 of 18 penguin species are declining and considered an extinction risk
- Two species are considered stable.
- The population status of the remaining five is unknown.

Studies have linked climate change to past, ongoing, and projected population declines of many penguin species. Because penguins live in different ocean habitats of the Southern Hemisphere, climate change affects penguins in these regions in different ways.

## How is climate change affecting Antarctic penguins?

The Antarctic continent is warming as a whole,<sup>1</sup> but the Antarctic Peninsula—the northernmost region that juts out towards South America—is warming faster than any other place in the Southern Hemisphere.<sup>2</sup> Because of this rapid warming, sea ice along the western Antarctic Peninsula is shrinking in size, and the sea-ice season is shorter.<sup>2</sup> The loss of sea ice is harming Emperor penguin chicks and adults. Emperor penguins rear their chicks on land-locked sea ice. When sea ice breaks up before their chicks have matured and grown their waterproof feathers, chicks that are swept into the ocean are likely to die. For adults, the loss of sea ice can lead to lower food availability, which can result in increased mortality.



The loss of sea ice is linked to Emperor penguin population declines at the warmer northern regions of Antarctica:

- The Emperor colony at Terre Adélie in East Antarctica—featured in the Academy Award-winning French documentary, *March of the Penguins*<sup>3</sup>—plummeted by more than 50% in the late 1970s during a warm period with little sea ice cover, when adults died en masse.<sup>4</sup> Because the sea ice continues to disintegrate, and the prolonged blizzards cause ongoing chick mortality,<sup>4</sup> the colony has yet to recover.

- On the fast-warming Antarctic Peninsula, another Emperor colony has declined from 250 pairs to 10 pairs since 1960, due to the rapid loss of the sea ice.<sup>5</sup>

Another Antarctic penguin that is being affected by global climate change is the Adélie penguin. Unlike the Emperor penguin, the Adélie does not raise its chicks on sea ice. Instead, it builds a nest out

of pebbles on the sparse areas of the Antarctic shoreline that are free of ice and snow.<sup>6</sup> On the western Antarctic Peninsula, warmer temperatures allow the air to hold more moisture, and this leads to more snowfall in the region.<sup>7</sup> Adélie penguin populations are disappearing rapidly because they cannot find snow-free ground for nesting.<sup>8</sup> The loss of winter sea ice in this region is also impacting the Adélie’s food supply negatively.<sup>9</sup> As sea ice declines, the more ice-intolerant Chinstrap and Gentoo penguins are expanding southward into Adélie breeding areas in the Antarctic Peninsula, replacing Adélie penguins.<sup>10</sup>

Both Emperor and Adélie penguins face a bleak future from global climate change. According to a study by Antarctic researchers, a temperature increase of 1.3°C will jeopardize 40% of the world’s Emperor penguins and 70% of the world’s Adélie penguins—largely because of diminishing sea ice.<sup>5</sup> (At present rates, the world will

exceed 1.3°C of warming before mid-century.<sup>11</sup>) Penguin scientists also predict that sea-ice loss due to global climate change will push the Emperor population chronicled in *March of the Penguins* to the brink of extinction within this century.<sup>12</sup>

### How is climate change affecting sub-Antarctic penguins?

For the penguin species that live in the Southern Ocean, which encircles Antarctica, global climate change is also having significant impacts. In the Atlantic sector of the Southern Ocean, ocean warming and the melting of sea-ice are linked to the decline of the penguins’ major food supply—Antarctic krill. Krill in this region have declined by as much as 80% since the 1970s.<sup>13</sup> Since krill graze on algae that grow on the bottom of the sea ice, the loss of ice leads to the loss of krill. Researchers project that a 1°C rise in sea surface temperature in this region could result in a further 95% reduction of krill.<sup>14</sup> This collapse in the food supply would be disastrous for the penguins like the Macaroni, which has already suffered a 50% population decline at its main breeding site in this region—the South Georgia Island—between the mid-1970s and mid-1990s.<sup>15</sup>

There is also evidence that ocean warming has led to penguin population declines in other regions of the sub-Antarctic by reducing their food supply.

- On Marion Island in the southern Indian Ocean, a 60% decline in Southern Rockhopper population,<sup>16</sup> and a 50% decline in the Macaroni population have been attributed to ocean warming<sup>17</sup>.

- On the sub-Antarctic islands of New Zealand, Southern Rockhopper



Adélie Penguin (*Pygoscelis adeliae*) feeding young. Photo: Jerzy Strzeleck

penguin populations plummeted by 50–94% during a period of warmer ocean temperatures.<sup>18</sup>

•Likewise, researchers studying King penguins in the southern Indian Ocean found that warm-water events negatively impact adult survival and breeding success, and they warn that King penguins are at extinction risk under future warming scenarios.<sup>19</sup>

### How is climate change affecting temperate penguins?

It may seem odd to think of penguins living along the Equator at the Galápagos Islands or on the desert coasts of Africa and South America, but penguins are able to inhabit places where upwelling brings cold, nutrient-rich ocean water to the surface, which creates a bountiful food supply. The penguins living in these upwelling ecosystems periodically face extreme food shortages when El Niño events usher in warm water and prevent cold water from reaching the surface. Leading climate scientists believe that global climate change will lead to stronger El Niño events in the future.<sup>20</sup> Two particularly strong El Niño events that occurred in recent decades provide a window into how penguins in temperate regions are likely to be harmed by global climate change.

For example, the Galápagos penguin has proven to be extremely vulnerable to starvation during El Niño events. Adults are forced to abandon their eggs and chicks to search for food, leaving their chicks to starve.<sup>20</sup> Following the powerful El Niño events of 1982–1983 and 1997–1998, the Galápagos penguin population plummeted by 77% and 65%, respectively,<sup>21</sup> leaving less than 2,000 penguins today—the world’s smallest penguin population.

### Emerging threats

In addition to global climate change effects harming penguins, two emerging threats resulting from the world’s greenhouse gas pollution are gaining attention:

- sea level rise; and
- ocean acidification.

Rising sea levels threaten to drown important coastal nesting sites for penguins—especially in places where natural barriers like cliffs, or human barriers like roads and developments, prevent penguins from retreating inland.



Galápagos penguin (*Spheniscus mendiculus*) at Elizabeth Bay on the island of Isabela, Galápagos. Photo: putneymark, Flickr

Our greenhouse gas emissions are also causing the oceans to become acidic, which threatens the entire ocean food web from plankton to penguins. The oceans absorb a large portion of the carbon dioxide produced by our industrial society. As ocean waters have absorbed this excess carbon dioxide, the acidity of the ocean has increased by 30% and carbonate ions have become less available.<sup>22,23</sup> Carbonate ions are used by calcifying creatures such as plankton, corals, and clams to build their shells. As ocean acidification reduces carbonate ion availability, these creatures will become increasingly unable to build new shells and existing shells will begin to dissolve,<sup>24,25</sup> which leaves these animals with no way to survive, and therefore, affects the penguins’ food supply.

Although all oceans are affected by acidification, the Southern Ocean, and the upwelling systems where penguins live, will be among the first regions to be impacted. For example, at current rates of greenhouse gas emissions, the pteropod—a planktonic snail which forms a key part of the food web in the Southern Ocean—may be unable to survive as early as 2030.<sup>26</sup> The loss of the pteropod will have profound impacts on the Southern Ocean food web, and the penguins that depend on it.

### How can we protect penguins from further decline?

Rapidly reducing global greenhouse gas emissions is the single most important action needed to protect penguins from global climate change. If we continue on our current course, global temperatures will rise by an average of 2.8–4°C in this century (4 to 6 times more than during the previous century)<sup>11</sup>, ocean waters will become corrosive

from the depths to the surface in many regions,<sup>27</sup> and Antarctic sea ice will disappear at accelerating rates.<sup>28</sup> We risk not only losing penguins but also destroying the web of life. Leading climate scientists have concluded that the atmospheric carbon dioxide level must be reduced from its current level of 385 parts per million (ppm) to less than 350 ppm to prevent dangerous climate change, which includes massive species extinction and catastrophic sea level rise.<sup>29</sup>

Even with rapid reductions in greenhouse gas pollution, greenhouse gases that have been emitted already ensure we are still committed to decades of continued warming and centuries of continued sea-level rise.<sup>29,30</sup> It is critical, therefore, to reduce other threats to penguins to increase their ability to survive the added pressures from this warming. The biggest of these threats is industrial fishing. Large-scale commercial fisheries deplete the penguin's food sources, as well as entangle and drown penguins in longlines and other fishing gear. Other current threats to penguins include:

- oil spills
- marine pollution
- introduced non-native predators at penguin breeding sites
- diseases
- habitat destruction
- human disturbance
- direct harvest of eggs and birds

One important tool for protecting penguins globally is the U.S. Endangered Species Act.<sup>31</sup> This Act is the world's strongest biodiversity protection law that provides important safeguards for animals and plants threatened with extinction. Currently, one penguin species is listed under the Act, and seven have been proposed for protection in response to a scientific petition from the Center for Biological Diversity. The Endangered Species Act listing process helps species like penguins by:

- drawing attention to their plight
- educating the public about the threats they face, and

- making additional funds and resources available for their study and management

Once penguins are listed, the Act provides important regulatory protections to penguins from both climate and non-climate threats. For example, under the law, U.S. federal agencies approving projects that emit significant levels of greenhouse gas emissions would be required to analyze the impacts of those emissions on listed penguins, as well as adopt solutions to reduce emissions so that they do not jeopardize penguins. Additionally, U.S. federal agencies approving high seas fishing permits would need to analyze and reduce the impacts of those fishing activities to protect listed penguins. The Endangered Species Act, therefore, provides an important tool for both addressing the root causes of climate change, as well as protecting penguin populations to increase their resilience to climate change.

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