EMPEROR PENGUINS AND CLIMATE CHANGE

Tough times for hot chicks

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Summary

- Emperor Penguins are an iconic and charismatic species, highly adapted to living in the unforgiving conditions of the Antarctic .

- For much of the year, Emperor Penguins live on thick sea ice, which they use for mating, chick rearing and moulting.

- In some regions of the Antarctic, seasonal sea ice extent and thickness have reduced in recent decades following climate change. Continued warming will lead to further reductions in sea ice, impacting Emperor Penguins, with more northerly colonies being most at risk.

- The biomass of Antarctic krill has decreased in recent decades correlating with decreases in sea ice. Changes in krill abundance are likely to negatively affect Emperor Penguins and many other Antarctic species.

- Emperor Penguins highlight the possible impacts of rising sea temperatures and melting sea ice due to climate change. These changes directly or indirectly affect many other species in the Antarctic marine ecosystem.

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The Emperor Penguin's *(Aptenodytes forsteriis)* charismatic appearance and behaviour, as well as the feature documentary 'March of the Penguins', have made the species an icon of Antarctica. They inhabit shorelines all around Antarctica and are the largest, both in height and weight, of all the living penguin species.

Antarctica is an extremely harsh environment with temperatures dropping to below -40°C and winds reaching more than 140 km/h. While most other animals leave the region during the winter, Emperor Penguins remain to incubate their eggs.

Emperor Penguins keep warm by having a very high proportion of insulation feathers and, overall, the highest density of feathers of any bird (100 feathers per square inch). The thick layer of fat that they accumulate over the summer months insulates their bodies, but as this is gradually used up over the winter for energy, huddling and shivering become increasingly important for survival.

What do we know about Emperor Penguins?

For most of the year, Emperor Penguins live on the thick sea ice surrounding the continent of Antarctica. Because they incubate their eggs during the Antarctic winter, when scientists are unable access the colonies, much remains unknown about the location or total number of breeding colonies. Thirty-eight colonies are currently known to exist. This figure includes 10 new colonies that have recently been indentified using satellite images which highlighted reddish brown patches of penguin droppings (or guano) against the white ice.

Fish, squid and Antarctic krill form the main diet of Emperor Penguins. They hunt for food at sea in the open water or through cracks in the sea ice. Emperor Penguins are extremely accomplished divers that may remain submerged for up to 18 minutes and reach depths of up to 500m. They are able to do this due to their unusual blood haemoglobin composition, which allows them to function at low oxygen levels.

Emperor Penguins have a number of natural predators.. Chicks are vulnerable to predation by Giant Petrel and South Polar Skua, while Leopard Seals and Killer Whales frequently prey on adults.

In autumn, as the hours of daylight become shorter, Emperor Penguins begin the long journey to their breeding grounds. Leaving the open ocean behind, they walk distances of up to 200 km across the sea ice to reach their breeding sites.

Once at the breeding site, Emperor Penguins court and mate. Emperors are said to be serial monogamists, pairing and mating with the same mates for one season, but choosing a different mate each year. Females lay a single egg, which the males then incubate on top of their feet for the 2 month gestation period. Leaving her mate to care for the egg, the female immediately journeys back to the ocean to feed and recover the energy used for egg production and her long journey.

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The male remains on the ice for at least another two months without food, protecting the egg until it hatches. Throughout this period, males are exposed to severe weather conditions. Huddling together in large groups, individuals attempt to conserve body heat by constantly moving in an attempt to escape the worst of the wind, By the time the female returns, males could have fasted for up to 115 days and lost around 20kg, potentially more than half their original body weight.

The females return to the breeding grounds as the eggs hatch, and feed the chicks by regurgitation. The pair then swaps roles; the female continues to brood the chick, while the male heads to the sea to feed. Both parents make multiple trips to feed their growing chick and, as the young penguins grow, the adults leave them in groups called crèches.

This shared parenting continues until the middle of the Antarctic summer, when the chicks fledge. By this time the melting ice edge is approaching the breeding colony and food is much more easily available. The adults then depart from the colonies and the chicks are able to feed for themselves.

How is climate change affecting Emperor Penguins?

Over the past 50 years, the west coast of the Antarctic Peninsula has been one of the most rapidly-warming parts of the planet, the British Antarctic Survey reports. Here, annual mean air temperatures have risen by nearly 3°C, with the greatest warming occurring in the winter season. This is approximately 10 times the mean rate

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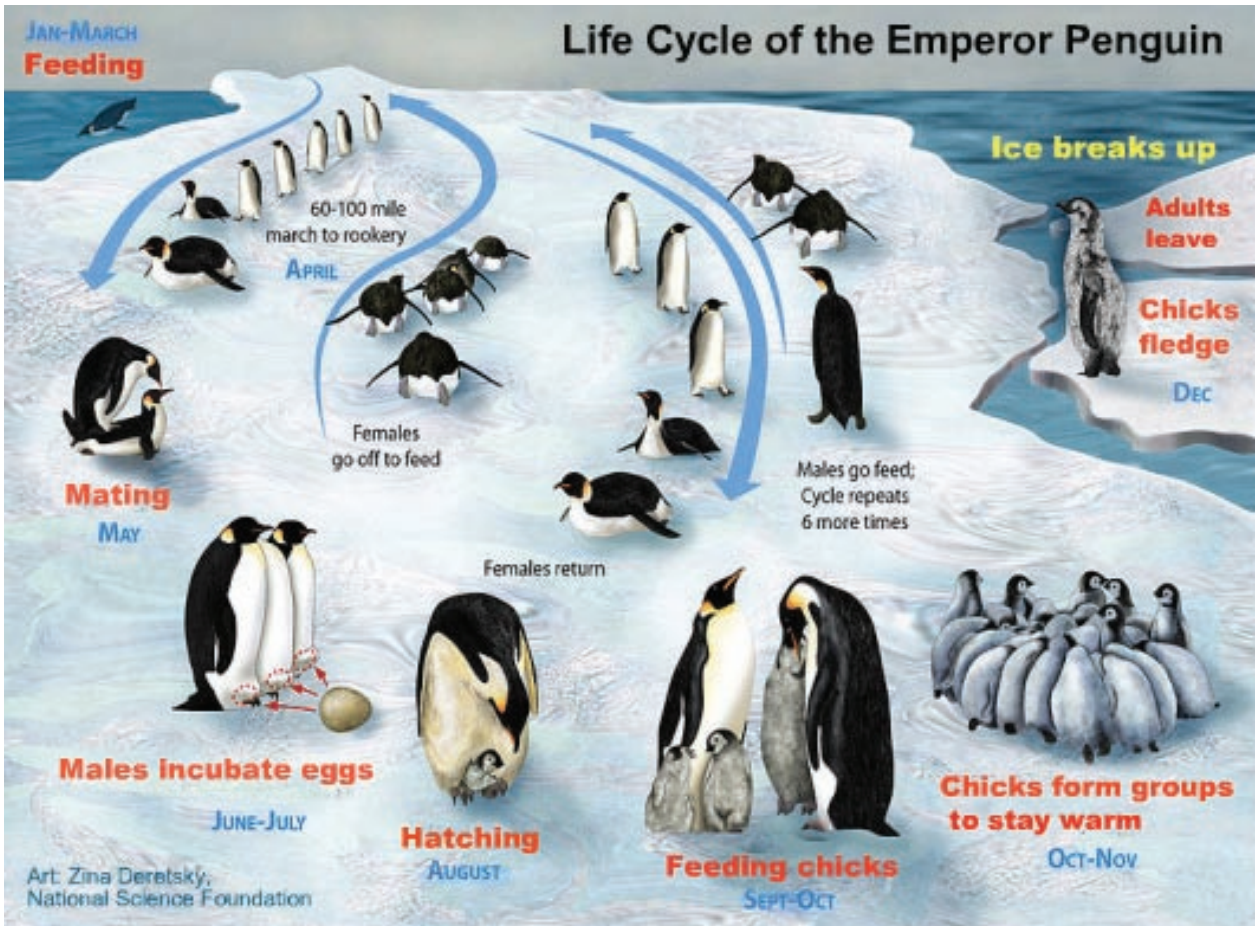

of global warming reported by the Intergovernmental Panel on Climate Change (IPCC). The east coast of the Peninsula has also warmed, though less rapidly, and here the largest warming has taken place in summer and autumn.

Significant warming has also been observed in the Southern Ocean, with upper ocean temperatures to the west of the Antarctic Peninsula having increased by over 1°C since 1955. As a result, sea ice cover may decline by around 25% (although there are considerable uncertainties associated with this prediction). Changes in seasonal sea ice have already been observed, including sea ice declines in the Antarctic Peninsula region.

Thinning sea ice:

Changes in seasonal sea ice are potentially a considerable threat to breeding Emperor Penguins. While it is sometimes argued that a reduction in sea-ice extent could actually benefit Emperor Penguins by reducing the distance adults have to travel to feed during the breeding season, there are also numerous and important negative effects that should be taken into consideration.

Pack ice extent reaches its minimum in late summer. A this time, however, ice is still essential as a platform for crèched chicks before they fledge, and later, for adults so that they can successfully moult. The platform is needed for growing chicks and for moulting adults as they are unable to survive without their waterproof feathers. Early ice break-up in warm years has caused chicks to be swept into the ocean and drowned.

Should global temperatures increase by 2°C, scientists estimate that colonies to the north of 70°S would probably become unviable. This means that 40 percent of all colonies, and almost 40 percent of the total breeding population of Emperor Penguins would be affected.

In 2001, a large iceberg collided with the Ross Sea ice shelf in the vicinity of a well-established Emperor Penguin breeding colony. The sea ice supporting a considerable proportion of the colony was broken. In addition to the direct impacts of the collision, the colony was affected for several years afterwards by the continued presence of the iceberg. Chick production was markedly reduced and remained lower than usual for some years. With increases in temperature and thinning of the sea ice, such incidences are likely to occur more frequently.

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Reduced food availability:

Antarctic krill are small (maximum size 5.5 cm) shrimplike invertebrates that form the basis of much of the Antarctic food web. Krill make up an estimated biomass of over 500 million tonnes, which is about twice that of humans. Krill feed on phytoplankton or algae found in the open ocean, or on the underside of sea ice. Projected declines in sea ice extent are likely to reduce the number of krill in the Southern Ocean, which would, in turn, have profound effects on the Antarctic food chain. In addition to its direct effects on Emperor Penguins, krill availability is likely to have impacts on other penguin prey species abundance, such as of fish and squid, which also feed on krill.

Can Emperor Penguins adapt to climate change?

Little is known about Emperor Penguins' capacity to adapt to climate change. Emperor Penguin colonies exist at the edge of the Antarctic continent, so there is little potential for colonies to move southward. However, two Emperor Penguin colonies are known to occur on land rather than on ice, and these have remained stable over the last 20 years. This suggests that other colonies could potentially shift to land as sea ice decreases, though this would depend on finding land areas with suitable access to food resources. Access to reliable food sources is probably key to determining the location of Emperor Penguin colonies.

Other threats

Emperor Penguins are currently listed as 'Least Concern' on the 2009 IUCN Red List. Aside from climate change, they face few significant threats, but declines in food availability could become a concern if Southern Ocean krill fisheries become established.

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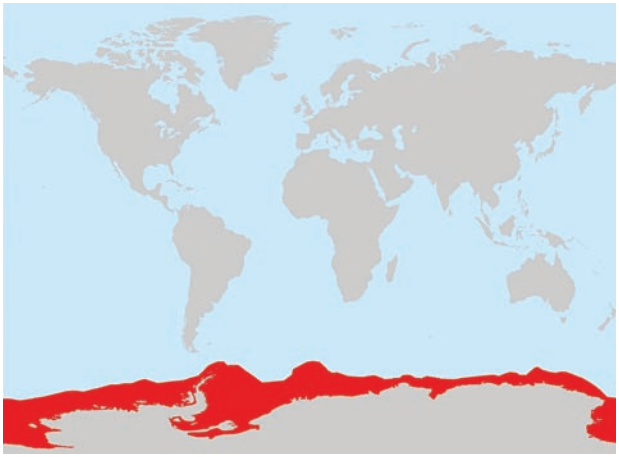

Emperor Penguin geographical range – © IUCN Red List

"Emperor Penguins are not only the largest penguins alive, they are also the oldest. Their forefathers inhabited Gondwana, the great super continent. When Gondwana spilt into the southern continents some 200 million years ago, some of the birds stayed on the part which is now Antarctica and started to evolve into Emperor Penguins about 130-160 million years later. As Antarctica drifted farther south and got colder, these birds adapted gradually to the harsh conditions that characterise Antarctica today. Having been successful on this planet for millions of years, Emperor Penguins now face the most serious challenge in their long history; in geological terms a very rapid warming of their home. They stand to lose their breeding grounds on the fast ice and potentially their main prey species. Will they be able to adapt rapidly to a completely altered Southern Ocean ecosystem?
Their chances are slim."

- Barbara Wienecke

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