

Antarctic Penguins



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Penguins are the most common birds in the Antarctic. Living in colonies with populations larger than some cities, and surviving in the harshest of conditions, it is no wonder that penguins are seen as the emblem of Antarctica.

However, of the 17 different species of penguin, only two (emperor and Adélie) make the Antarctic continent their true home, although others (chintrap, gentoo and macaroni) breed on the northern tip of the Antarctic Peninsula, where conditions are less harsh. King penguins only breed on the warmer more northerly subantarctic islands. One species, the Galapagos penguin, even lives on the Equator.

The real home of all penguins is the cooler water of the Southern Hemisphere.

❶ Where did the name 'penguin' come from?

No-one knows. It could come from the Welsh 'pen gwyn', which means 'white head', or from the Latin 'pinguis', referring to the fat or blubber of the bird. The name penguin was first given to another type of bird, the auk (also a large, flightless, black and white bird).

Image: King penguin colony on the island of South Georgia.



Images: **Top:** Map of the Antarctic and Southern Ocean. **Bottom:** An adult gentoo penguin.

The basic penguin

Antarctic penguins have a striking black and white coat. The distinctive colours and features of each penguin species are on their heads and neck – some are black and white, some have yellow patches, and others have elaborate coloured eyebrows.

All penguins have similar body form and structure, but they vary greatly in size, from the little penguin weighing 1.1 kg and about 40cm tall, to the emperor penguin, which weighs up to 40kg and is about 115cm tall.

Penguin Species	approximate weight	approximate height
Emperor	38 kg	115 cm
King	16 kg	94 cm
Gentoo	5.6 kg	75 cm
Adélie	5.3 kg	71 cm
Chinstrap	5.0 kg	71 cm
Macaroni	5.0 kg	71 cm



❶ Primitive penguins?

Penguins were once thought to be the most primitive of birds. Members of Captain Scott’s famous expedition went on what they described as “the worst journey in the world” in the Antarctic winter to obtain an emperor penguin embryo to prove this point. But they were wrong – penguins are highly evolved to be able to live in the coldest of places.

Image: An adult macaroni penguin.

Getting about

Although they have wings and feathers, penguins cannot fly. Instead, they have evolved into the most efficient swimmers and divers of all birds. Some species spend 75% of their time at sea – the most of any birds.

Penguin wings are stiff, short flippers to propel them underwater – they literally fly through the sea. Their legs are set far back in the body, and together with the tail, form an underwater rudder to their perfectly streamlined bodies. Their 'cruising' speed in water is about 10km per hour. To catch their breath and to save energy whilst swimming, penguins leap clear of the water every few metres.

They are excellent divers, descending to depths of over 250m, though most of their dives will be in the top 10m. Unlike flying birds, their bones are dense to make diving easier. Underwater they are every bit as fearsome to their prey as lions are to theirs!



However, penguins are rarely seen underwater, so our main impression of them is confined to how they appear on land. With their legs set far back for efficient movement underwater, the penguins walk awkwardly in a very upright position. This is possibly the reason for their extraordinary appeal – they look like funny little people.

Even on land, penguins are surprisingly agile. They can travel vast distances on foot or by 'tobogganing', sliding on their bellies over the ice, propelled by their wings and feet. Some penguins are able to hop up great heights compared to their size.

Penguins of old

Fossil records show that penguins evolved from flying birds (petrels) about 50 million years ago. There were at least 25 species, many of which have become extinct. Some fossil penguins were larger than the ones that exist today, with one species almost as tall as a man (170cm).

i Do penguins have knees?

Yes they do, but hidden under their feathers. Penguins appear to have very short legs, but this is because the upper part can't be seen underneath their baggy coat.

Image: Emperor penguins tobogganing across the sea ice.

Keeping warm

Penguins cope well in the cold – some breed in the coldest conditions in the world. Their short outer feathers overlap, like tiles on a roof, to form a thick waterproof layer; and underneath are fluffier feathers for warmth. Like seals and whales, a thick layer of fat under the skin provides insulation (and extra reserves for when food is scarce). As a rule, the larger the penguin, the easier it is to conserve heat. In fact, many penguins are so good at keeping warm that they have a problem with overheating during the summer months.



Colonies

Penguins are sociable creatures both on land and at sea. Their colonies – known as 'rookeries' – are often huge, with up to a million nesting pairs. In the pure Antarctic air, you can smell a penguin rookery from a long way away! Penguins generally breed on exposed rock, beaches or tussock grass, with the exception of the emperor, which breeds on sea ice.

Enemies

A healthy adult penguin on land has no natural predators, though eggs and chicks are eaten by other birds (skuas and giant petrels). Penguins usually live in places free of land predators, against which they would be defenceless. However, in water, penguins are hunted by leopard seals and killer whales. Leopard seals cruise the ice edge next to penguin colonies, waiting for the birds to plunge into the water.

Food

The penguin diet consists mainly of fish, squid and crustaceans. In the Antarctic, the smaller penguins mostly feed on shrimp-like krill. Although krill are small (up to 5cm in length) they form dense swarms which are a rich food source. Penguins can adapt their diet to what is available, and their diet varies considerably with season.

❶ Why don't penguins' feet freeze?

Penguins stand for hours on ice, but they have two clever ways of keeping their feet the right temperature – a few degrees above freezing. Blood flow to their feet is tightly controlled, with reduced flow in cold conditions. Heat exchangers at the top of their legs take heat from the blood flowing to the feet, and use it to heat up the blood flowing back into the body.

Image: Adélie penguin's feet.

Electronic dive recorders fitted to the backs of penguins give a picture of their feeding habits, recording the times and depths of their dives. The deepest diving penguins are the kings and emperors as they search for squid and fish – the record holder is a female emperor who reached an astonishing 535m.

Though the smaller penguins do not reach such depths, for their size their diving performance is just as remarkable. Gentoo penguins dive to 150m, and a quarter of their dives exceed 100m – in extreme cases they can dive almost continuously for 15 hours, completing over 450 dives.

Numbers

The total number of breeding pairs of penguins in the Antarctic region is estimated to be about 20 million. Although this covers a huge geographical area, the penguins are concentrated in coastal regions. Huddled up in the cold of winter, emperor penguins can reach a density of 19 birds per square metre.

Breeding

The timing of breeding is crucial for penguins. Unlike humans, which can have babies at any time of year, the penguin breeding cycle is finely tuned, so that chicks hatch and are ready to fend for themselves when food is most plentiful. They are very sensitive to environmental conditions. Breeding success is usually controlled by the abundance and availability of prey. If sea ice does not break away, or krill numbers are low, then huge breeding failures can occur, and few chicks survive.

Older birds are the most successful breeders.



❗ Why don't penguins live in the Arctic?

To penguins, swimming in warm seas is like walking around in winter clothes in the height of summer! The warm waters of the equator are a barrier to penguins. Even the penguins living close to the equator stick to the cooler water coming from the south. If penguins could travel to the Arctic, they would find their niche already taken by another bird – the puffin. Puffins are also black and white birds with colourful beaks. However, puffins need to be able to fly to escape land-based predators.

Image: A pair of gentoo penguins on the Antarctic Peninsula.

Most penguins (except the emperor and king) lay more than one egg, usually two. Incubation duties are shared by both parents, working in shifts until the chick hatches, with varying shift lengths from daily changeovers (gentoo) to over a month (emperor). When they are old enough, the chicks gather together in a crèche, watched over by a few adults. This allows both parents to feed at sea, and provides protection from the cold and predators.

Case study: *In 2008/09 on the island of South Georgia, the gentoo colony had a disastrous breeding year with only 1% of chicks surviving to fledge (40-60% survive in normal years). However, the nearby macaroni colony had normal levels of breeding success. Both species feed mainly on krill, but in 1998 krill numbers were low. The macaroni penguins were able to change their diet to smaller crustaceans which were still plentiful. The gentoos' other preferred food, the icefish, is also krill dependent, so the gentoos had little to eat.*



Feathers and moulting

A penguin's feathers keep it waterproof and warm, and must be well oiled (using oil from a special gland at the base of the tail). Feathers become worn out and must be replaced every year. During the 3-4 weeks of moulting, penguins come ashore. Because they are no longer waterproof when they lose their feathers and cannot go to sea to feed, penguins fatten up before moulting, gaining an astonishing 50-70% in weight.

❶ How do you monitor a penguin colony?

Firstly, by counting the penguins daily over many months, to find out the timing of events such as egg laying and hatching. With thousands of pairs in a colony, this is not an easy task! When adults return from the sea to feed the chick, their diet is analysed. Satellite tracking monitors the location of penguins at sea. All this data is tied in with information about the fish, krill and squid in the nearby waters to build up a picture of how penguins 'go about their business'.

Image: Macaroni penguin colony on Bird Island, South Georgia.

Adélie penguins

Pygoscelis adeliae

With their black back and head, and white front, Adélie penguins are like miniature men in evening dress. They are named after the wife of Dumont d'Urville, the French Antarctic explorer.

Adélies are truly Antarctic penguins, restricted to Antarctic coastal waters. During winter they spend their time in the pack ice, then in the summer they move south, back to the Antarctic coast.

Closely packed Adélie rookeries of many thousands of pairs are found all around the Antarctic continent, on ice-free slopes and islands, often far from open water. Fishing mainly for krill, they can dive up to 175m, but mainly catch their food at the surface.

They experience the briefest of breeding seasons in the harshest conditions. The males arrive at the breeding ground first, walking many miles over sea ice. When the females arrive a few days later, a brief courtship of flipper-waving and calling follows – but they must hurry, with such short summers, they don't have much time. Two eggs are laid in mid-November, tended by both parents, which hatch in late December. The chicks join a crèche at three weeks, and by mid-February they are at sea.

Adélies are very vulnerable until they reach the crèche stage, and less than two-thirds of them make it this far. Once at sea they are fairly safe, and can live more than 16 years. Though they have the highest mortality for juveniles and adults of any penguins species, they are a successful species, with four to five million pairs.



❶ Penguins with attitude

Though only small, Adélies are penguins with attitude, and will rush out of a colony to attack a visiting scientist with their flippers.

Image: Adélie penguins on the move.

Chinstrap penguins

Pygoscelis antarctica



Named after the black band of feathers under their chin, chinstrap penguins are probably the most abundant penguin in the Antarctic regions, with an estimated population of over four million pairs, concentrated on the Antarctic Peninsula.

Living mainly on a diet of crustaceans (they can dive up to 70m but catch most of their food in half-minute dives in the top 10m of the sea), chinstraps stick close to their breeding grounds. Unusually, they often dive at night.

They nest on ice-free slopes with thousands of breeding pairs, sometimes with their closest relatives, Adélie and gentoo penguins. The highest slopes are the most popular (they become ice-free first) and they use their beak and claws to reach seemingly improbable spots.

They form a strong pair bond, returning each year to the same nest site with the same partner. Because of their warmer breeding location, chinstraps enjoy a longer breeding season than the Adélie.

The eggs are laid late in November and hatch in early January, and the chicks have usually fledged two months later. The two chicks are treated equally by the parents, but breeding success is severely reduced if the sea ice does not break away from near their colonies.

📌 Penguin colonies

In the world of penguins, chinstraps live in some of the largest cities, with colonies of over 100,000 pairs on some islands.

Image: An adult chinstrap penguin.

Gentoo penguins

Pygoscelis papua

Gentoo penguins live up to their Latin name *pygoscelis* – brush tailed. They have the most prominent tail of all penguins, which sticks out behind and sweeps from side to side as they walk.



They have white patches extending from their eyes and a bright red-orange beak. No-one knows where the name 'gentoo' came from, but they are one of the least numerous Antarctic penguins, with about 300,000 breeding pairs.

Gentoo penguins are less likely to stick together than other penguins and can be found in small groups, sometimes with other species. Although they are not strongly attached to the same nest site (they have plenty of choice of sites) their pair-bonding is strong, and they usually mate with the same partner as the previous year.

They nest on low hilltops or open beaches. When available, they make a nest with pebbles and other objects, and sometimes use a scrape in the ground – but all nests are fiercely defended. Two eggs are laid. In southern locations the first and second-born chicks are equally likely to survive, but the second gentoo chick to hatch in more northerly islands usually dies. If both chicks die, breeding may take place again. Once hatched, the chicks join the crèche about a month later.

There are large differences in gentoo penguins from different locations. Fledging is far quicker in the south (62-82 days) than in the north (85-117 days) and gentoos from the south are smaller than their northerly relatives. Unusually for penguins, their breeding times are not well synchronised and their breeding success fluctuates greatly from year to year.

📍 International travellers

Young gentoo penguins are very adventurous and have been spotted on the coasts of New Zealand and Africa.

Image: Gentoo penguin, with its distinctive orange beak.

King penguins

Aptenodytes patagonicus

King penguins are the second largest penguins, with a striking patch of orange-gold feathers on their neck. They are expert divers, reaching depths of greater than 240m, but walk slowly and deliberately on land.



Unlike their closest relative, the emperor penguin, kings prefer warmer temperatures and live in regions of the subantarctic. Although they look similar, king and emperor penguins rarely meet. King penguins live on the vegetated margins of subantarctic islands, meaning that they do not have to put up with the temperature extremes of the Antarctic continent. However, they too have highly unusual breeding cycles.

A single egg is laid any time from November to April and incubated on the feet. Both parents share the parenting as open water is always close by. It can take 10 to 13 months to fledge a chick. Because of this long chick-rearing period, king penguins only produce two chicks every three years. When six weeks old, the chick joins a crèche whilst its parents go fishing. In a king penguin colony there may be 12-month-old chicks around whilst other birds are incubating eggs.

They live in colonies of varying sizes, from 30 birds to tens of thousands. In the 19th and 20th centuries, populations were reduced through exploitation for their oil, flesh, eggs and skins – populations are now thought to be expanding, and there are estimated to be over one-and-a-half million breeding pairs.

❶ A remarkable metamorphosis

The woolly-coated king penguin chicks were listed as an entirely different species from their parents, ‘the woolly penguin’, in scientific books of the 19th century.

Image: A pair of king penguins in a colony on South Georgia.

Macaroni penguins

Eudyptes chrysolophus

Named after the bizarre ‘Macaroni coiffure’ hairstyles of 18th century dandies, macaroni penguins have orange tufty plumes for eyebrows.

With an estimated population of over six million breeding pairs, macaroni penguins are the most numerous penguins, but only a proportion of them live in the Antarctic region where they inhabit subantarctic islands (although there is one macaroni rookery on the Antarctic Peninsula).

Macaronis are very colonial, forming massive colonies of hundreds of thousands of birds, nesting on hillsides and rocky cliffs. They are very vocal, especially when establishing territories.

Like other crested penguins, the macaroni has a curious egg-laying habit. Two eggs are laid, the first much smaller than the second. The small egg rarely hatches, and only one chick is ever raised. Why? No-one knows.

On the island of South Georgia they arrive at their breeding grounds in late October and lay their eggs about two weeks later. Long incubation shifts are shared between both parents, who can lose up to half of their body weight. The chick fledges two months after hatching. Only one third of the breeding pairs raise a chick to fledge, but this success rate is very stable. The macaroni does not experience the boom and bust cycles of other penguins, possibly because they concentrate their efforts on just one chick.



❶ Mysterious macaronis

Scientists are still puzzling as to why the smaller of the two eggs laid by crested penguins will produce a chick only if the larger egg is lost.

Image: An adult macaroni penguin.

Emperor penguins

Aptenodytes forsteri

The emperor is the giant of the penguin world and one of the largest of all birds. Gold patches on their ears and on the top of their chest brighten up their black heads. If the Adélies are the comics of the penguin world, the slow, dignified emperors are the elder statesmen.

Emperors and their closest relative, the king penguin, have unique breeding cycles, with very long chick-rearing periods. The emperor penguins breed the furthest south of any penguin species, forming large colonies on the sea ice surrounding the Antarctic continent. They are true Antarctic birds, rarely seen in the subantarctic waters.

So that the chicks can fledge in the late summer season, emperors breed during the cold, dark winter, with temperatures as low as -50°C and winds up to 200km per hour. The female lays a single egg in May then passes it over to her mate to incubate whilst she goes to sea to feed. For nine weeks the male fasts, losing 45% of his body weight.

The male balances the egg on his feet, which are covered in a thick roll of skin and feathers. The egg can be 70°C warmer than the outside temperature. To achieve this amazing preservation of heat, emperors have a special combination of adaptations, with a dense double layer of feathers and a large fat reserve. They also cast aside the aggression of other species, with up to 5,000 adults and chicks huddling together for warmth, shuffling round so each gets a turn on the outside. To prevent heat loss, emperor penguins have proportionally smaller beaks and flippers compared to other penguins.

When the female arrives back in August, just around the time when the chicks are due to hatch, she takes over feeding the chick whilst the male treks up to 100km over the ice to find food. Afterwards, both adults rear the chick.

When the sea ice begins to break out in December/January the chicks are shedding their soft down, but still go to sea, weighing only 60% of adult weight, the lowest value for any penguin. It is thought that emperors evolved this unusual winter breeding to allow the chick to be independent at a time when food is most plentiful. They can breed when they are three years old, but many will not start until they are six. They can live for up to 20 years.

They have a high survival rate compared to other penguins, with an average of 95% surviving the year. However, if it is a harsh sea-ice year, many chicks will die of starvation. Emperors are the least common Antarctic penguin, however recent satellite monitoring has revealed more than were thought – up to 600,000 birds living in colonies right around the Antarctic continent.

Birds of the sea

Emperor penguins may be the only bird never to set foot on land. They even breed on the frozen sea.



The future

Antarctic penguins are very abundant, perhaps due to the remoteness of their breeding grounds, and their future is not under any immediate threat.

However, they are highly sensitive to changes in their food supply – the fish, krill and squid of the Southern Ocean. Fisheries in this region are closely managed to take account of the demands of penguins.

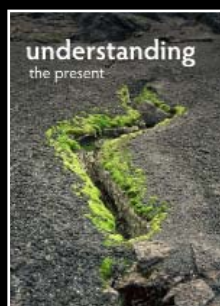
Climate change is likely to cause a redistribution of penguin populations, with less hardy penguins travelling further south as conditions become more favourable to them.

For example, the gradual warming of the Antarctic Peninsula has reduced the area covered by winter sea ice. New, ice-free areas have become available to the open-water loving chinstrap penguin. The pack ice loving Adélie penguin must range further south to find ideal conditions in which to live.

The fossil record shows that past climate change may have caused the extinction of many penguin species. Penguins are an indicator species for the effects of future climate change, as a small shift in temperature in icy regions can have a larger, more widespread impact.

The seas in the Antarctic Peninsula region are an important nursery for the main food source of the Southern Ocean – the Antarctic krill. Krill supplies are closely interlinked with breeding success in penguin populations. Recent research shows that there could be serious consequences for penguins if climate change in the Antarctic region affects krill populations.

Image: *Adult emperor penguins on the sea ice.*



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