

= Macaroni penguin =

The macaroni penguin (*Eudyptes chrysolophus*) is a species of penguin found from the Subantarctic to the Antarctic Peninsula . One of six species of crested penguin , it is very closely related to the royal penguin , and some authorities consider the two to be a single species . It bears a distinctive yellow crest , and the face and upperparts are black and sharply delineated from the white underparts . Adults weigh on average 5 @. @ 5 kg (12 lb) and are 70 cm (28 in) in length . The male and female are similar in appearance , although the male is slightly larger and stronger with a relatively larger bill . Like all penguins , it is flightless , with a streamlined body and wings stiffened and flattened into flippers for a marine lifestyle . They also have red eyes .

Its diet consists of a variety of crustaceans , mainly krill , as well as small fish and cephalopods ; the species consumes more marine life annually than any other species of seabird . These birds moult once a year , spending about three to four weeks ashore , before returning to the sea . Numbering up to 100 @, @ 000 individuals , the breeding colonies of the macaroni penguin are among the largest and densest of all penguin species . After spending the summer breeding , penguins disperse into the oceans for six months ; a 2009 study found that macaroni penguins from Kerguelen travelled over 10 @, @ 000 km (6 @, @ 200 mi) in the central Indian Ocean . With about 18 million individuals , the macaroni penguin is the most numerous penguin species . However , widespread declines in populations have been recorded since the mid @- @ 1970s . Their conservation status is being reclassified as vulnerable .

= = Taxonomy = =

The macaroni penguin was described from the Falkland Islands in 1837 by German naturalist Johann Friedrich von Brandt . It is one of six or so species in the genus *Eudyptes* , collectively known as crested penguins . The genus name is derived from the Ancient Greek words eu " good " , and dyptes " diver " . The specific epithet *chrysolophus* is derived from the Greek words *chryse* " golden " , and *lophos* " crest " .

The common name was recorded from the early 19th century in the Falkland Islands . English sailors apparently named the species for its conspicuous yellow crest ; Maccaronism was a term for a particular style in 18th @- @ century England marked by flamboyant or excessive ornamentation . A person who adopted this fashion was labelled a " maccaroni " or " macaroni " , as in the song " Yankee Doodle " .

Molecular clock evidence using DNA suggests the macaroni penguin split from its closest relative , the royal penguin (*Eudyptes schlegeli*) , around 1 @. @ 5 million years ago . Although the two have generally been considered separate species , the close similarities of their DNA sequences has led some , such as the Australian ornithologists Les Christidis and Walter Boles , to treat the royal as a subspecies of the macaroni . The two species are very similar in appearance , although the royal penguin has a white face instead of the usually black face of the macaroni . Interbreeding with the Indo @- @ Pacific subspecies of the southern rockhopper penguin (*E. chrysocome filholi*) has been reported at Heard and Marion Islands , with three hybrids recorded there by a 1987 ? 88 Australian National Antarctic Research Expedition .

= = Description = =

The macaroni penguin is a large , crested penguin , similar in appearance to other members of the genus *Eudyptes* . An adult bird has an average length of around 70 cm (28 in) ; the weight varies markedly depending on time of year and sex . Males average from 3 @. @ 3 kg (7 lb) after incubating , or 3 @. @ 7 kg (8 lb) after moult to 6 @. @ 4 kg (14 lb) before moult , while females average 3 @. @ 2 kg (7 lb) after to 5 @. @ 7 kg (13 lb) before moult . Among standard measurements , the thick bill (from the gape) measures 7 to 8 cm (2 @. @ 8 to 3 @. @ 1 in) , the culmen being around a centimetre less . The wing , from the shoulder to the tip , is around 20 @. @ 4 cm (8 @. @ 0 in) and the tail is 9 ? 10 cm (3 @. @ 5 ? 3 @. @ 9 in) long . The head , chin ,

throat , and upper parts are black and sharply demarcated against the white under parts . The black plumage has a bluish sheen when new and brownish when old . The most striking feature is the yellow crest that arises from a patch on the centre of the forehead , and extends horizontally backwards to the nape . The flippers are blue @-@ black on the upper surface with a white trailing edge , and mainly white underneath with a black tip and leading edge . The large , bulbous bill is orange @-@ brown . The iris is red and a patch of pinkish bare skin is found from the base of the bill to the eye . The legs and feet are pink . The male and female are similar in appearance , although males tend to be slightly larger . Males also bear relatively larger bills , which average around 6 @. @ 1 cm (2 @. @ 4 in) compared to 5 @. @ 4 cm (2 @. @ 1 in) in females ; this feature has been used to tell the sexes apart .

Immature birds are distinguished by their smaller size , smaller , duller @-@ brown bill , dark grey chin and throat , and absent or underdeveloped head plumes , often just a scattering of yellow feathers . The crest is fully developed in birds aged three to four years , a year or two before breeding age .

Macaroni penguins moult once a year , a process in which they replace all of their old feathers . They spend around two weeks accumulating fat before moulting because they do not feed during the moult , as they cannot enter the water to forage for food without feathers . The process typically takes three to four weeks , which they spend sitting ashore . Once finished , they go back to sea and return to their colonies to mate in the spring . Overall survival rates are poorly known ; the successful return of breeding adults at South Georgia Island varied between 49 % and 78 % over three years , and around 10 % of those that did return did not breed the following year .

= = Distribution and habitat = =

A 1993 review estimated that the macaroni was the most abundant species of penguin , with a minimum of 11 @, @ 841 @, @ 600 pairs worldwide . Macaroni penguins range from the Subantarctic to the Antarctic Peninsula ; at least 216 breeding colonies at 50 sites have been recorded . In South America , macaroni penguins are found in southern Chile , the Falkland Islands , South Georgia and the South Sandwich Islands , and South Orkney Islands . They also occupy much of Antarctica and the Antarctic Peninsula , including the northern South Shetland Islands , Bouvet Island , the Prince Edward and Marion islands , the Crozet Islands , the Kerguelen Islands , and the Heard and McDonald Islands . While foraging for food , groups will range north to the islands off Australia , New Zealand , southern Brazil , Tristan da Cunha , and South Africa .

= = = Conservation = = =

Although the population of macaroni penguins is estimated at around 18 million mature individuals , a substantial decline has been recorded in several locations . This includes a 50 % reduction in the South Georgia population between the mid @-@ 1970s to mid @-@ 1990s , and the disappearance of the species from Isla Recalada in Southern Chile . This decline of the overall population in the last 30 years has resulted in the classification of the species as globally Vulnerable by the IUCN Red List of Threatened Species . Long @-@ term monitoring programs are underway at a number of breeding colonies , and many of the islands that support breeding populations of this penguin are protected reserves . The Heard Islands and McDonald Islands are World Heritage Sites for the macaroni penguin . The macaroni penguin may be being impacted by commercial fishing and marine pollution . A 2008 study suggests the abilities of female penguins to reproduce may be negatively affected by climate- and fishing @-@ induced reductions in krill density .

= = Life history = =

Like most other penguin species , the macaroni penguin is a social animal in its nesting and its foraging behaviour ; its breeding colonies are among the largest and most densely populated . Scientist Charles Andre Bost found that macaroni penguins nesting at Kerguelen dispersed

eastwards over an area exceeding 3×10^6 km² . Fitted with geolocation sensors , the 12 penguins studied travelled over 10 @, @ 000 km (6 @, @ 200 mi) during the six- to seven @-@ month study period and spent their time largely within a zone 47 ? 49 ° S and 70 ? 110 ° E in the central Indian Ocean , not coming ashore once . This area , known as the Polar Frontal Zone , was notable for the absence of krill .

Living in colonies results in a high level of social interaction between birds , which has led to a large repertoire of visual , as well as vocal , displays . These behaviours peak early in the breeding period , and colonies particularly quieten when the male macaroni penguins are at sea . Agonistic displays are those which are intended to confront or drive off or , alternatively , appease and avoid conflict with other individuals . Macaroni penguins , particularly those on adjacent nests , may engage in ' bill @-@ jousting ' ; birds lock bills and wrestle , each trying to unseat the other , as well as batter with flippers and peck or strike its opponent 's nape . Submissive displays include the ' slender walk ' , where birds move through the colony with feathers flattened , flippers moved to the front of the body , and head and neck hunched , and general hunching of head and neck when incubating or standing at the nest .

= = = Diet = = =

The diet of the macaroni penguin consists of a variety of crustaceans , squid and fish , although the proportions that each makes up vary with locality and season . Krill , particularly Antarctic krill (*Euphausia superba*) , account for over 90 % of food during breeding season . Cephalopods and small fish such as the marbled rockcod (*Notothenia rossii*) , painted notie (*Lepidonotothen larseni*) , *Champsocephalus gunneri* , the lanternfish species *Krefftichthys anderssoni* , *Protomyctophum tenisoni* and *P. normani* become more important during chick @-@ rearing . Like several other penguin species , the macaroni penguin sometimes deliberately swallows small (10 ? to 30 @-@ mm @-@ diameter) stones ; this behaviour has been speculated to aid in providing ballast for deep @-@ sea diving , or to help grind food , especially the exoskeletons of crustaceans which are a significant part of its diet .

Foraging for food is generally conducted on a daily basis , from dawn to dusk when they have chicks to feed . Overnight trips are sometimes made , especially as the chicks grow older ; a 2008 study that used surgically implanted data loggers to track the movement of the birds showed the foraging trips become longer once the chick @-@ rearing period is over . Birds venture out for 10 ? 20 days during incubation and before the moult . Macaroni penguins are known to be the largest single consumer of marine resources among all of the seabirds , with an estimated take of 9 @. @ 2 million tonnes of krill a year . Outside the breeding season , macaroni penguins tend to dive deeper , longer , and more efficiently during their winter migration than during the summer breeding season . Year round , foraging dives usually occur during daylight hours , but winter dives are more constrained by daylight due to the shorter days .

Foraging distance from colonies has been measured at around 50 km (31 mi) at South Georgia , offshore over the continental shelf , and anywhere from 59 to 303 kilometres (37 to 188 mi) at Marion Island . Macaroni penguins normally forage at depths of 15 to 70 m (49 to 230 ft) , but have been recorded diving down to 100 m (330 ft) on occasions . Some night foraging does occur , but these dives are much shallower , ranging from only 3 to 6 m (9 @. @ 8 to 19 @. @ 7 ft) in depth . Dives rarely exceed two minutes in duration . All dives are V @-@ shaped , and no time is spent at the sea bottom ; about half the time on a foraging trip is spent diving . Birds have been calculated as catching from 4 to 16 krill or 40 to 50 amphipods per dive .

= = = Predators = = =

The macaroni penguin 's predators consist of birds and aquatic mammals . The leopard seal (*Hydrurga leptonyx*) , Antarctic fur seal (*Arctocephalus gazella*) , Subantarctic fur seal (*A. tropicalis*) , and killer whale (*Orcinus orca*) sometimes hunt adult macaroni penguins in the water . Colonies suffer low rates of predation if undisturbed ; predators generally only take eggs and young that have

been left unattended or deserted . Skua species , the snowy sheathbill (*Chionis alba*) , and kelp gull (*Larus dominicanus*) prey on eggs , and skuas and giant petrels also sometimes take chicks .

= = = Courtship and breeding = = =

Female macaroni penguins can begin breeding at around five years of age , while the males do not normally breed until at least six years old . Females breed at a younger age because the male population is larger . The surplus of male penguins allows the female penguins to select more experienced male partners as soon as the females are physically able to breed . Commencing a few days after females arrive at the colony , sexual displays are used by males to attract partners and advertise their territory , and by pairs once together at the nest site and at changeover of incubation shifts . In the ' ecstatic display ' , a penguin bows forward , making loud throbbing sounds , and then extends its head and neck up until its neck and beak are vertical . The bird then waves its head from side to side , braying loudly . Birds also engage in mutual bowing , trumpeting , and preening . Monitoring of pair fidelity at South Georgia has shown around three @-@ quarters of pairs will breed together again the following year .

Adult macaroni penguins typically begin to breed late in October , and lay their eggs in early November . The nest itself is a shallow scrape in the ground which may be lined with some pebbles , stones , or grass , or nestled in a clump of tussock grass (on South Georgia Island) . Nests are densely packed , ranging from around 66 cm apart in the middle of a colony to 86 cm at the edges . A fertile macaroni penguin will lay two eggs each breeding season . The first egg to be laid weighs 90 ? 94 g (3 @.@ 2 ? 3 @.@ 3 oz) , 61 ? 64 % the size of the 145 ? 155 g (5 @.@ 1 ? 5 @.@ 5 oz) second , and is extremely unlikely to survive . The two eggs together weigh 4 @.@ 8 % of the mother 's body weight ; the composition of an egg is 20 % yolk , 66 % albumen , and 14 % shell . Like those of other penguin species , the shell is relatively thick to minimise risk of breakage , and the yolk is large , which is associated with chicks born in an advanced stage of development . Some of the yolk remains at hatching and is consumed by the chick in its first few days .

The fate of the first egg is mostly unknown , but studies on the related royal penguin and erect @-@ crested penguin show the female tips the egg out when the larger second egg is laid . The task of incubating the egg is divided into three roughly equal sessions of around 12 days each over a five @-@ week period . The first session is shared by both parents , followed by the male returning to sea , leaving the female alone to tend the egg . Upon the male 's return , the female goes off to sea and does not return until the chick has hatched . Both sexes fast for a considerable period during breeding ; the male fasts for 37 days after arrival until he returns to sea for around 10 days before fasting while incubating eggs and young for another 36 days , and the female fasts for 42 days from her arrival after the male until late in the incubation period . Both adults lose 36 ? 40 % of their body weight during this period . The second egg hatches around 34 days after it is laid . Macaroni penguins typically leave their breeding colony by April or May to disperse into the ocean .

From the moment the egg is hatched , the male macaroni penguin cares for the newly hatched chick . For about 23 to 25 days , the male protects its offspring and helps to keep it warm , since only a few of its feathers have grown in by this time . The female brings food to the chick every one to two days . When they are not being protected by the adult male penguins , the chicks form crèches to keep warm and stay protected . Once their adult feathers have grown in at about 60 to 70 days , they are ready to go out to sea on their own .