



Australian blue whales now call Antarctica home

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The first evidence of interbreeding between subspecies of blue whales suggest that their ecology is changing, possibly due to historic whaling or climate change.

An adult blue whale can weigh more than 160 tonnes, a mass unsurpassed by any animal known to have existed. Their length can reach up to 30 metres, which has only been met or surpassed by the long-necked, long-tailed and thick-legged terrestrial dinosaurs known as sauropods.

Blue whales might be the largest living animal yet they are one of the most mysterious. The vastness of the ocean – which occupies over 70% of the Earth’s surface – and their ability to travel long distances makes blue whales difficult to observe.

Finding the Rare and Elusive Blue Whale

Blue whales can migrate thousands of kilometres between breeding grounds close to the Equator that they occupy in winter and feeding grounds in colder waters that they occupy in summer. While each population of blue whales uses particular feeding and breeding grounds, they may share feeding grounds with blue whales from other populations.

Although immense in size, the blue whale feeds exclusively on small, shrimp-like crustaceans known as krill. Feeding aggregations of blue whales occur where there are sufficient densities of krill to meet the high energy demands of these whales.

Australia is home to two known feeding grounds of blue whales: along the Bonney coast in Victoria and South Australia, and at the underwater canyon, known as the Perth Canyon, located west of Rottnest Island in Western Australia. Blue whales feeding at these grounds are thought to migrate to breeding grounds that include waters off Indonesia in the Banda Sea.

Blue whales feeding in waters off Australia are actually a population of a subspecies of blue whale known as the pygmy blue whale. As the subspecies name suggests, they are shorter than other subspecies but can still reach 24 metres in length.

The other known subspecies in the Southern Hemisphere is the Antarctic blue whale. It has feeding grounds in the ice cold habitat of the Antarctic, and breeding grounds that likely include areas close to the Equator in the Indian and Pacific oceans.

It has been thought that this subspecies has little, if any, interaction with pygmy blue whales. However, recent genetic analyses indicate otherwise.

DNA Tells Many Tales

DNA is the basis of life. We would not be able to exist without it. Everybody – except identical twins – has a different DNA “fingerprint”. DNA can be used to identify you, your relatives and your genetic ethnicity. It has been used to identify the most closely related species to us. The same analyses can be applied to ecological and evolutionary questions about wild animals.

There are more genetic differences between individuals from different populations, subspecies or species than there are between individuals of the same population, subspecies or species. These differences can be used to identify when an individual is in a location that is different from where its population or subspecies exists, or if an individual is an offspring of parents from different populations, subspecies or species.

Our research team looked at DNA from blue whales feeding off Australia and blue whales feeding off Antarctica. The 109

blue whales sampled off Australia were all pygmy blue whales. However, four of 155 blue whales sampled off Antarctica were pygmy blue whales from the Australian population and six were hybrids between the Australian population of pygmy blue whales and the Antarctic blue whales.

Why Are Australian Pygmy Blue Whales Living in Antarctica?

The proportion of pygmy blue whales off Antarctica was greater than expected based on previous non-genetic analyses of the length of individuals found off Antarctica. Our genetic analyses are based on samples collected since 1990, whereas previous analyses were based on historical whaling records that span from 1913 to 1973. Therefore the different findings of the analyses may be explained by a real, recent change in the proportion of pygmy blue whales off Antarctica.

The detection of six hybrids between the Australian population of pygmy blue whales and the Antarctic blue whales means that the two subspecies are interbreeding. This is the first evidence of hybridisation between any blue whale subspecies.

Why would the proportion of pygmy blue whales have recently changed? It could be due to human impacts. Hundreds of thousands of blue whales were killed during 20th century whaling. Antarctic blue whales were the most severely hunted subspecies, with numbers dropping to less than 1% of their original abundance. Antarctic blue whales conceivably went from the most numerous subspecies to equal or less than the abundance of pygmy blue whales.

The proportion of pygmy blue whales off Antarctica may therefore have increased due to a decrease in Antarctic blue whale abundance, even if the absolute number of pygmy blue whales off Antarctica remained unchanged. Alternatively, the absolute number of pygmy blue whales may have increased due to more opportunities for pygmy blue whales to go to the Antarctic since there is now less competition with Antarctic blue whales for environmental resources like krill.

Recent climate change could also have increased the proportion of pygmy blue whales off Antarctica. Animals are adapted to live in certain environments, but global warming can force populations, subspecies or species that are limited to certain



A pygmy blue whale feeds on krill in waters off Australia.

temperatures to shift towards the poles so they can remain at their adapted environmental temperature. Pygmy blue whales would move towards Antarctica, as our genetic analyses indicate, and Antarctic blue whales would contract further towards Antarctica's ice edge.

Another possibility is differences in the methods used caused differences between the findings of genetic and non-genetic data. This would mean that a real change in the proportion of pygmy blue whales has not occurred. Instead, the perceived change is just an artefact of the methods.

However, our research team also conducted genetic analyses that looked at the proportion of pygmy blue whales off Antarctica over evolutionary time scales, specifically since the last



Credit: research team

common ancestor of the two subspecies. The proportion of pygmy blue whales off Antarctica from these analyses agrees with non-genetic analyses of historical whaling catches, and is therefore different to the findings of genetic analyses looking at recent time scales.

Taken together, this suggests that the ecology of the Australian population of pygmy blue whales and the Antarctic blue whales has recently changed due to human impacts.

Why Are the Subspecies Interbreeding?

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Subspecies are expected to be able to hybridise and produce fertile offspring. However, subspecies do not interbreed often since they usually live in different locations.

Interbreeding may have occurred due to a recent increase in the proportion of pygmy blue whales off Antarctica. If so, it would mean that humans are changing the natural genetic architecture of the blue whale subspecies.

However, waters off Antarctica are recognised as a blue whale feeding ground – not a breeding ground. Populations and subspecies can theoretically co-exist in feeding grounds without interbreeding.

Pygmy blue whales using waters off Antarctica could still migrate and then breed during the winter with the Antarctic blue whales at their breeding grounds. Another possibility is – unexpectedly – that the subspecies may interbreed off Antarctica outside the normal winter breeding season.

What is particularly intriguing is that the pygmy blue whales and hybrids detected off Antarctica were all found in the same area: between 0° and 16°E, which is roughly south of Africa. This was also an area where many blue whales were caught during historic whaling. This suggests site fidelity of individuals to specific areas of Antarctica.

It is thought that calves, including hybrids, would learn where breeding grounds, feeding grounds and migratory routes are located from their mother. Therefore a hybrid may learn from its mother to annually return to this feeding region off Antarctica.

Conserving Blue Whales

While blue whales are currently protected from whaling, they are still recovering from the drastic reduction in numbers caused by 20th century whaling. Other anthropogenic pressures also currently threaten and may inhibit their recovery from historic whaling.

Our research and the research of others indicate that current climate change is a threat to blue whales and other wildlife worldwide. Whales and dolphins are also threatened by marine pollution from urban run-off, plastic bags and oil spills, and by changes in habitat due to the construction of oil and gas platforms, marinas and ports.

While blue whales are conserved through international, national and regional management entities, every person can help. You can reduce your carbon footprint, dispose of waste thoughtfully, recycle, and use the marine environment responsibly. This is needed to allow the continued existence of Earth's largest living animal.

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