

 **BLOG:****SOON AFTER DIGGING
THE SNOW PITS ...**

a curious emperor penguin slid and waddled between the groups taking a long hard look at what was going on. A few hours later it was joined by a friend, and when we left the floe there were five of these splendid looking birds basking in the sun. By this time they had turned into rather aloof stars who simply know they are wonderful.



Viruses to whales


The tiniest life

FREEZING TEMPERATURES, WIND CHILL, dehydration, ice, low light and ultraviolet radiation – it's amazing anything survives in the Antarctic. But so much does. The oceans around it, the coastlines and even the dry valleys are home to a unique and thriving fauna and flora. Everything from viruses to blue whales is found here, each adapted to these extreme conditions. The story begins under the microscope, since microscopic organisms are the founding blocks of the food chain and are more important than largely appreciated. To emphasise the point, the weight of all the viable bacteria in the Southern Ocean is more than that of all the whales.

ANCIENT ICE Bacteria have been extracted from glacial ice over 20,000 years old from sites as diverse as Greenland, the Antarctic and high Tibetan plateaus. In the Vostok ice core too, bacteria have been retrieved from ice 3.5 km (2 miles) from the surface and just 150 m (492 ft) above the sub-glacial Lake Vostok. The ice at this point of the core is actually frozen lake water stuck to the bottom of the overlying ice sheet, so scientists are predicting that viable bacteria will be present within the ancient lake waters further down. Many of the species recovered from these ancient ice samples are spore-forming species, which are very resilient resting stages of the bacteria that enable them to survive harsh conditions. Clearly they have survived very well for many thousands of years. These ancient bacteria may give us clues as to how life forms survive on the ice of extraterrestrial systems such as on Mars or the icy moon of Jupiter, Europa.

COLOURED SNOW Not all the microbes on Antarctica are ancient and some can have quite startling effects on their surroundings. Against the vast white expanse, huge patches of red, green and yellow can appear on the snow surface, caused by microscopic algae. The various colours come from the combinations of pigments produced in the algal cells for photosynthesis and to protect against ultraviolet radiation. To grow, the cells need water, light and a source of nutrients such as nitrogen and phosphorus. They get water from the melting snow. The tiny amounts of nitrogen and phosphorus they need are also trapped in snow. Where there are animals, especially birds, their faeces and guano are a rich supply of nutrients, supporting a richer growth of algae.



 The footprints of Adélie penguins are highlighted by snow algae that move through the snow.

BLOG:

... our engineer, will do a check of the pump filters. He often finds an array of sea creatures including spiders, lice, worms and various fish. The lice are particularly amazing and are surprisingly large... with long, elongated legs. They have a dark coloured back, but the underside of their bodies is creamy white in colour and translucent. I haven't seen anything quite like them before. They are kind of creepy looking and a little out of this world. Makes you wonder what else is lurking about under the ice. ■

➡ Invertebrates – no backbone

There are no terrestrial vertebrates on Antarctica – penguins and seals do not live on the land they just use it as a resting and breeding place – but there are some invertebrates, those animals without a backbone. Like the plants, numbers are low and poorly distributed. They are also mostly very small and include animals such as nematode worms, springtails and mites. It's not so much the freezing temperatures that limit their activity, but rather the threat of dehydration. Some produce antifreezes which enable them to combat the threat, enabling them to cool down to between -20 and -50°C (-4 and -58°F) without freezing. The mite, *Nanorchestes antarcticus*, is considered to be the most southerly occurring animal at 85° 35'S. It not only tolerates temperatures as low as -40°C (-40°F), but remarkably it can also survive very warm temperatures of 37°C (98.6°F).

LIFE ON LAND Species of the small, segmented group called tardigrades (water bears), and the multi-cellular rotifers have devised a very effective survival strategy. These organisms live in the soil, and plant debris, as well as in the bases of lichens and within cushions of moss. When external conditions get dangerous, say temperatures plummet or there is high radiation, they undergo a state of cryptobiosis, where they halt their metabolism and reduce their water content down to as little as 1%. Essentially, they go into suspended animation. It's thought tardigrades might be able to stay this way for hundreds of years.

Springtails, at 2 mm (0.07 in) long, are one of the biggest land-living animals on the continent. They can be found in swarms around penguin colonies, eating mainly dead vegetation and fungi. Soil-living nematodes are also numerous and are vital for the breakdown of organic matter and the resulting release of nitrogen and phosphorus into the ground. They feed on bacteria, fungi and algae, and can also enter cryptobiotic states. Not to be forgotten of course are the nematodes, fleas and lice that live within the fur of animals, between the feathers of birds and amongst the baleen plates of whales. These are surely among the warmest places in Antarctica for invertebrates to live. However, the invertebrates that have it best are the numerous parasitic organisms that live inside the mammals and birds.

INVERTEBRATES UNDER THE SEA In contrast to the few invertebrates on land, the sea is heaving with invertebrate life. Many are sessile suspension feeders such as sponges, jellyfish and echinoderms. They live on food particles in the water, from bacteria to small crustaceans. As is also known from the cold, deep sea, some species of Antarctic molluscs and crustaceans can grow much larger than their counterparts in shallow waters in warmer regions. Antarctic sea spiders, for example, at 40 cm (16 in) across bigger than a large dinner plate, are 100 times the size of the common European sea spider. The woodlice-like isopods such as *Glyptonotus antarcticus*, found throughout Antarctic waters, grow up to 20 cm (8 in) long. Isopods in other parts of the world may reach a paltry few centimetres. Other 'giants' include sponges 2–4 m (6 ½–13 ft) tall and ribbon worms 3 m (10 ft) long.



➡ A research diver reaches out to a jellyfish. He can only stay under the pack ice for about 40 minutes.

THE ELEPHANT OF THE SOUTHERN OCEAN Much more obvious are the colossal southern elephant seals *Mirounga leonine*, which haul out on the northern beaches of the Antarctic Peninsula and the sub-Antarctic islands, in particular South Georgia and Macquarie islands. Males can balloon to 3700 kg (582 stone), as much as an Asian elephant, while females weigh in at a more slender 300–850 kg (47–133 stone). They spend 90% of their lives at sea, their immense blubber reserves crucial to their survival in the icy waters. Despite their bulk, elephant seals are superb divers reaching depths of 1500 m (4921 ft) in two-hour dives looking for fish and their favourite, squid. The South Georgia population of southern elephant seals alone are thought to eat 3.5 million tonnes of squid each year. Elephant seals were thought to generally avoid pack ice of any description, especially when young. However, recent satellite tracking from the Antarctic Peninsula has shown that adult female elephant seals can spend long periods around pack ice, feeding on Antarctic silverfish.



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Southern elephant seals can become entangled in fierce battles over territories and harems.

➔ The biggest of them all

The largest organisms to roam the Southern Ocean, indeed on Earth, are the whales. These majestic animals are a favourite with many people, but some species are an increasingly rare sight. Commercial whaling (mostly between 1900 and 1960) slashed the blue and humpback whale populations to 1%. It is now illegal to whale commercially in the Southern Ocean, but this decimation cannot be reversed and numbers of some species remain low. A prerequisite for all whales in ice-covered waters is that there are sufficient areas of open water for them to surface and breathe. Consequently, few whales are found deep within the pack ice during winter, and typically they only migrate to feed in southerly parts of the Southern Ocean in the ice-free summer months.

KILLERS OF THE PACK Besides the leopard seals, killer whales, *Orcinus orca*, are the top predatory animals. They typically hunt in pairs, or on occasions, in pods of up to 50 individuals, around the outer margins of the pack ice. By feeding in pods, killer whales can tackle large prey such as other whales. They've even been seen making co-ordinated leaps into the air, coming down to smash up ice floes, tossing any resting seals or penguins into the water. A phenomenal adaptation to life in the frozen ocean. There are two types of killer whale in the Antarctic. The white form as it's known feeds on penguins, seals and other whales, and swims in more open waters and loose pack ice. In contrast, the yellow form, yellow due to a covering of small microscopic organisms called diatoms, feeds mainly on fish deeper in the pack ice.

Sperm whales, *Physeter macrocephalus*, are the largest of the toothed whales and cruise the outer margins of the Antarctic pack-ice zone. These whales feed almost exclusively on squid, and can dive for periods of up to two hours and to depths of 3000 m (9843 ft). Sperm whales have a characteristic bulbous

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Orcas travel within the pack ice, but need cracks in the ice through which to come up for air.

