Freshwater fauna of Antarctica – pre-glacial survivors or recent invaders from the north?

Most Antarctic freshwater lakes contain a range of invertebrate animals – including tardigrades, rotifers, nematodes and crustacea – that graze on bacteria, algae and other small organisms. However the origins of these fauna are unclear.

Some people argue that complete glaciation of the Antarctic continent at the last glacial maximum destroyed all freshwater habitats and that all the species currently present have colonised Antarctica from more temperate areas, such as South America, over the last 12 000 years. However, glaciation is now known not to have been complete. It is possible then that some freshwater habitats continued to exist through the ice ages, and that animals that survived in these refuges have spread in more recent times. If the latter process – termed 'vicariance' – occurred, some of the fauna present in Antarctic lakes may have been associated with Antarctica for a very long time.

Which of these two processes was responsible for the Antarctic fauna we see today? We are currently undertaking a project that aims to answer this question for animals in the lakes of East Antarctica and the Antarctic Peninsula.

A simple approach to the question is to look at current animal distributions. For example, the copepod *Boeckella poppei* occurs in Patagonia and along the western side of the Antarctic Peninsula. It is easy to conclude that it has colonised Antarctica from South America. However, a further, isolated, population of *Boeckella poppei* occurs in lakes in the Prince Charles Mountains, many thousands of kilometres from the Antarctic Peninsula. How did this population get there?

One suggestion is that human activity has resulted in the transfer. But a detailed study of the morphology (physical characteristics) of animals in the Prince Charles Mountains lakes showed that each population is slightly different from the others and from animals from the Antarctic Peninsula and South America. This indicates that they have been separated from each other long enough to evolve individual characteristics. These findings argue for the occurrence of *Boeckella poppei* on the Antarctic continent for a significant time span. It is possible that the current distribution is derived from both colonisation from South America and vicariance on the continent.

Another approach to the question is to study the distribution of animal remains in sediments from freshwater lakes. When an animal dies, hard parts of its body and other remains – such as eggs and spermatophores – may be preserved in the sediment. By taking a sediment core from a lake and systematically searching for these remains, we can build a picture of how the animal community in the lake has changed over time.

Through our study of sediment cores from lakes in three ice-free regions in East Antarctica, as well as from the Antarctic Peninsula, we are detecting several trends.

Firstly, many species currently found in the lakes are present in the oldest sediments (typically 5000–10 000 years old), suggesting that they reached the lakes soon after the lakes were formed. Secondly, biodiversity has in some cases decreased with time, indicating that an initial pulse of invasions has not continued. These results suggest a local source for the fauna, rather than an intercontinental invasion.

We have a particularly interesting sediment core from Lake Reid in the Larsemann Hills. Radiocarbon dating indicates that the oldest sediments in this lake were deposited prior to the last glacial maximum (15 000–18 000 years ago). Remains of the cladoceran *Daphniopsis studeri* occur in the oldest sediment in this lake and throughout the remainder of the core. This indicates that the animal is not a recent invader from subantarctic islands, where it also occurs. Rather, we may be getting a rare glimpse of the fauna of Antarctic freshwater lakes as they were prior to the last ice age.

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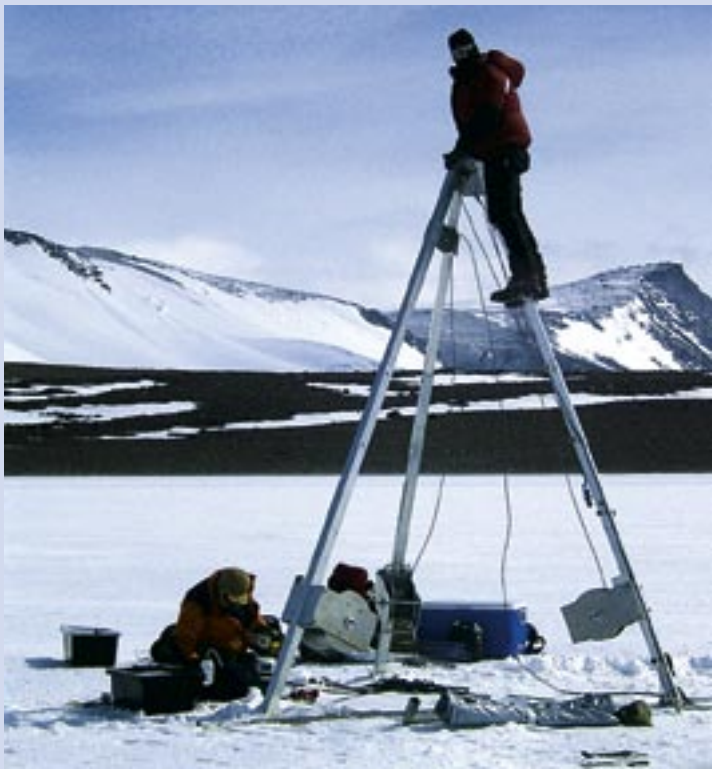

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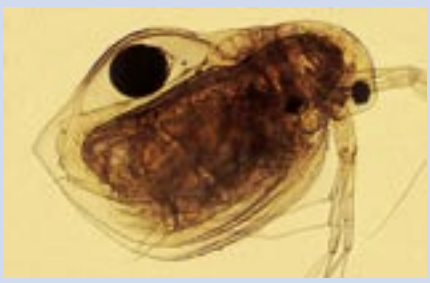

Right: At 2 mm, the cladoceran (water-flea) *Daphniopsis studeri* is the largest known crustacean in the lakes of the Australian Antarctic Territory. This female is carrying an egg in her brood pouch (ephippium).

Far right: Louise Cromer (on the ice) and Jonothon Newman (on the tripod), preparing to core Lake Terrasovoje on the Amery Oasis, with the Loewe Massif in the background.