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Age riddle confounds fair fishing for krill

Stephen Nicol

Antarctic krill is one of the bigger species of krill, growing to a maximum size of 6.5 cm and weighing more than one gram. They are an important part of the diet of baleen whales, seals, penguins, fish and squid. In pre-whaling days, baleen whales of the Southern Ocean consumed about 190 million tons of krill each year. Today, the remaining whales consume only about 40 million tonnes. There has been speculation that some of this 150 million tonne 'krill surplus' could be exploited by fisheries.

Antarctic krill was once considered a vast untapped source of protein for the 'starving masses'. But trawling in the Southern Ocean is expensive and logistically difficult, so krill has been fished in relatively low volumes, for high-value products such as food additives, sport-fishing bait and feeds for farmed fish.

As a result, Antarctic krill may be one of the last substantial marine living resources that is not over-exploited.

But there are plans to expand the fishery as the technology becomes available to make high-value products more cheaply, and the value of krill as feed for the rapidly growing aquaculture industry begins to rise. Scientists estimate that the world catch of krill – of which there are 85 species – may increase from 150 000 tonnes a year to more than five million tonnes.

To ensure krill fisheries remain sustainable under expansion, more information about their biology is needed. At the Australian Antarctic Division in Kingston, near Hobart, Dr Stephen Nicol and PhD student Angela McGaffin are attempting to age Antarctic krill (*Euphausia superba*), to gain a better understanding of their life span and population structure.

'Krill were thought to live for two years, but at the division we've kept them alive for up to 10 years,' Nicol says.

'This means they live five times longer than previously thought, so their production rate is one fifth what was initially estimated. This slower turnover could have implications for the amount of krill that can be commercially harvested.'

While size is often a good indication of age, krill can actually shrink in winter and grow rapidly in summer. Their growth rate is related to the amount of food available, but may also depend on temperature and light cycles. This variability confounds the ageing process.

So rather than rely on size as a clue to age, McGaffin is evaluating a biochemical technique that measures the accumulation of pigments in the animals' brains with time.

'Like all animals, as the krill get older, their cell membranes begin to break down and fatty deposits called "lipofuscins", or age pigments, accumulate in their cells,' McGaffin says. 'This process is caused by the production of membrane-damaging free radicals.'

McGaffin has grown krill under different temperature and food regimens designed to simulate a range of natural conditions and has prepared a time series of krill from these experiments. This has involved freezing krill every 30 days for a period of one year.

Her next step is to take sections through the animals' eye-stalk and brain tissue and look for fluorescing lipofuscin granules using an epifluorescence microscope.

'I hope to see a build up of lipofuscin in the nerve cells as I progress through the time series of krill,' McGaffin says.

Using a second technique known as high performance liquid chromatography, McGaffin will record how much lipofuscin is present in each sample, in the form of a peak. 'With young krill, we expect to see a small peak, while older krill will produce larger peaks if they have accumulated more lipofuscin,' McGaffin says.

'We should be able to tell the difference between old and young krill, even if they're the same size, and we hope to get a quantitative lipofuscin range that we can then relate to natural processes.'

Information from this research will help to improve the accuracy of mathematical models used to assess the sustainable harvest of krill in the Southern Ocean, and the management advice provided to krill fisheries.

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More about Antarctic krill

Nicol S (1995) Krill, Antarctic. *Encyclopedia of Environmental Biology*, Vol 2: 389–402.

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