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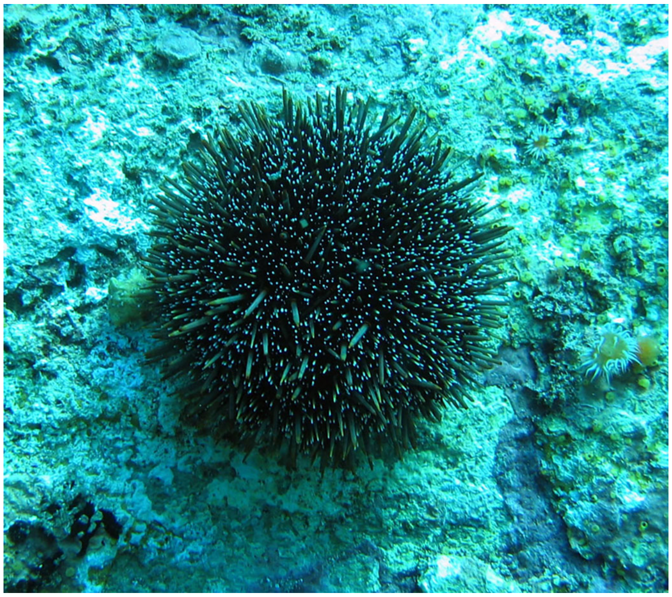
INSIDE JEB

Ocean acidification will impede swimming in sea urchin sperm



A kina sea urchin. Photo credit: Mary Sewell.

The grim impact of ocean acidification on many marine creatures is becoming brutally evident. Pretty much any animal that depends on a calcium carbonate shell or skeleton – including molluscs and coral reefs – is at risk as the oceans soak up human CO_2 emissions. But other aspects of their lifestyle may also be affected by the oceans' plummeting pH. Sea urchin sperm are triggered into action when released into seawater with a pH higher than 8, raising their internal pH and activating the motor proteins that drive their powerful beating tails as they search for an egg. However, some researchers are concerned that the lower pH of seawater as acidification takes hold may mean it will no longer activate sea urchin sperm when released. Without the essential internal pH rise, the sperm may be too sluggish to locate and fertilise eggs. But no one had directly checked how the ocean pH reductions that are predicted to occur by 2100 and 2150 could impact the New Zealand sea urchin (*Evechinus chloroticus* – known in Māori as the kina). Michael Hudson and Mary Sewell from the University of Auckland, New Zealand, decided to check out what the future may hold for the self-propelled gametes.

'We prepared the experimental seawaters by bubbling precise mixes of gases through special injectors at a set temperature', says Hudson, who then diluted fresh kina sperm into two versions of future seawater – simulating the sea in the year 2100 (pH 7.77) and in 2150 (pH 7.51) – to monitor how the gametes would propel themselves. Unfortunately, only 74% of the sperm were able to swim in the turn-of-the-century predicted water conditions, falling to 64% by 2150, compared with 83% in present day seawater. And when Hudson checked their swimming style, he found the 2150 sperm were no more sluggish than the 2100 sperm; however, the gametes took more indirect curving paths, slowing their forward movement, with implications for future fertility. 'Fertilisation requires sperm to collide with eggs and it is known that the end result of fewer sperm swimming and lower swimming speeds is reduced levels of sperm–egg collisions and lower fertilisation rates', says Hudson.

But how will the dramatic environmental pH decline impact the internal pH of the sperm and their ability to manoeuvre? This time, Hudson bathed the sperm in a fluorescent dye which changed colour depending on their internal pH. Alarmingly, this showed that the pH of the sperm that were transferred to the 2100 ocean conditions plummeted from today's value of pH 7.52 to pH 7.35 and fell even lower to pH 7.31 in 2150. Kina sperm seems to be unable to compensate for the reduction in environmental pH to maintain their internal pH. Yet, when the team compared the impact of future pH on sperm from different males, some swam fine while those from other males were not so mobile. 'There was a lot of individual variability', says Sewell, suggesting that some other mechanism related to sperm health may also contribute to their ability to initiate swimming.

Even though some sperm were relatively unaffected by the more acidic conditions they will encounter in the future, Hudson and Sewell suspect that ocean acidification will impact kina fertility. Acidic conditions are also known to reduce the jelly coating surrounding each egg, making the eggs smaller and reducing the attractive scents they release to guide sperm their way. The future isn't looking rosy for New Zealand's sea urchins.

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