Animal foraging tactics unchanged for 50m years

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50-million-year-old sea urchin foraging tracks at Zumaia in northern Spain.

Animals have used the same technique to search for food that's in short supply for at least 50 million years, a study suggests.

Researchers analysed fossilised Eocene-era sea urchin trails from northern Spain and found the tracks reflect a search pattern still used by a huge range of creatures today.

But this is the first example of extinct animals using such a strategy.

The findings could explain why so many modern animals use the technique, and suggest the pattern may have an even more ancient origin.

Creatures including sharks, honeybees, albatrosses and penguins all search for food according to a mathematical pattern of movement called a Lévy walk – a random search strategy made up of many small steps combined with a few longer steps. Although a Lévy walk is random, it's the most efficient way to find food when it's scarce.

'How best to search for food in complex landscapes is a common problem facing all mobile creatures,' says Professor David Sims of the Marine Biological Association in Plymouth, UK, lead author of the study.

'Finding food in a timely fashion can be a matter of life or death for animals – choose the wrong direction to move in often enough and it could be curtains. But moving in a random search pattern called a Lévy walk is mathematically the best way to find isolated food,' he explains.

Scenery at Zumaia in northern Spain.

Even though a wide range of modern creatures search for food according to this pattern, scientists had no idea how the pattern came about, until now.

The fossilised tracks Sims and colleagues from NERC's National Oceanography Centre, the University of Southampton, Rothamsted Research, VU University Amsterdam and London's Natural History Museum analysed were made by sea urchins that lived on the deep sea floor around 50 million years ago. The long trails are preserved in rocky cliffs in a region called Zumaia in northern Spain.

'Finding the signature of an optimal behaviour in the fossil record is exceedingly rare and will help to

understand how ancient animals survived very harsh conditions associated with the effects of dramatic climate changes,' says Sims. 'Perhaps it's a case of when the going got tough, the tough really did get going.'

'The patterns are striking, because they indicate optimal Lévy walk searches likely have a very ancient origin and may arise from simple behaviours observed in much older fossil trails from the Silurian period, around 440 million years ago.'

'It's amazing to think that 50-million-year-old fossil burrows and trails have provided us with the first evidence of foraging strategies in animals that live on and in the deep-sea floor – studies which would be nearly impossible and very expensive to do in modern oceans,' says Professor Richard Twitchett of London's Natural History Museum, co-author of the study.

'Trace fossils are remarkable and beautiful records of the movements of ancient animals which have been frozen in time and tell us so much about the evolution of life on Earth and the environments of the past.'

The researchers think the collapse of primary producers such as phytoplankton and widespread food scarcity caused by mass extinctions, which show up in the fossil record, could have triggered the evolution of Lévy-like searches.

The Eocene lasted from 56 to 33.9 million years ago, and began as a time of global warming, with temperatures soaring across the planet.

Lévy walks aren't just confined to animals; our ancient hunter-gatherer ancestors used exactly the same approach, as do modern hunter-gatherers in northern Tanzania.

The study is published in The *Proceedings of the National Academy of Sciences*.

More information: David W. Sims, Andrew M. Reynolds, Nicolas E. Humphries, Emily J. Southall, Victoria J. Wearmouth, Brett Metcalfe, and Richard J. Twitchett, "Hierarchical random walks in trace fossils and the origin of optimal search behavior," The *Proceedings of the National Academy of Sciences*, published 14th July 2014, www.pnas.org/cgi/doi/10.1073/pnas.1405966111