Sedgwick Museum
of Earth Sciences

When size first mattered and why

It was around 566 million years ago that metre-sized life appeared for the first time. These marine pioneer 'giants' were Ediacarans, members of an intriguing extinct group of soft-bodied organisms which inhabited Earth's tropical oceans in Late Proterozoic times.

Why this sudden boom in size from millimetres to metres happened has puzzled scientists for some time with the assumption being that it was for access to more or better food resources. But now, Emily Mitchell from the University of Cambridge and Charlotte Kenchington from Memorial University, Newfoundland have come up with a surprising and convincing alternative for the rangeomorph Ediacarans, which got bigger in order to spread their offspring further.

Bigger for better offspring dispersal

After more than 3 billion years of microbial evolution in the oceans, the rangeomorph Ediacarans were amongst the first of Earth's life-forms to grow to metre-scale in size. To understand why this occurred, Emily Mitchell and Charlotte Kenchington carried out a detailed spatial analyses of

abundant fossil Ediacarans preserved on the ancient seabed strata of Newfoundland. Their results correlate increase in height by rangeomorph Ediacarans with

greater offspring dispersal rather than competition for water-column food resources as had previously been claimed.

The Ediacaran biota

The extinct Ediacaran organisms represent one of the most intriguing topics of current palaeobiological research. These puzzling fossils first appear in the fossil record around 575 million years ago and diversified into more than 200 different species throughout the tropical oceans of the world before becoming extinct around 541 million years ago. This mysterious Ediacaran biota was replaced by more familiar invertebrate organisms such as sponges, annelids, molluscs and arthropods.

Characteristically, the Ediacarans were soft-bodied, seabed dwelling organisms with immobile frond and disc-shaped bodies. Without distinct anatomical features for feeding or movement, they had ribbed or quilted bodies with high surface areas in relation to their body volume. As a result, it is generally thought that they acquired nutrients by direct absorption from the surrounding seawater.

Rangeomorph Ediacarans

The development of frond-shaped rangeomorph Ediacarans dominated deep-sea ecosystems for some 15 million years. Some of them grew as flat fronds over the seabed but others developed rooted stem-like structures, which lifted their branched fronds off the seabed for close to 3 metres. It was the discovery in Newfoundland of these 2 metre sized ‘giants’ that prompted the question of what advantage size increase gave them and what drove it.

Mistaken Point, Newfoundland

Surprisingly, it is the inhospitable rocky cliffs of Newfoundland’s Mistaken Point that has proven to be a mecca for palaeobiologists investigating the mysteries of the Ediacaran biota. Here ancient strata preserve astonishing numbers of fossils preserved as external moulds of the original soft-bodied organisms with remarkable detail on the ancient sedimentary rock seabed surfaces.

Since the fossils are preserved exactly where they lived and died, their diversity and abundance is thought to represent an unusually good ‘snapshot’ of the original seabed community. Most fossil assemblages have been modified to some extent or other from their original communities. The researchers analysed three separate large seabed assemblages, whose community composition differs but are dominated by rangeomorph Ediacarans that originally lived in deep-marine turbiditic environments.

Their analyses showed that there is no correlation between height and competition for food. The different Ediacaran organisms did not occupy different levels of the water column to avoid competition for resources. Rather the possession of stems for increase in height must have served another function. Mitchell and Kenchington found that the tallest rangeomorphs were surrounded by the largest clusters of offspring, indicating that the benefit of increased height was to increase the chances of colonising the surrounding environment.

Douglas Palmer, Sedgwick Museum

Reference
Emily G. Mitchell and Charlotte G. Kenchington. 'The utility of height for the Ediacaran organisms of Mistaken Point.' Nature Ecology and Evolution (2018). DOI: 10.1038/s41559-018-0591-6

Inset image:
A close-up view of the Mistaken Point 'E' surface community. Credit: Emily Mitchell.

See also http://www.cam.ac.uk/research/news/why-life-on-earth-first-got-big