# Unknown ocean bacteria create entirely new theories

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The earth's most successful bacteria are found in the oceans and belong to the group SAR11. In a new study, researchers from Uppsala University provide an explanation for their success and at the same time call into question generally accepted theories about these bacteria. In their analysis they have also identified a rare and hitherto unknown relative of mitochondria, the power stations inside cells.

The findings were published in two articles in the journals Molecular Biology and Evolution and *PLoS One* in the last week.

"The huge amounts of DNA information now being produced from the oceans gives us a glimpse of a world that could never be studied before. It's incredibly fascinating to look for answers to the fundamental questions of life in these data, says Siv Andersson, professor of molecular evolution and lead author of the studies.

Bacteria belonging to the group SAR11 make up 30-40 percent of all bacteria cells in the oceans and therefore play a considerable role in global carbon cycles. Nowhere else are these bacteria so common. The open seas are poor in nutrients, and SAR11 bacteria have an extremely small cell volume in order to maximize the concentration of nutrients in the cells. Their genomes are small, consisting of fewer than 1.5 million building blocks.

According to previous research they are related to an equally specialized group of bacteria that includes the typhus bacterium. These bacteria also

have small genomes, but they are adapted to humans, animals, and insects. However, the advanced analyses of evolutionary relationships performed by the Uppsala researchers contradict these findings, indicating instead that SAR11 bacteria evolved from ocean- and earth-dwelling bacteria with genomes that are three to ten times as large. But unlike their closest relatives, SAR11 bacteria lack genes that are thought to be important in repairing damage to DNA. This might also explain why they have been so successful.

"The loss of genes means that the bacteria can more readily exchange genes with each other, and beneficial genes can then spread rapidly in the oceans as an adaptation to changes in nutrient content, temperature, and UV radiation, says Johan Viklund, a doctoral candidate at the Department of Molecular Evolution.

By digging into the data produced by ongoing international surveys of DNA from all the bacteria in the oceans, the Uppsala scientists have also found DNA sequences for proteins that participate in cell respiration, when sugar is broken down into carbon dioxide and water. By comparing these with the corresponding proteins for cell respiration in the so-called mitochondria of humans, animals, and insects, the researchers managed to identify a rare, previously unknown group of bacteria.

"These bacteria are very similar to mitochondria. Our findings thus indicate that the origin of mitochondria might be the oceans, but that the closest relatives are not related to the SAR11 group as was previously thought, says Thijs Ettema, a postdoctoral fellow with the team.

**More information:** *PLoS One* article: dx.plos.org/10.1371/journal.pone.0024457

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