Metagenomic Data

Hamilton: Bacteria, archaea key to the persistence of complex life

While many of earth's species have come and gone throughout billions of years of changing environment, its oldest inhabitants have somehow managed to evolve and adapt, despite their simplistic structure.

The oldest forms of life on Earth, bacteria and archaea, have managed to evolve and adapt to Earth's changing environment over billions of years. As a result, bacteria and archaea could hold the answers to the persistence of complex life. Trinity Hamilton, assistant professor of biological sciences at the University of Cincinnati, is searching for answers in caves, hot springs and glaciers as she processes the metagenomic data of these microbial communities through the Ohio Supercomputer Center.

Two of the basic building blocks of life, carbon and nitrogen, seem to be plentiful on Earth, but these elements are actually unavailable for use by most organisms until microorganisms transform them into biologically available sources that our bodies can process. Hamilton is studying communities of these microorganisms and how they facilitate nutrient flow within small-scale environments.

"These are the kinds of things that happen on a much larger scale, and we don't fully understand them, so we've picked a more simple community to start to understand why these communities coexist," Hamilton said.

Hamilton and her team traveled to the Pacific Northwest to gather samples of supraglacial organisms that thrive on top of the ice and snow. While they knew carbon fixation, the process of converting inorganic carbon to organic carbon compounds, was occurring within these communities, they wanted to know which members of the communities were responsible. There are very few nutrients in ice and thus light might serve as the dominant form of energy, fueling photosynthesis. They are also studying samples of nitrogen-fixing organisms from hot springs in Yellowstone National Park.

On the darker side of things, the team is studying organisms that are found in caves where carbon and nitrogen cycling occur in the absence of light.

"This is very unique," Hamilton said. "There's no photosynthesis, which is one of the major sources of energy for ecosystems today."

Using high performance computing, Hamilton and her team look at all the functional genes encoded by these microbial communities with next generation sequencing. This gives them a fingerprint for bacteria and archaea, providing a better look at how these communities function to provide energy to the surrounding environment.

"This data, in combination with high resolution geochemical and geological data from natural systems, will aid in elucidating the role of biology in planetary evolution," Hamilton said. •

Sunset on Collier Glacier on the mountain of North Sister in Oregon.

Project Lead: Trinity Hamilton, Ph.D., University of Cincinnati
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