Scientist explores the likelihood of complex life existing elsewhere in the universe

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This is the "South Pillar" region of the star-forming region called the Carina Nebula. Like cracking open a watermelon and finding its seeds, the infrared telescope "busted open" this murky cloud to reveal star embryos tucked inside finger-like pillars of thick dust. Credit: NASA

If the origin of life is common on other worlds, the universe should be a cosmic zoo full of complex multicellular organisms. Dirk Schulze-Makuch, a Washington State University astrobiologist, uses the evolution of Earth life as a model to predict what humans might find living on

distant planets and moons in a new paper published in the journal *Life*.

The results of his work, conducted in collaboration with William Bains, a biochemist working for the Massachusetts Institute of Technology, show that once life originates, the evolution of organisms functionally similar to plants or animals on Earth will naturally follow given enough time and a suitable environment.

"If the origin of life can occur rather easily, a percentage of organisms on other worlds will reach higher levels of animal- or plant-like complexity," Schulze-Makuch said. "On the other hand, if the origin of life is a rare event, then chances are we live in a rather empty universe."

Evolutionary answers

There are physical and chemical limits to how life can evolve, and scientists have determined that many of those requirements have been met on Earth. Therefore, the route Earthly lifeforms took from simple, single-celled organisms to successively more complex entities can give hints of how life might play out elsewhere in the cosmos.

In their study, Schulze-Makuch and Bains first identified the key evolutionary innovations that drove the development of Earth life from microbes to space-faring humans. These include the transition from single cell life to multicellular life, the rise of photosynthesis, the evolution of macroscopic life and the rise of intelligent life.

Then they analyzed whether or not these important evolutionary occurrences happened many times in different organisms or were due to random, isolated events.

They found that most of the critical innovations were "invented" several times. For example, photosynthesis originated independently at four

different points in life's history, and multicellularity arose several times in different classes of organisms.

"Given that we have multiple examples of these key evolutionary adaptions occurring along the path from the simplest organism to humans, we must accept that they are not extremely improbable, but that it 'only' takes a long time and the proper conditions for them to arise," Schulze-Makuch said. "Therefore, in any world where life has arisen and sufficient energy flux exists, we are confident that we will find complex, animal-like life."

The one caveat is that the research doesn't address the likelihood of the origin of life occurring elsewhere or of there being aliens with human like intelligence. Earth is the only planet where life is known to exist, and humans are the only known species to have developed technology. So it is impossible to say whether this should be a common occurrence on other worlds, a very rare event or something in between, Schulze-Makuch said.

Future implications

The work has major implications for the search for life on other worlds. Schulze-Makuch and Bains write that not only should scientists expect to find microbial biosignatures on a planet with life, but also signatures resulting from large and complex, multicellular organisms such as vegetation's red edge, which is the wavelength of light suggesting the existence of plant life.

"In particular, our research is relevant to the selection of tools scientists use in searching for life on planets in other solar systems," Schulze-Makuch said. "On future missions, researchers at NASA, the SETI (search for extraterrestrial intelligence) Institute and other organizations should consider using instruments that are capable of finding signatures

of a global and diverse biosphere on other worlds."

More information: William Bains et al, The Cosmic Zoo: The (Near) Inevitability of the Evolution of Complex, Macroscopic Life, *Life* (2016). DOI: 10.3390/life6030025

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