

Tardigrades: The last survivors on Earth

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The world's most indestructible species, the tardigrade, an eight-legged micro-animal, also known as the water bear, will survive until the Sun dies, according to a new Oxford University collaboration.

The new study published in *Scientific Reports*, has shown that the tiny creatures, will survive the risk of extinction from all astrophysical catastrophes, and be around for at least 10 billion years - far longer than the human race.

Although much attention has been given to the cataclysmic impact that an astrophysical event would have on human [life](#), very little has been published around what it would take to kill the tardigrade, and wipe out life on this planet.

The research implies that life on Earth in general, will extend as long as the Sun keeps shining. It also reveals that once life emerges, it is surprisingly resilient and difficult to destroy, opening the possibility of life on other planets.

Tardigrades are the toughest, most resilient form of life on [earth](#), able to survive for up to 30 years without food or water, and endure temperature extremes of up to 150 degrees Celsius, the deep sea and even the frozen vacuum of space. The water-dwelling micro animal can live for up to 60 years, and grow to a maximum size of 0.5mm, best seen under a microscope. Researchers from the Universities of Oxford and Harvard, have found that these life forms will likely survive all astrophysical calamities, such as an asteroid, since they will never be strong enough to

boil off the world's oceans.

Three potential events were considered as part of their research, including; large asteroid impact, and exploding stars in the form of supernovae or gamma ray bursts.

Asteroids

There are only a dozen known asteroids and dwarf planets with enough mass to boil the oceans (2×10^{18} kg), these include (Vesta 2×10^{20} kg) and Pluto (10^{22} kg), however none of these objects will intersect the Earth's orbit and pose a threat to [tardigrades](#).

Supernova

In order to boil the oceans an exploding star would need to be 0.14 light-years away. The closest star to the Sun is four light years away and the probability of a massive star exploding close enough to Earth to kill all forms of life on it, within the Sun's lifetime, is negligible.

Gamma-Ray bursts

Gamma-ray bursts are brighter and rarer than supernovae. Much like supernovas, [gamma-ray bursts](#) are too far away from earth to be considered a viable threat. To be able to boil the world's oceans the burst would need to be no more than 40 light-years away, and the likelihood of a burst occurring so close is again, minor.

Dr Rafael Alves Batista, Co-author and Post-Doctoral Research Associate in the Department of Physics at Oxford University, said: "Without our technology protecting us, humans are a very sensitive species. Subtle changes in our environment impact us dramatically.

There are many more resilient species' on earth. Life on this planet can continue long after humans are gone.

"Tardigrades are as close to indestructible as it gets on Earth, but it is possible that there are other resilient species examples elsewhere in the universe. In this context there is a real case for looking for life on Mars and in other areas of the solar system in general. If Tardigrades are earth's most resilient species, who knows what else is out there."

Dr David Sloan, Co-author and Post-Doctoral Research Associate in the Department of Physics at Oxford University, said: "A lot of previous work has focused on 'doomsday' scenarios on Earth - astrophysical events like supernovae that could wipe out the human race. Our study instead considered the hardiest species - the tardigrade. As we are now entering a stage of astronomy where we have seen exoplanets and are hoping to soon perform spectroscopy, looking for signatures of life, we should try to see just how fragile this hardiest life is. To our surprise we found that although nearby supernovae or large asteroid impacts would be catastrophic for people, tardigrades could be unaffected. Therefore it seems that life, once it gets going, is hard to wipe out entirely. Huge numbers of species, or even entire genera may become extinct, but life as a whole will go on."

In highlighting the resilience of life in general, the research broadens the scope of life beyond Earth, within and outside of this solar system. Professor Abraham Loeb, co-author and chair of the Astronomy department at Harvard University, said: "It is difficult to eliminate all forms of life from a habitable planet. The history of Mars indicates that it once had an atmosphere that could have supported life, albeit under extreme conditions. Organisms with similar tolerances to radiation and temperature as tardigrades could survive long-term below the surface in these conditions. The subsurface oceans that are believed to exist on Europa and Enceladus, would have conditions similar to the deep oceans

of Earth where tardigrades are found, volcanic vents providing heat in an environment devoid of light. The discovery of extremophiles in such locations would be a significant step forward in bracketing the range of conditions for life to exist on planets around other stars."

More information: 'The Resilience of Life to Astrophysical Events' David Sloan, Rafael Alves Batista, and Abraham Loeb, *Scientific Reports* (2017). DOI: 10.1038/s41598-017-05796-x , www.nature.com/articles/s41598-017-05796-x

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