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TARDIGRADES, THOUSAND ENVIRONMENTS TO SURVIVE

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The Tardigrade is a small invertebrate with sizes ranging from 100 to 1200 μm (Neves et al. 2020) and it has been used in different space missions with astrobiological interest (Rebecchi et al. 2009). This is because it is a polyextremophilic organism, since it can survive in different environments in its cryptobiosis state, triggered by external physical parameters to which it is exposed: lack of oxygen, low water availability, high and low temperatures, pressure changes, exposure to radiation, high concentration of salts, etc. Cryptobiosis involves different metabolic mechanisms for proteins, sugars, etc., which allow it to enter a state of dormancy for long periods (Neves et al. 2020; Guil et al. 2018). In this work we examine the different environments in which tardigrades live.

Tardigrades are considered cosmopolitan organisms since the four classes: Heterotardigrada, Eutardigrada, Mesotardigrada, and Apotardigrada, are distributed in all environments such as intertidal zones, freshwater bodies, limnoterrestrial zones, deserts, and even urban environments (Guil et al. 2018). The records obtained to date show a great variety of species worldwide, as is the case of the genus *Ramazzottius* sp., which was found in the Arctic, living in small ice niches called cryonites. Another record in Japan reports that genus *Macrobiotus* sp. was found living in the crevices of a parking lot. Finally, the finding of *Archequiniscus* sp. inhabiting in the intertidal zones of Florida, in sediments of barnacles.

These microorganisms have been included in some space missions. For example, in the mission, FOTON-M3/TARSE (2007) the effects of the space environment on tardigrades of the species *Macrobiotus richterside* were analyzed. In these experiments, it was found that tardigrades were not affected by microgravity or radiation and maintained a stable life cycle (Rebecchi et al. 2009). Since this and other missions, it is believed that it is possible that tardigrades can survive on different planets and moons. In the case of Enceladus (moon of Saturn) covered by ice and SiO_2, with internal temperatures $> 90°$ C associated with the geothermal activity of possible hydrothermal zones in deep oceans, more than 40 km (Hansen et al. 2006). Because of their adaptability to various extreme environments on our planet, tardigrades are strong candidates to be sent to different sites in the Solar System in future space exploration missions, and even elsewhere in the universe.

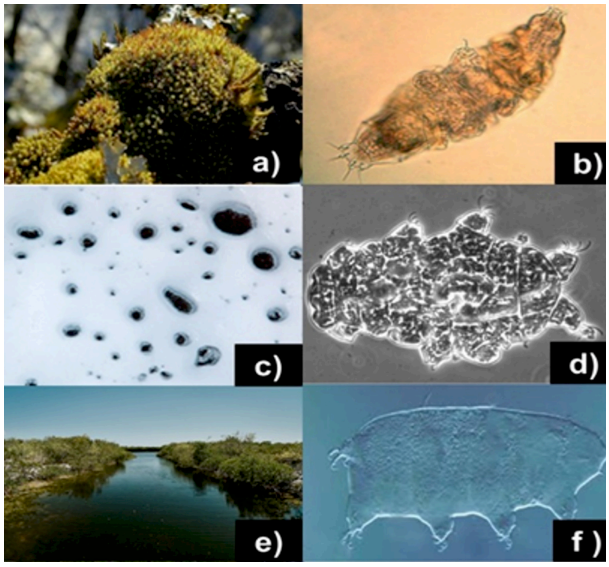

Fig. 1. a) *Ulota crispa* species of moss inhabited by tardigrades, by Michael Lth. b) *Milnesium tardigradum* cosmopolitan species that inhabits bryophytes, by Martin Mach. c) Cryonites in the Arctic, by Arizona State University. d) Undetermined registered species of *Ramazzottiidae* found within a cryonite in Zawierucha et al. e) Biscayno National Park, Homestead, Florida. f) *Archechiniscus biscaynei* marine tardigrade from Biscayno National Park, Florida.

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