The Concomitant Locomotion of the Microorganisms Inhabiting the Marine and Freshwater Niches of Antarctica's South Shetland Islands during the Summer

Jessica E. Snyder [1] and Lynn J. Rothschild[2]
[1]Universities Space Research Association (Moffett Field, California, USA, jessica.e.snyder@nasa.gov)
[2] NASA Ames Research Center (Moffett Field, California, USA, lynn.j.rothschild@nasa.gov)

Introduction: During the late summer, the author sailed to the Antarctic South Shetland Islands to survey the microorganisms living in marine (tidal pools) and freshwater (moss saturated with snow melt) environmental niches. Equipped with a microscope to take video of samples within hours of collection to capture a pristine condition, the authors found a dense and diverse ecology that included species with unique patterns of locomotion. Capturing the organism's movement expedited identification, but it also showed the dynamic way each organism's mobility fit together like a puzzle to create a complex ecosystem.

Materials and Methods: The experimental method included 3 tasks - collect, observe, and identify.

Collect. We collected samples in 6 places - as far northeast as Trinity Island (63.75° S, 60.67°W) and as far southwest as Pleneau Island (65.10° S, 64.06°W) from Jan 31 until Feb 8, 2019. Because Antarctic vegetation grows very slowly (the fastest species grows at a rate of 0.1 mm/year), we minimized disruption of the terrestrial plants by collecting the effluent in the plant, not the plant itself. We selected wet areas, places where melting snow formed streams flowing through moss beds next to rocks, or tide pools adjacent to the water. We gently pressed on the vegetation to release microorganisms nested in the niche and collected the water. To increase the ecological diversity, we also sampled area with evidence of recent bird activity – abandoned nesting sites of Gentoo penguins.

Observe. Sample were inspected using a digital microscope (Dino-Lite Edge AM73915MZT) with variable magnification, the view window could be as large as >1.0 cm or as small as 1.0 mm.

Identify. The organisms were identified using the reference book Broch Biology Microorganisms while at sea and online resources upon return.

Results and Discussion: As part of our ongoing work in life in extreme environments, we began studying several environmental niches which seasonally freeze and thaw. The findings (once fully analyzed) show the range and interdependence of life in these places.

Tidal pools: Limpets and leafy red algae grew in the tidal pools 1-2 m above the low tide line of Enterprise Island. The most prolific organism in the tide pools was green cyanobacteria, which made constant, rapid, movements across the microscope's view field. Rotifers loped along by extending their head, which elongated their body sometimes four-fold before their backside slid to catch up. Amoeba floated into view, decelerated to a stop, turned on a dime, and continued on in a purposeful zig-zag pattern between islands of plant debris. A larval form of krill crawled along the debris in the sample, showing the early forms of segmented crustacean body.

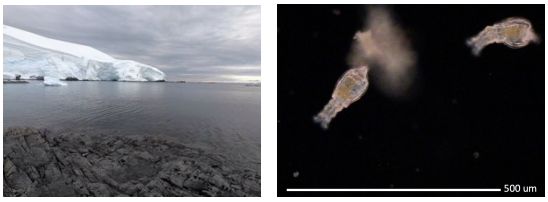

Figure 1. (Left) Collection site for tidal pools on Enterprise Island and (Right) two rotifers.

Moss beds situated in streams of snowmelt. These samples were less diverse than the tidal pools. Terrestrial arthropods swept into the sample were present.

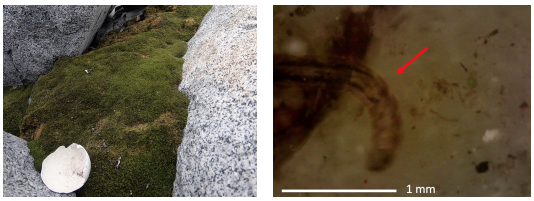

Figure 2. (Left) Moss bed collection with evidence of past bird nesting and (Right) a terrestrial arthropod.

Unmelted snow: Unmelted green snow collected adjacent to waterline had the expected green matter, which did not animate one the snow thawed. However, on close inspection, several terrestrial arthropods (identified to be springtails *Cryptopygus antarcticus*) began crawling once the snow thawed.

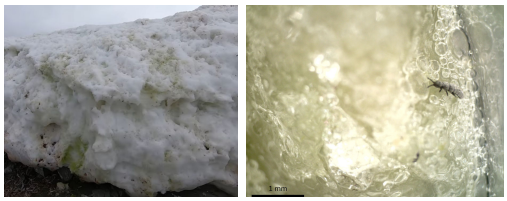

Figure 3. (Left) Collection site for green snow on Trinity Island and (Right) springtail thawing from sample.

Conclusion: Solving the evolutionary cat-and-mouse game between the organisms using their propulsion mechanisms could provide new insight into the ecological pressure on evolution. The broader impact of such findings could help the community ask – are we searching for life in the universe or ecosystems?

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