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

Jessica E. Snyder and Lynn J. Rothschild
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)

Motivation

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, we found a dense and diverse ecology that included species with unique patterns of locomotion. The Ocean Tramp cruised for 12 days (beginning January 30, 2019) through 588 nautical miles of the South Shetland Islands, between -62.9 to -65.1 latitude and -60.5 to -64.1 longitude.

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.** The vial was then transported back to the boat and 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 to detect artefacts as small as 100nm.

- **Tide Pool Results: Swarm, Swim, Slide**

  - **Swimming + Crawling**
    - **Enterprise Island**
      - Latitude: -64.2
      - Longitude: -62.0
    - **0 s**
    - **2 s**
    - **4 s**
  
  - **Swarming**
    - **Challenger Island**
      - Latitude: -64.3
      - Longitude: -61.6
    - **0 s**
    - **2 s**
    - **4 s**
  
  - **Sliding**
    - **Challenger Island**
      - Latitude: -64.3
      - Longitude: -61.6
    - **0 s**
    - **2 s**
    - **4 s**

- **Moss Bed Results: Crawling and Inchwormaling**

  - **Inchworming**
    - **Challenger Island**
      - Latitude: -64.3
      - Longitude: -61.6
    - **0 s**
    - **2 s**
    - **4 s**

These samples were less diverse than the tidal pools. Terrestrial arthropods swept into the sample writhed uncomfortably when submerged in the water. Few rotifers were observed.

Conclusions for Mission Design

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?

Acknowledgements

The authors thank Laura K.O. Smith and Federico Guerrero, owners of Quixote Expeditions, for their Guest Scientist program, which made this study possible. We also thank the crew of the Ocean Tramp led by Captain David Roberts.

Final Paper Number: 141-159
Abstract ID: #482307
eLightning Presentation: Tuesday, June 25 10:15- 12:15 PM
Presentation Length: 10:42 AM - 10:45 AM
Session Number and Title: 205: Examining the Habitability of Mars, Europa, Titan or Enceladus through Analog research and lab simulations.

https://ntrs.nasa.gov/search.jsp?R=20190029083 2019-09-05T22:05:55+00:00Z
https://www.nasa.gov/offices/oct/home/roadmaps/index.html