THE PLANETARY LAKE LANDER (PLL) PROJECT – A NOVEL LAKE ECOSYSTEM IN THE CHILEAN ANDES.

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Introduction: A robotic lake lander was deployed for over 3 years at Laguna Negra in the Chilean Andes with goal to develop and test a science payload, technology, and operational systems relevant to the exploration of lakes and seas on Titan [1-3]. Part of the project included to assemble an environmental database to support the development of adaptive exploration strategies [1]. A critical aspect of this environmental baseline was to quantitatively assess how much can actually be understood of a deep lake habitat, its dynamics, and evolution when committing to surface and shallow subsurface exploration such as in the TiME and TALISE mission concepts [4-5]. To support this objective, a survey over the entire depth of the water column was performed using both bathymetry and an adapted multilayer Rapid Environmental Assessment (REA) along depth transects, which resulted in the discovery of a novel ecosystem.

Data Collection: The environmental assessment of the lake ecosystem included a complete bathymetric survey [1, 6], temperature and light distribution [1, 7], water chemistry [8], and the distribution of organics [9] and biodiversity [10-11]. A transect along an underwater traverse and jump dives [12] provided data over the entire water column down to the deepest point of the lake (272 m). Underwater imaging produced 201 hours of video imaging, and samples were retrieved from three landing sites at 265 and 272 m.

Deep Lake Habitat and Ecosystem: Sonar sounding shows a 6 x 1.7-km large, 272-m deep lake carved by glacial valleys and local tectonic deformation in bedrock and sediment. Exceptional water transparency allows light penetration down to ~90 m depth, while UVB and UVA penetrate 18 m and 25 m, respectively, during the meltseason [7]. A GoPro3 camera with casing and lights rated for 300 m was guided along a transect that covered the west shoreline to the deepest part of the lake. The transect was video-recorded, with landing sites at 1, 2, 5, 10, 50, 100, 150, 200, 265, and 272 m depth (two sites for the latter). The videos were used to complete an adapted multilayer REA, a simple but robust method that uses semi-quantitative data from imaging to evaluate the relative abundance and diversity of taxa, and the magnitude of pressure and impact on the lake ecosystem [13-14]. This method utilizes a broad spectrum of environmental indicators and bridges the gap between detailed/quantitative and qualitative assessments of aquatic systems and management requirements. This method is used for unknown deep seafloor exploration and allows the identification of distinct habitats according to dominant parameters, and environmental and community associations [15-16], and shows potential for the exploration of alien seas and lakes [14, 17].

The REA demonstrated a great abundance of life, including on the lake floor at 272 m. All jump dives and traverses showed a heavy particle flux composed of a large fraction of planktonic organisms over the entire water column. Within the first 25 m, the relatively abundant flora and fauna was heavily impacted by biologically-damaging UV, and benthic flora was mostly covered by invasive filamentous green algae which were still visible in deeper areas. Macrophyta were still present at the limit of light penetration (90m). Zooplankton activity was observed over the entire water column. Most noticeably, lakebed morphology, bioturbation, organisms, DNA extraction, and biomarkers revealed the presence of a novel ecosystem in the deepest part of the lake that will be detailed in our presentation. This is the first report of such an ecosystem in freshwater systems, which presents many similarities with deep seafloor counterparts.

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