Dear JEB editors,

Please find our manuscript titled "Colonial Architecture Modulates Speed and Efficiency of Multi-Jet Swimming in Salp Colonies" to be considered for publication as a Research Article in the Journal of Experimental Biology.

Aquatic animals swim via a variety of propulsive strategies. While studies on pulsed jets date back to the 1970s, multi-jet propulsion is one of the least studied modes of aquatic locomotion, found in understudied colonial gelatinous invertebrates such as salps and siphonophores. Previous studies have shown that multi-jet propulsion is an efficient strategy that confers mechanical advantages over single-jet propulsion and provides a promising avenue for bioinspired underwater vehicle design. Salp colonies develop into different species-specific architectures with distinct zooid orientations. This morphological diversity presents a natural laboratory to explore and understand the hydrodynamic implications of different multi-jet arrangement designs.

Salps inhabit remote open ocean environments with great bottom depths, posing unique challenges for accessing and observing them. Moreover, salps are extremely fragile and cannot be collected intact with nets nor maintained alive in containers for extended periods. To overcome these challenges, we embarked on diurnal and nocturnal SCUBA diving expeditions in the open ocean off the coast of Hawaii, where we found a broad diversity of salp species across all colonial architectures. Here we used state-of-the-art methods to record the swimming behavior and measure their respiratory physiology from 18 species of salp.

Our results indicate that linear colonies generally swim faster and more efficiently, as a result of a more hydrodynamic arrangement of their zooids, underscoring the importance of propeller arrangement. By leveraging lessons learned from salp diversity, this research builds a foundation for optimizing speed and energy efficiency in underwater multi-jet propulsion systems.

Salps play a crucial role in the oceanic carbon cycle, exporting large quantities of fixed carbon into the deep sea. Our study sheds light on the distribution of their ecological impact across the diversity of salp species as it relates to their respiration rates and their locomotory ability to perform long-distance vertical migrations. Further, this study follows up with our prior work on the evolutionary history of salp colonial architecture, testing many of the hypotheses generated by the reconstructed evolutionary transitions on the phylogeny.

We believe that our study advances our understanding of multi-jet locomotion and salp ecophysiology, as well as provides insights into bioinspired underwater vehicle design. We are confident that our cross-disciplinary study will be of interest to the broad readership of JEB.

Thank you for considering our manuscript.

Sincerely,

Alejandro Damian-Serrano, Ph.D.