Beyond the connectome: Contributing to the understanding on how neuromodulators shape neural circuits in the octopus

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Project Summary

Octopuses fascinate both scientists and the general public due to their intriguing physiology, richness and plasticity of behavioral repertoire, complex brain and vertebrate-like cognitive capabilities.

Aim of this PhD-project is to capitalize on an established cephalopod species, *Octopus vulgaris*, to address questions on how neural circuitry dynamics is achieved.

Though the gross structural anatomy of octopus brain has been documented in some detail, its underlying molecular and cellular components have not been described.

This PhD project wants to chart octopus brain complexity by studying the visual and tactile multi-sensory integrative systems. Main objective of this PhD project is to characterize neuronal populations at both neural-areas and single-cell levels in the brain via transcriptomics and *in situ* molecular techniques. Molecular and neuromodulator fingerprint of selected brain areas (considered relevant to both visual and tactile sensorimotor circuitry) will allow the creation of a consensus map of neural plasticity in the octopus brain. Taken together, gene expression, *in situ* hybridization, and immunohistochemistry experiments, coupled with tracing studies, will provide a first-ever detailed map of segregated and/or overlapping neural pathways characterized by a given or a combination of neuromodulators, and their associated receptors and transporters.

The expected results will represent the first-time exploration of the heretofore poorly characterized area of neural dynamics and their functional impact in the Lophotrochozoans. This will be the first invertebrate member of the clade where a study will go beyond the connectome, to explore how neuromodulators shape neural circuits. The interdisciplinary nature of the work will have a high research impact, revealing key insights into the evolution of nervous system function and behaviors.