Using a neuroscience approach to uncover and quantify patterns of collective pulsing behavior in xeniid corals

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Corals are mostly stationary organisms. A family of soft corals called xeniids, however, displays a unique behaviour: individual polyps within a colony actively pulse, increasing the local water flux and thus mass transfer (i.e. nutrient and gas exchange). From observations in the lab and in the field, it seems that this individual pulsing behavior generates collective pulsing patterns on the colony scale. Since cnidarians (corals, jellyfish, anemones, and their relatives) lack a centralized nervous system or integration centre, it is unclear how collective behaviour emerges within a colony. In this study, we examined whether recurring pulsing patterns could be observed and quantified within a small colony (i.e. whether the colony functions as a predictable network of polyps). Using a neuroscience approach to analyze our video data, we found repeated pulsing patterns when looking at four neighboring polyps within a colony. We then built models (random walk, Markov chain, coupled oscillators) that we compared to the collected data to find the best way of describing and modeling this collective pulsing behavior mathematically. Coupled oscillator models gave the best results for our small coral colonies but it is still unclear what the coupling consists of (neural, chemical, external, etc.). Future research will delve further into this coupling mode. Additionally, We are investigating the potential benefits of this collective pulsing behavior on nutrient and gas exchange rates using computational fluid dynamic models.