
TITLE: On the formation of coral reefs.

Autores: *Miguel Alvarez-Alegria, Manuel A. Matias y Damia Gomila.*

In this study, we introduce a novel model that effectively reproduces the intricate formations observed in coral reefs. Our model, grounded in partial differential equations, integrates decades of research on the physical and ecological dynamics operating at the micro- and mesoscales within coral reef ecosystems. These dynamics encompass clonal growth, facilitation, resource uptake by corals, and resource supply by ocean currents, among other factors. By employing bifurcation theory to mathematically analyze our model, we reveal that the interaction of a select few parameters is adequate to elucidate the emergence of various reef morphologies observed in nature. These morphologies include fringing reefs, enclosed atolls, and internal structures within atolls. Our findings yield valuable insights into the underlying mechanisms shaping the diverse morphologies of coral reefs.