QUANTITATIVE & SYSTEMS BIOLOGY COLLOQUIUM:

How Ants and Bacteria Became One

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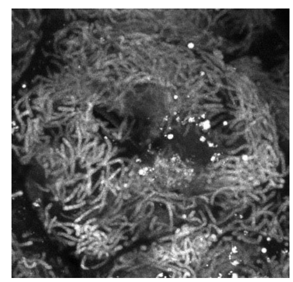
Date:
10/30/2020

Time:
2:30 PM-3:45 PM

Link:
Please email snsgradstaff@ucmerced.edu for Zoom link and passcode

About The Speaker:

Abouheif completed his PhD from Duke University in 2002 with Greg Wray. His PhD work on the development and evolution of gene networks in ant societies laid the foundations for Eco-Evo-Devo, an emerging field that seeks to understand how the evolution of complex biological systems is driven by interactions between genes and environment during development. Before finishing his PhD, Abouheif was recruited as an Assistant Professor at McGill University. The University allowed Abouheif to take a two-year postdoc position with Nipam H Patel at the University of Chicago (2002-2003) and University of California at Berkeley (2003-2004). He returned to Canada in 2004 as a Canada Research Chair, and in 2017, was named a James McGill Professor.



Abstract:

Obligate endosymbiosis, in which distantly related species integrate to form a single replicating individual, represents a major evolutionary transition in individuality. Although such transitions are thought to increase biological complexity, the evolutionary and developmental steps that lead to integration remain poorly understood. Here we show that obligate endosymbiosis between the bacteria Blochmannia and the hyperdiverse ant tribe Camponotini originated and also elaborated through radical alterations in embryonic development, as compared to other insects. The Hox genes Abdominal A (abdA) and Ultrabithorax (Ubx)—which, in arthropods, normally function to differentiate abdominal and thoracic segments after they form—were rewired to also regulate germline genes early in development. Consequently, the mRNAs and proteins of these Hox genes are expressed maternally and colocalize at a subcellular level with those of germline genes in the germplasm and three novel locations in the freshly laid egg. Blochmannia bacteria then selectively regulate these mRNAs and proteins to make each of these four locations functionally distinct, creating a system of coordinates in the embryo in which each location performs a different function to integrate Blochmannia into the Camponotini. Finally, we show that the capacity to localize mRNAs and proteins to new locations in the embryo evolved before obligate endosymbiosis and was subsequently co-opted by Blochmannia and Camponotini. This pre-existing molecular capacity converged with a pre-existing ecological mutualism to facilitate both the horizontal transfer and developmental integration of Blochmannia into Camponotini. Therefore, the convergence of pre-existing molecular capacities and ecological interactions—as well as the rewiring of highly conserved gene networks—may be a general feature that facilitates the origin and elaboration of major transitions in individuality.

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