Developmental symbiosis in a marine sponge

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Résumé

Symbionts that are vertically inherited will typically be present throughout the entire life cycle of their animal host. In marine animals with a biphasic life cycle, this can mean that host-symbiont interactions occur in quite different physiological contexts, from non-feeding planktonic larvae to filter-feeding, sessile benthic adults, all within a single animal species. Thus the host-symbiont dependencies may be expected to vary across the life cycle. Here we seek to understand this variation by analysing gene expression in individuals of the marine demosponge *Amphimedon queenslandica* and their maternally-inherited bacterial symbionts at five different stages of the life cycle. We find developmental changes in the expression of sponge genes are matched by those of symbiont genes, consistent with the bacterial symbionts being directly influenced by the developmental and physiological state of the host. Nonetheless, at all stages – embryos, larvae, postlarvae, juveniles and adults – the symbionts contribute disproportionately to the metabolic gene pool of the holobiont, greatly expanding its metabolic capacity. Carbohydrate metabolism, amino acid and vitamin biosynthesis in host and symbionts appearing to compliment and compensate for each other. This is particularly striking when the symbionts contribute precursor molecules involved in sponge cell signaling that is required for larval settlement, which is an obligatory yet disruptive life cycle transition. These results suggest that the sponge holobiont has evolved control systems that developmentally influence gene expression in host and symbionts and highlights why consideration of symbiosis may be important to many fields of marine biology, from conservation to aquaculture.

Mots-Clés: symbiosis, sponge, larval settlement, development, gene expression, genomics

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