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TITLE: Causes of decoupling between larval supply and settlement and consequences for understanding recruitment and population connectivity

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ABSTRACT:

Marine broadcast spawners have two-phase life cycles, with pelagic larvae and benthic adults. Larval supply and settlement link these two phases and are crucial for the persistence of marine populations. Mainly due to the complexity in sampling larval supply accurately, many researchers use settlement as a proxy for larval supply. Larval supply is a constraining variable for settlement because, without larval supply, there is no settlement. Larval supply and settlement may not be well correlated, however, and settlement may not consistently estimate larval supply. This paper explores the argument that larval supply (i.e., larval abundance near settlement sites) may not relate linearly to settlement. We review the relationship between larval supply and settlement, from estimates and biases in larval supply sampling, to non-behavioral and behavioral components, including small-scale hydrodynamics, competency, gregarious behavior, intensification of settlement, lunar periodicity, predation and cannibalism. Physical and structural processes coupled with behavior, such as small-scale hydrodynamics and intensification of settlement, sometimes result in under- or overestimation of larval supply, where it is predicted from a linear relationship with settlement. Although settlement is a function of larval supply, spatial and temporal processes interact with larval behavior to distort the relationship between larval supply and settlement, and when these distortions act consistently in time and space, they cause biased estimates of larval supply from settlement data. Most of the examples discussed here suggest that behavior is the main source of the decoupling between larval supply and settlement because larval behavior affects the vertical distribution of larvae, the response of larvae to hydrodynamics, intensification of settlement, gregariousness, predation and cannibalism. Thus, larval behavior seems to limit broad generalizations on the regulation of settlement by larval supply. Knowledge of the relationship is further hindered by the lack of a well founded theoretical relationship between the two variables. The larval supply?settlement transition may have strong general consequences for population connectivity, since larval supply is a result of larval transport, and settlement constrains recruitment. Thus, measuring larval supply and settlement effectively allows more accurate quantification and understanding of larval transport, recruitment and population connectivity.

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