Determination of larval dispersal and population connectivity in the blue mussel *Mytilus edulis* along the northern Gulf of Maine using trace element fingerprinting

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One of the most important challenges linking benthic ecology and biological and physical oceanography is in understanding mechanisms of connectivity among populations with planktonic larvae. Such knowledge is critical to marine conservation, specifically in the placement and design of marine reserves and the establishment of local harvesting limits. The blue mussel, *Mytilus edulis*, is abundant throughout the Gulf of Maine where it is spatially dominant in intertidal communities, plays a key role as an ecosystem engineer, and represents an important foundation species. The use of trace elemental fingerprinting in assessing population connectivity is supported its recent success in mussel populations along southern California. In this study, elemental fingerprinting was used to quantify connectivity among previously unexplored blue mussel populations in the Gulf of Maine and test predictions from biophysical larval transport models about the direction, scale and intensity of dispersal. During growth, $CaCO_3$ is deposited atop shell proteins, passively recording water chemistry. Larval and juvenile mussels (< 150 μm, 2 mm respectively) were deployed in mesh baskets while settlers were collected on anchored mesh pads at 15 sites in Maine. Concentrations of trace elements (Ba, Cr, Fe, Mg, Mn, Pb, Sr, Zn) relative to Ca were quantified using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Discriminant function analyses were performed to create a geospatial reference map. Larval shells of collected settlers were analyzed to determine natal origin. Larval and juvenile isotopic signatures were compared to determine age differences in shell chemical composition. Significant differences in several key elements among larval and juvenile shells were observed, while DFA analysis correctly assigned shells to sites with over 70% accuracy. Settler analysis revealed both local and regional dispersal patterns in 2014.

Elemental fingerprinting represents a powerful, unique approach to determine larval dispersal and improve understanding of the demographic, ecological and evolutionary consequences of the pelagic dispersal phases for the blue mussel and other ecologically important marine organisms.