Evolution in the North Atlantic: Processes Shaping Spatial Patterns of Genetic Diversity in Introduced Intertidal Invertebrates

Abstract

The movement of individuals and their genes across geographic space influences a species’ ecology and evolution, but it is often not possible to observe past or present movement directly. Molecular tools provide a means of inferring past movement and contemporary barriers to movement, because the known modes of mutation and inheritance underlying genetic variation provide clear predictions for patterns arising from movement and subdivision. In this thesis, I investigate how contemporary and historic patterns of movement shape evolutionary trajectories by investigating distributions of genetic variation in focal intertidal invertebrates of the North Atlantic. To determine how movement is affected by the interaction of currents with life-history traits, I sequenced mitochondrial and nuclear DNA of the intertidal amphipod Corophium volutator from discrete patches of mudflat habitat throughout the Northwest Atlantic. I detected patterns of genetic subdivision and gene flow concordant with hydrological patterns, demonstrating that currents shape evolution by determining dispersal pathways and cause fine-scale subdivision in marine communities. To test how C. volutator colonized the Northwest Atlantic coast, I investigated spatial genetic variation in populations from across its entire range using the same markers. I found that diversity in Northwest Atlantic populations was subsampled from more genetically diverse populations in the Northeast Atlantic, consistent with historic human-mediated introduction from the Northeast to the Northwest. To investigate how human-mediated dispersal affects species’ evolutionary trajectories, I characterized genomic variation in C. volutator and a co-occurring annelid Hediste diversicolor in populations from the Northeast and Northwest Atlantic coasts. I found extensive genetic divergence between the introduced and native ranges and genetic patterns consistent with historic admixture between populations within each range, providing evidence that human-mediated movement can create new allopatric lineages and erase ancestral genetic structure by promoting gene flow between otherwise isolated populations. Together, my results suggest that the increasing reach and magnitude of global human movement will change the evolutionary trajectories of species associated with human vectors of transport. While contemporary connectivity will continue to be affected by regional processes (such as currents), uncurbed human activity will likely disrupt diversification arising from barriers at regional scales while promoting the formation of new lineages at a global scale.
Ph.D. Candidate

Anthony Leon Einfeldt

Graduate Academic Unit

Biology

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Forestry & Geology Bldg.
Room 202

Examining Board:
Dr. Jason Addison (Biology) Supervisor
Dr. Gary Saunders (Biology)
Dr. Tony Diamond (Forestry & Environmental Mgt.)
Dr. Adrian Reyes-Prieto (Biology)

External Examiner:
Dr. Sean M. Rogers
Dept. of Biological Sciences
University of Calgary

The Oral Examination will be chaired by:
Dr. Heather Sears, Assistant Dean of Graduate Studies

BIOGRAPHY

Universities attended (with dates & degrees obtained):
2012-present PhD candidate, University of New Brunswick
2010-2012 MSc in Biology candidate, University of New Brunswick (transferred into PhD program on Sept. 1, 2012)
2008 BSc, University of British Columbia

Publications:
Peer-reviewed


In Preparation
Einfeldt AL, Jesson LK, and Addison JA. The geographic scale of evolution was reshaped by shipping in the Age of Exploration. To be submitted to Nature Ecology and Evolution.

Selected Conference Presentations
