Atelier
Atelier AARMS-CRM « Développement durable des écosystèmes aquatiques »
22—25 octobre 2013

Workshop
"AARMS-CRM Workshop on Sustainability of Aquatic Ecosystem Networks"
October 22—25, 2013

Investigating scallop population dynamics and connectivity on Georges Bank using biophysical modeling

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The giant sea scallop (Placopecten magellanicus) metapopulation on Georges Bank (GB) in the northwest Atlantic constitutes an economically important fishery, which is sustained by retention of planktonic larvae that are advected among three subpopulations. Dispersal of GB scallop larvae spawned in the fall is known to be sensitive to climate-related variability in the currents. Associated changes in temperature and stratification may elicit variations in biological responses that can also affect transport and these need to be examined. Additionally, no investigation has been made into transport of larvae spawned in spring or the relative influence of spring and autumn spawning to total annual production, despite the spring spawn being a consistently recurring phenomenon. We quantified the influence of larval depth-distribution, planktonic larval duration (PLD), production, mortality and spawning phenology on the retention and exchange of P. magellanicus larvae on GB using a 3-D particle-tracking model to simulate larval transport in both spawning seasons Simulations examining temperature-dependent larval development and mortality demonstrated significant effects of thermal history on PLD and survivorship. Larval transport in the spring exhibited increased downstream losses as well as sensitivity of retention to larval depth and spawning location. Our results demonstrate that biological factors significantly influence larval dispersal, and we need to reduce the uncertainty associated with estimates of these factors in order to predict effects of climate change on population connectivity.

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