Modeling growth of Atlantic cod larvae on the southern flank of Georges Bank in the tidal-front circulation during May 1999

R.G. Lough [1], E.A. Broughton [1], L.J. Buckley [2], L.S. Incze [3],

K. Pehrson Edwards [4], R. Converse [4], A. Aretxabaleta [4], F.E. Werner [4]

[1]*Northeast Fisheries Science Center, NMFS, NOAA, Woods Hole, MA 02543, USA*

[2]*University of Rhode Island/NOAA CMER Program, Graduate School of Oceanography, Narragansett, RI 02882, USA*

[3]*Bioscience Research Institute, U. Southern Maine, Portland, ME 04104 USA*

[4] *Marine Sciences Department, University of North Carolina, Chapel Hill, NC 27599-3300, USA*

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[1]Corresponding author. Fax: 1-508-495-2258

E-mail address: glough@whsun1.wh.whoi.edu (R. Gregory Lough)

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Abstract

Cruises were conducted in spring 1999 to describe the interaction between tidal-front processes and the transport, retention and growth of cod and haddock larvae and their prey during the transition to stratified-water along the southern flank of Georges Bank. All the physical and biological observations were integrated in coupled circulation-trophodynamic simulations. Data assimilation methods described in Aretxabaleta et al. (Cont. Shelf Res., vol. xx, 2005) were used in the circulation model to achieve the cell-like secondary circulation associated with the tidal front A larval cod biophysical model (IBM) was used to consider trophodynamic effects on the growth and survival of larval cod and haddock. Prey fields were specified for mixed and stratified water columns from net profiles and allowed to mix in the circulation model. Encounter and ingestion rates of larvae were functions of prey concentration, larval search patterns, sensitivity to light, swimming speeds of predator and prey, and turbulence. Model outputs provide hourly depth-dependent estimates of growth, prey biomass ingested, larval length and weight. Simulations were conducted on a 2-D transect across the tidal front before and after a wind event during 19-22 May. Observed larval growth, based on RNA-DNA, was higher in the surface 20 m at the front and stratified stations. Following the storm, larval growth decreased 1-2 % d^{-1} at the stratified and frontal stations, corresponding with a 1-2°C decrease in surface temperature. Simulations indicate that larval growth can be maximized at the tidal-mixing front due to the accumulation of prey in a region of near optimal temperature, turbulence, and light. Post-storm, simulated growth decreased slightly at the stratified station, consistent with the observed growth pattern.