Environmental effects on the growth and development of eastern oyster, Crassostrea virginica (Gmelin, 1791), larvae: A modeling study
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The effects of temperature, food concentration, salinity and turbidity on the growth and development of Crassostrea virginica larvae were investigated with a time-dependent mathematical model. Formulations used in the model for larval growth are based upon laboratory data. Simulations were done using temperature conditions characteristic of Laguna Madre, Galveston Bay, Apalachicola Bay, North Inlet and Chesapeake Bay. These simulations show that the duration of the planktonic larval phase, which is determined by larval growth rate, decreases at lower latitudes in response to warmer water temperatures. Also, oysters in the more southern locations have a longer spawning season during which the oyster population can produce more larvae. Simulations were done for Galveston Bay and Chesapeake Bay using idealized time series of food supply that included higher concentrations in the spring, summer or fall. Additional simulations considered the effects of increased food supply in both spring and fall seasons. The results show that shifting the period of enhanced food supply from March-April to April-May, when temperatures are warmer, reduces the minimum larval planktonic period from 44 to 34 days. Shifting the fall bloom from August-September to September-October, however, does not appreciably change the minimum larval planktonic period. The final set of simulations considered the effect of low salinity events and turbidity on the planktonic period of the larvae of Crassostrea virginica. By imposing a simulated low salinity (5 ppt) event of one month duration in August, the larval planktonic time is increased by about 39% over normal August salinities. Turbidity concentrations less than 0.1 g l super(-1) result in slightly decreased planktonic times. These model results show clearly the importance of ambient environmental conditions in determining the planktonic time of larvae of Crassostrea virginica, and hence their ultimate recruitment to the adult oyster population.