Climate-related changes in recruitment of the bivalve Macoma balthica

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ABSTRACT: Population dynamics of common intertidal bivalves (*Cerastoderma edule*, *Macoma balthica*, *Mya arenaria*, *Mytilus edulis*) are strongly related to seawater temperatures. In northwestern European estuaries, series of mild winters followed by low bivalve recruit densities lead to small adult stocks. In this study, we examine temperature-induced effects on reproductive output (eggs m^{-2}), onset of spawning (day of the year), and the juvenile instantaneous mortality rate (per day) of *M. balthica*. Data analysis was based on an extensive long-term data set (1973-2001) originating from the western Wadden Sea. Our results strongly suggest that rising seawater temperatures affect recruitment by a decrease in reproductive output and by spring advancement of bivalve spawning. Apparently, global warming upsets the evolved reproductive strategy of this marine bivalve to tune its reproduction to the most optimal environmental conditions for the first vulnerable life stages, most importantly the match/mismatch of time of spawning with that of the phytoplankton bloom and the settlement of juvenile shrimps on the tidal flats. It is hypothesized that the observed density-dependent mortality of juvenile bivalves may act via competition for food, a behavioral response of shrimp to low spat densities, or be the result of the response of age and size at metamorphosis of marine bivalves to resource variability. It is to be expected that prolonged periods of lowered bivalve recruitment and stocks will lead to a reformulation of estuarine food webs and possibly a reduction of the resilience of the system to additional disturbances, such as the depletion and disturbance by shellfish fisheries.