Survival probability of larval sprat in response to decadal changes in diel vertical migration behavior and prey abundance in the Baltic Sea

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ABSTRACT: We employed a coupled three-dimensional biophysical model to explore long-term inter- and intra-annual variability in the survival of sprat larvae in the Bornholm Basin, a major sprat spawning area in the Baltic Sea. Model scenarios incorporated observed decadal changes in larval diel vertical distribution and climate-driven abiotic and biotic environmental factors including variability in the abundance of different, key prey species (calanoid copepods) as well as seasonal changes, long-term trends, and spatial differences in water temperature. Climate forcing affected Baltic sprat larval survival both directly (via changes in temperature) and indirectly (via changes in prey populations). By incorporating observed changes in larval diel vertical migration, decadal changes in modeled and observed survival of Baltic sprat agreed well. Higher larval survival (spawning stock biomass) was predicted in the 1990s compared to the 1980s. After changing their foraging strategy by shifting from mid-depth, low prey environment to near-surface waters, first-feeding larvae encountered much higher rates of prey encounter and almost optimal feeding conditions and had a much higher growth potential. Consequently, larvae were predicted to experience optimal conditions to ensure higher survival throughout the later larval and early juvenile stages. However, this behavioral shift also increased the susceptibility of larvae to unfavorable winddriven surface currents, contributing to the marked increase in interannual variability in recruitment observed during the past decade.