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# Spatial synchrony in the response of a long distant migratory specie (*Salmo Salar*) to climate change in the North Atlantic Ocean

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A challenge in understanding the response of populations to climate change is to separate out the effects of local drivers acting independently on specific populations, from the effects of global drivers that are susceptible to impact multiple populations simultaneously and synchronize their dynamics. We investigated the environmental drivers and the demographic mechanisms of the widespread decline of marine survival rate in Atlantic salmon (*Salmo salar*) in the North Atlantic Ocean over the last four decades. We developed a hierarchical Bayesian life cycle model to quantify the spatial synchrony in the marine survival of 13 large groups of populations (called stock units, SUs) from two continental stock groupings (CSG) in North America (NA) and Southern Europe (SE) over the period 1971-2014. We found strong coherence in the temporal variation in marine survival among the 13 SUs of NA and SE. The common trend synthesizing the temporal variation of the marine survival for the 13 SUs captures 37% of the temporal variability and declines by a factor 1.8 over the time series. Synchrony in survival is stronger within each CSG. The common trends at the scale of NA and SE capture 60% and 42% of the total variance of temporal variations, respectively. The remaining part of the variability was explained by local variations. Then we selected sea surface temperature and primary production as proxies of the variability in the marine environment. We showed that (i) temporal variations of the marine survival is mainly explained by the temporal variations of environmental conditions encountered by salmon in the common feeding areas and (ii) environmental covariates act as synchronizing agent of marine survival. Our findings support the hypothesis of a response of salmon populations to large scale bottom-up environmentally driven changes in the North Atlantic susceptible to simultaneously impact several populations reproducing in distant habitats.

Key words: Spatial covariation, climate change, stage-based life cycle model, marine survival, Atlantic salmon, environmentally driven changes, bottom-up, hierarchical Bayesian model