



# Demographic response of Atlantic salmon populations to multiple stressors : a Bayesian hierarchical modelling approach at broad ocean scale

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**Demographic response of Atlantic salmon populations to multiple stressors:  
a Bayesian hierarchical modelling approach at broad ocean scale**

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Understanding the mechanisms of demographic response of populations to multiple stressors is a major challenge for research in ecology and for providing management advice. The life cycle of anadromous fishes is shaped by migrations and homing behaviour resulting in meta-population structures. They are therefore interesting ecological models to analyse the effect of anthropogenic and environmental pressures at multiple scales of space and time.

We developed a life cycle model of Atlantic salmon (*Salmo salar*) population dynamics for the six main stocks units considered by the Ices Working Group on North Atlantic Salmon (wgnas) for stock assessment in the eastern Atlantic Ocean. The model, carried out within the ecknows project, is developed in the Hierarchical Bayesian Modelling framework, which provides flexibility and consistency for embedding population dynamics within a statistical approach. The model assimilates a 40-years time series of data compiled by the ices wgnas. It integrates the recruitment process by separating freshwater and marine water phases and different migration strategies, and accounts for distant mixed-stock and homewater fisheries.

Results show that salmon survival during the first months at sea has decreased over the time series and support the hypothesis of a synchronous collapse of marine survival with ecosystem changes observed in the North Atlantic in the early 1990s. Simultaneously, the proportion of salmon returning to freshwater after one year at sea has increased. Ecological interpretations of these trends are discussed with regards to ecological literature on recent ecosystem changes in the Atlantic Ocean.

**Keywords:** Atlantic salmon, Bayesian Hierarchical Model, life cycle, scale, climate change

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