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Mathieu Buoro, Etienne Prévost, Olivier Gimenez

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Joint estimation of reaction norm, selective survival and reproduction cost in Atlantic salmon: a Bayesian State Space modeling approach of CMR data

mathieu Buoro, Etienne Prevost, Olivier Gimenez

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Abstract

Atlantic salmon is an anadromous and philopatric fish species. It shares its life cycle between freshwater, where reproduction and juvenile rearing take place, and the ocean where individuals undertake a long range migration. In Brittany (France) young of the year fish emerge from the gravels of the spawning grounds in early spring and the following spring they face the choice of migrating to the sea (smolt stage) or to stay an additional year in freshwater. For the males staying in freshwater, a second choice is between sexual maturation or remaining immature in their second year of life. The life history choices of migration and maturation would mainly be the expression of the phenotypic plasticity of the species through a reaction norm dependent on growth and energy reserves previously accumulated. Survival in freshwater could be size selective and affected by maturation (reproduction cost).

Inspiring from Gimenez et al. (in press, *Ecol. Model.*), we apply the state space modeling (SSM) framework to individual capture-mark-recapture (CMR) data gathered from the Scorff river (Brittany). Joint estimation of all the model unknowns is worked out by Bayesian statistical inference using MCMC sampling techniques. The Bayesian SSM approach allows to separate the CMR observation process from the life history dynamics of primary interest. Probabilistic reaction norms (for migration and sexual maturation), selective mortalities and reproduction cost are then jointly estimated in a single and consistent framework. Results are discussed regarding both the merits and limitations of the Bayesian SSM approach and their implications for the evolutionary ecology of the Atlantic salmon.