The flirtyShadBrain model

Paumier Alexis, Drouineau Hilaire, Sebastien Boutry, Lambert Patrick

Reproduction activity is the result of complex behaviors that involve multiple environmental parameters. Developing models that predict reproduction in uncertain environments is a challenging task that requires advances in artificial intelligence. Here, we present an approach aiming to evaluate the environmental control of reproduction for allis shad in the Garonne basin. Basically, the model first calculates the probability to spawn for each day according to environmental factors perceivable by a fish. Then, the daily proportion of reproductive acts in a season are computed based on the probabilities to spawn in respect with three biological constrains: a maximum of three reproductions spaced by a minimum of three days between them within 30 days of presence on the spawning grounds. Finally, we multiply the reproductive act proportions by the number of spawners that arrived according to a migration pattern. The model result is finally compared with the time series of observed reproductive acts. The probability to spawn is based on an artificial neural network with reinforcement learning (RL) (Salimans et al., 2017). The strategy known as neuro-evolution (Risi and Togelius, 2014), is to trained the artificial neural networks through an evolutionary algorithms. The relative proportion of reproductive acts is computed considering a success after several failures. The annual migration patterns are simulated with a Gaussian distribution. All the model parameters (i.e. the weights of neural networks, the migration parameters and the number of spawners) were calibrated using the covariance matrix adaptation evolution strategy CMA-ES (Hansen and Ostermeier, 2001). We will present how the objective function has been iteratively built. Once the model is calibrated, we will analyze the relative importance of environmental variables on the choice to spawn with the Olden methodology and will test the model with the new environmental conditions induced by global change.