

**Assessing the Role of Environmental Factors on Baltic Cod Recruitment, a Complex Adaptive System Emergent Property**

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For decades, fish recruitment has been a subject of intensive research with stock–recruitment models commonly used for recruitment prediction often only explaining a small fraction of the inter-annual recruitment variation. The use of environmental information to improve our ability to predict recruitment, could contribute considerably to fisheries management. However, the problem remains difficult because the mechanisms behind such complex relationships are often poorly understood; this in turn, makes it difficult to determine the forecast estimation robustness, leading to the failure of some relationships when new data become available. The utility of machine learning algorithms such as artificial neural networks (ANNs) for solving complex problems has been demonstrated in aquatic studies and has led many researchers to advocate ANNs as an attractive, non-linear alternative to traditional statistical methods. The goal of this study is to design a Baltic cod recruitment model (FishANN) that can account for complex ecosystem interactions. To this end, we (1) build a quantitative model representation of the conceptual understanding of the complex ecosystem interactions driving Baltic cod recruitment dynamics, and (2) apply the model to strengthen the current capability to project future changes in Baltic cod recruitment. FishANN is demonstrated to bring multiple stressors together into one model framework and estimate the relative importance of these stressors while interpreting the complex nonlinear interactions between them. Additional requirements to further improve the current study in the future are also proposed.

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