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**Title: Pattern-based prediction of population outbreaks**

**Abstract:**

The complexity and practical importance of insect outbreaks have made the problem of predicting outbreaks a focus of recent research. We propose the Pattern-Based Prediction (PBP) method for predicting population outbreaks. It uses information on previous time series values that precede an outbreak event as predictors of future outbreaks, which can be helpful when monitoring pest species. We illustrate the methodology using simulated datasets and an aphid time series obtained in wheat crops in Southern Brazil. We obtained an average test accuracy of 84.6% in the simulation studies implemented with stochastic models and 95.0% for predicting outbreaks using a time series of aphids in wheat crops in Southern Brazil. Our results show the PBP method's feasibility in predicting population outbreaks. We benchmarked our results against established state-of-the-art machine learning methods: Support Vector Machines, Deep Neural Networks, Long Short Term Memory and Random Forests. The PBP method yielded a competitive performance associated with higher true-positive rates in most comparisons while providing interpretability rather than being a black-box method. It is an improvement over current state-of-the-art machine learning tools, especially by non-specialists, such as ecologists aiming to use a quantitative approach for pest monitoring. We provide the implemented PBP method in Python through the pypbp package.