Detection and Tracking of Soil Protists using Deep Learning

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Abstract

Plastic residues can fragment into nanoplastics and bring various pollutants to the soil, which results in a massive environmental risk that is endangering entire ecosystems. Soil protists, as a vital part of microbial food webs and carbon cycles, are also considered to be strongly affected by the presence of nanoplastics. Until now, many studies have found that plastic residues can have either positive or negative effects on different elements of ecosystems. However, no research has been conducted to quantify the impact of plastic on soil protists due to a lack of tools for visualizing and studying these microorganisms. Therefore, we try to use a deep learning-based object detection model, You Only Look Once (YOLO), to track and record the speed and trace of the protists in the soil chips.

In this work, YOLOv8 model is used to detect and classify 9 classes of protists in the videos acquired from the soil chips. To achieve better performance, several model improvement methods are tested. Generative Adversarial Networks (GANs) are also applied to generate synthetic images to solve the lack of data. Then we record the speed and trace and compare them among different treatment conditions to analyze the effects of nanoplastics on the protists. In conclusion, we demonstrate the feasibility of leveraging the power of AI and deep learning to help scientific research. We also conclude that high-concentration nanoplastics will cause the protists to move slower than usual, different protists have disparate moving patterns.