

Computer-vision based automated assessment of post-disturbance forest resilience

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As a result of climate change, disturbances regimes are changing around the globe. This is challenging the sustainable provisioning of ecosystem services to society. Understanding the disturbance resilience of forest ecosystems is crucial for forest management, yet estimating resilience in the field remains difficult. A rapid assessment of important indicators associated with failing tree regeneration post disturbance would help managers to prioritize efforts on disturbed areas.

Here, we propose an innovative approach for resilience assessment leveraging recent advancements in computer vision and deep neural networks (DNNs) to estimate post disturbance resilience based on indicators derived from GoPro-photos taken in the field. We build on an extensive empirical dataset of post-disturbance development pathways (resilience, restructuring, replacement or reassembly) derived across four forest types (spruce, beech, pine, oak) in Bavaria. We use these empirical data in combination with computer vision models trained on images collected from disturbed plots and their surroundings (N=1240 images) to predict indicators related to ground cover (e.g., percent covered by grass) and forest structure (e.g., deadwood, structural complexity). These computer-vision derived indicators were subsequently related to field-based assessments to test their suitability of detecting disturbances and disturbance strength as well as their ability of predicting post-disturbance pathways. Preliminary results demonstrate a medium to strong ability of computer vision-derived indicators to correctly detect disturbances and predict post-disturbance forest development.

Our findings suggest that computer-vision methods offer a low-cost, low-threshold tool to support forest managers in prioritizing post-disturbance management decisions.