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Green Attack or Overfitting? Comparing Machine-learning-based and Vegetation-index-based Methods to Early Detect European Spruce Bark Beetle Attacks Using Multispectral Drone Images

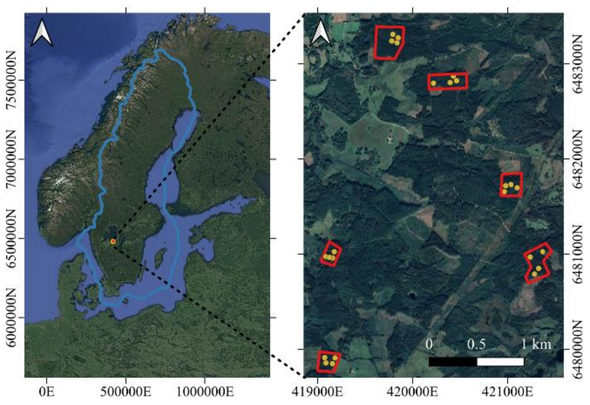
OBJECTIVE

- **Quantifying the detectability of the attacked trees with different duration of infestations**
- **Comparing machine learning methods with VIs.**
- **Testing their transferability on untrained areas.**

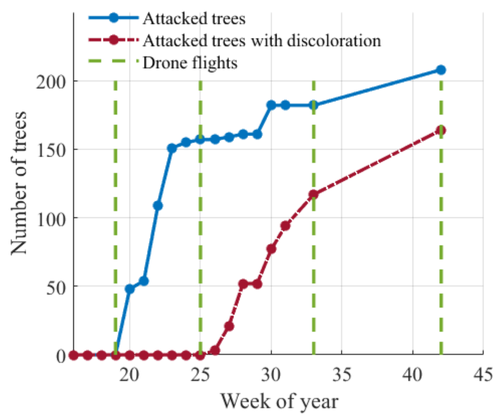
METHODS

➢**Experimental forests**

- **A controlled experiment**
  - Pheromone dispensers in 24 plots
  - 977 spruces monitored, 208 spruces attacked
- **Weekly field inventory**
  - Holes on the barks, discoloration, defoliation



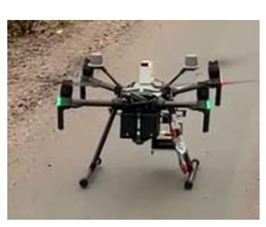
Study area and plots in Sweden



Number of attacked trees recorded every week

➢**Drone images**

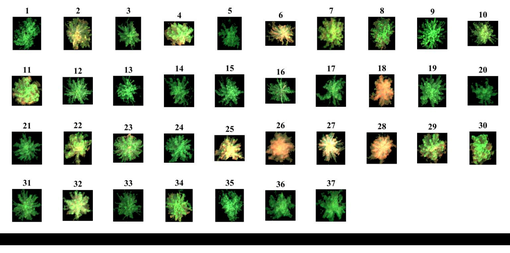
- DJI M210 with MAIA S2 camera
- Multispectral drone images, 9 bands as Sentinel-2
- 80 m above the ground, 0.04 m resolution

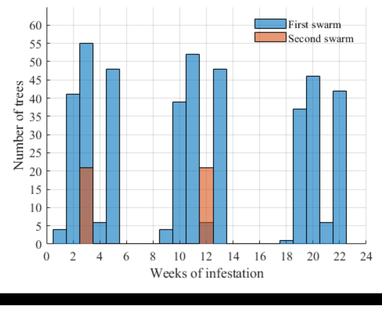


Radiometric reference target, DJI M210 drone, and MAIA S2 multispectral camera

➢**Segmented trees and sample size**

- Marker-controlled watershed segmentation
- Group tree segmentations with the same durations of infestation.
- 486 segmentations (samples).



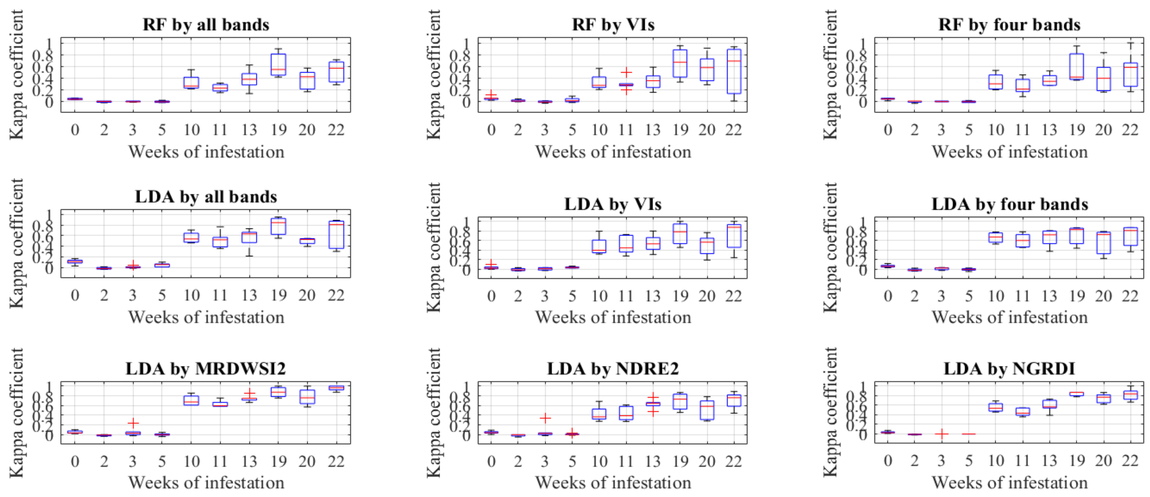


➢Training and testing methods

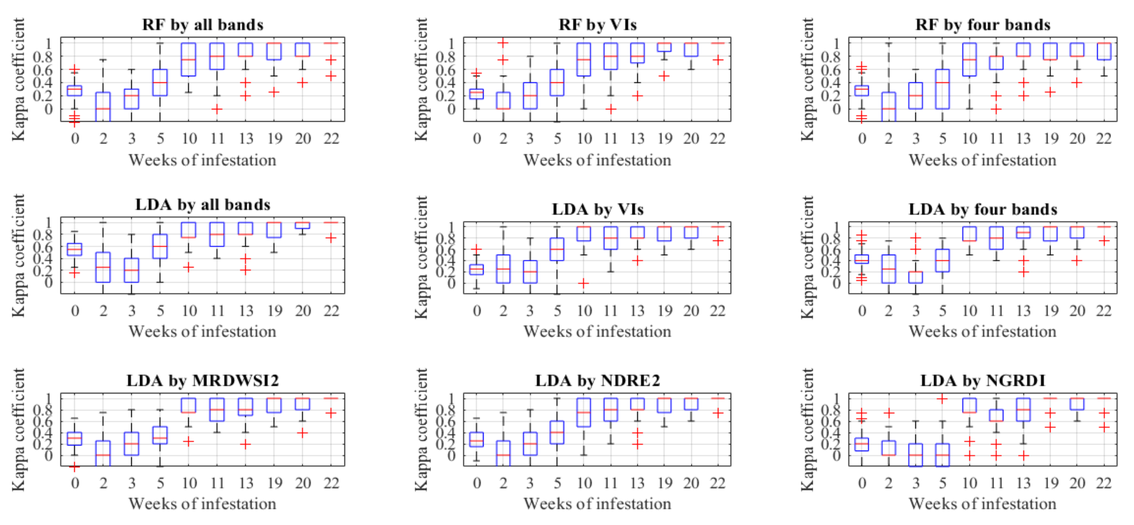
- Random Forest (RF), Linear Discriminant Analysis (LDA)
- Vegetation indices (VIs)
- All bands, four bands, and VIs as input to RF and LDA
- Validation A: 90% training data and 10% testing data
- Validation B: training on 5 stands and test on the other one stand

RESULTS AND CONCLUSIONS

- **RF and LDA with multiple variables showed overfitting and low transferability on untrained area.**
- **Using single VIs showed higher accuracy and robustness.**
- **Infestations with <5 weeks showed very low detectability.**
- **Testing on untrained area is crucial to show the transferability of a model.**



Kappa coefficient of the RF and LDA models using different variables when training on 5 stands and testing on the remaining stand.



Kappa coefficient of the RF and LDA models using different variables when variables when training and testing on 90% and 10% of all trees, respectively

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