

# Comparing Spectral Differences Between Healthy and Early Infested Spruce Forests Attacked by Bark Beetles Using Satellite Images

## OBJECTIVE

Testing the limitation of green-attacks sensed by satellite images.

## HYPOTHESIS

No spectral difference can be identified between green-attacked and healthy forests if the differences do not exist before the attacks.

## METHODS

### Experimental forests

#### Plot level:

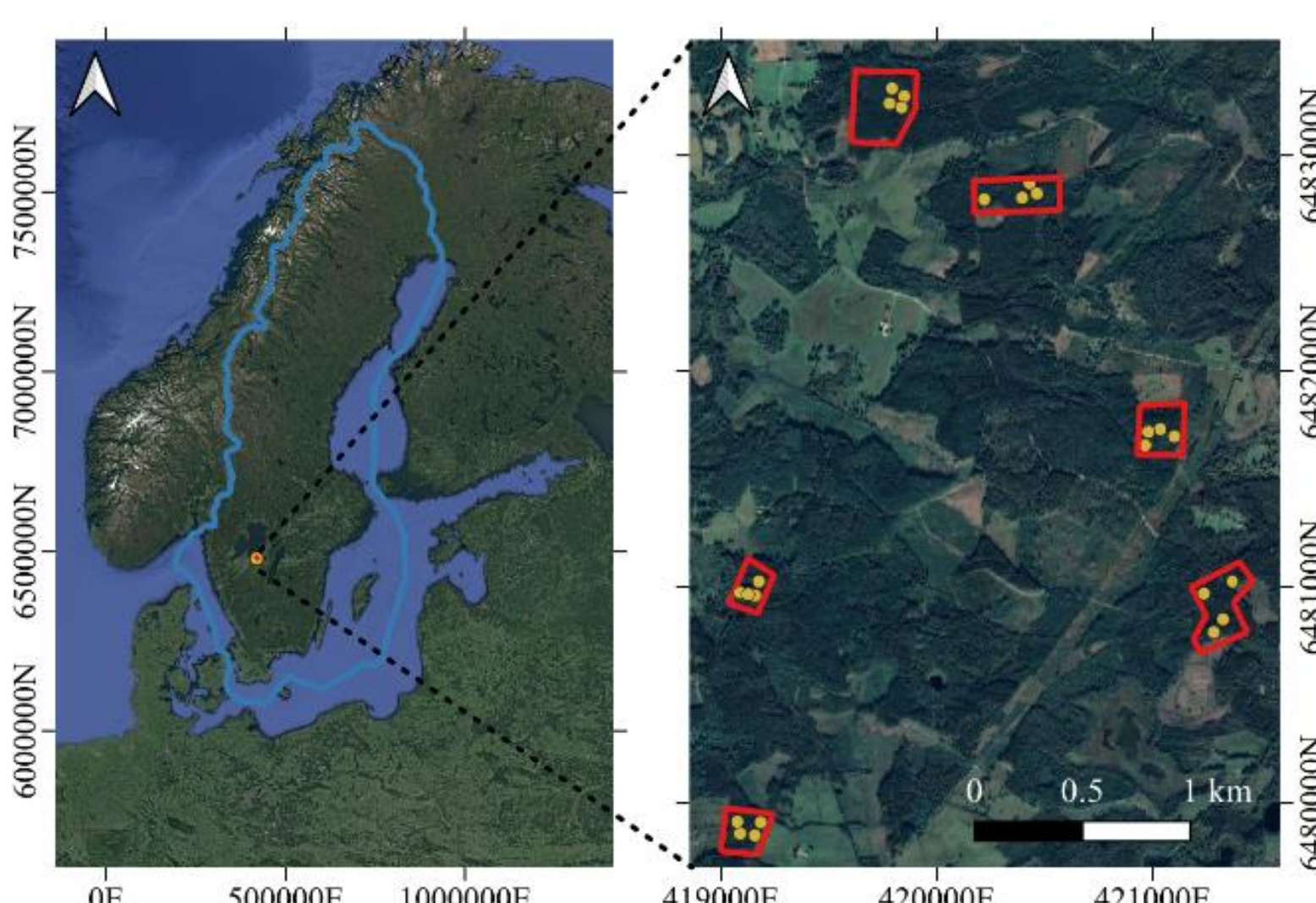
##### A. Experimental plots:

- severe infestation (6 plots, with > 10 damaged trees)
- moderate infestation (9 plots, with 5–10 damaged trees)
- mild infestation (9 plots, with < 5 damaged trees)

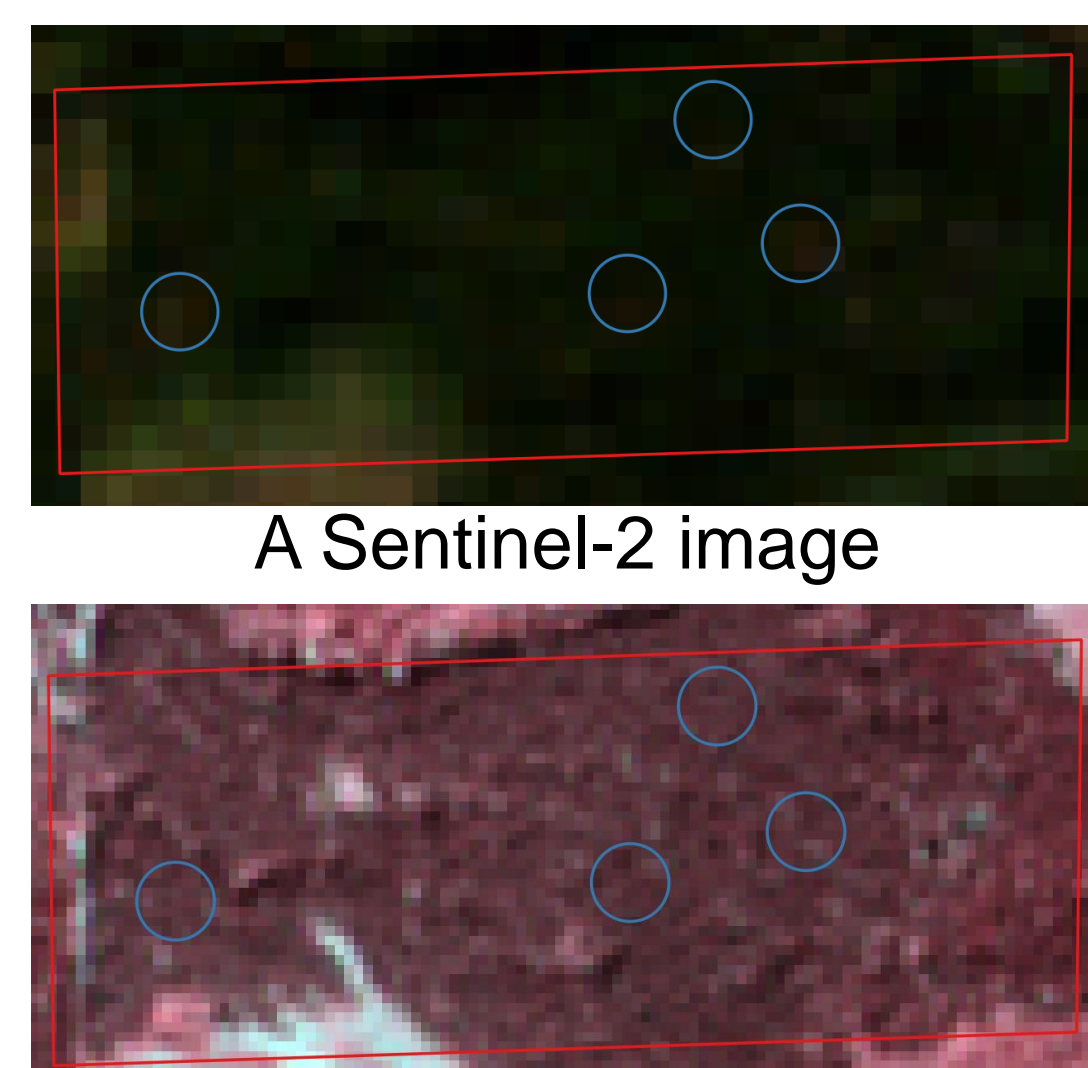
##### B. Control plots (24 plots, with only healthy trees)

#### Individual tree level, we labeled the trees as:

- infested trees, attacked before image acquisition
- vulnerable trees, attacked after image acquisition
- healthy trees in experimental plots
- healthy trees in control plots.



Study area and plots in Sweden



A WorldView-3 SWIR image

### Satellite images

#### Sentinel-2

- Acquired in April, June, August, September, October
- Blue, green, red, NIR bands with 10 m resolution
- Red-edge, NIR, and SWIR bands with 20 m resolution
- For the plot level

#### WorldView-3 SWIR

- Acquired in June
- 8 SWIR bands with 3.7 m resolution
- For the plot and tree levels

## RESULTS

### Sentinel-2

#### Severe attacks V.S. control plots

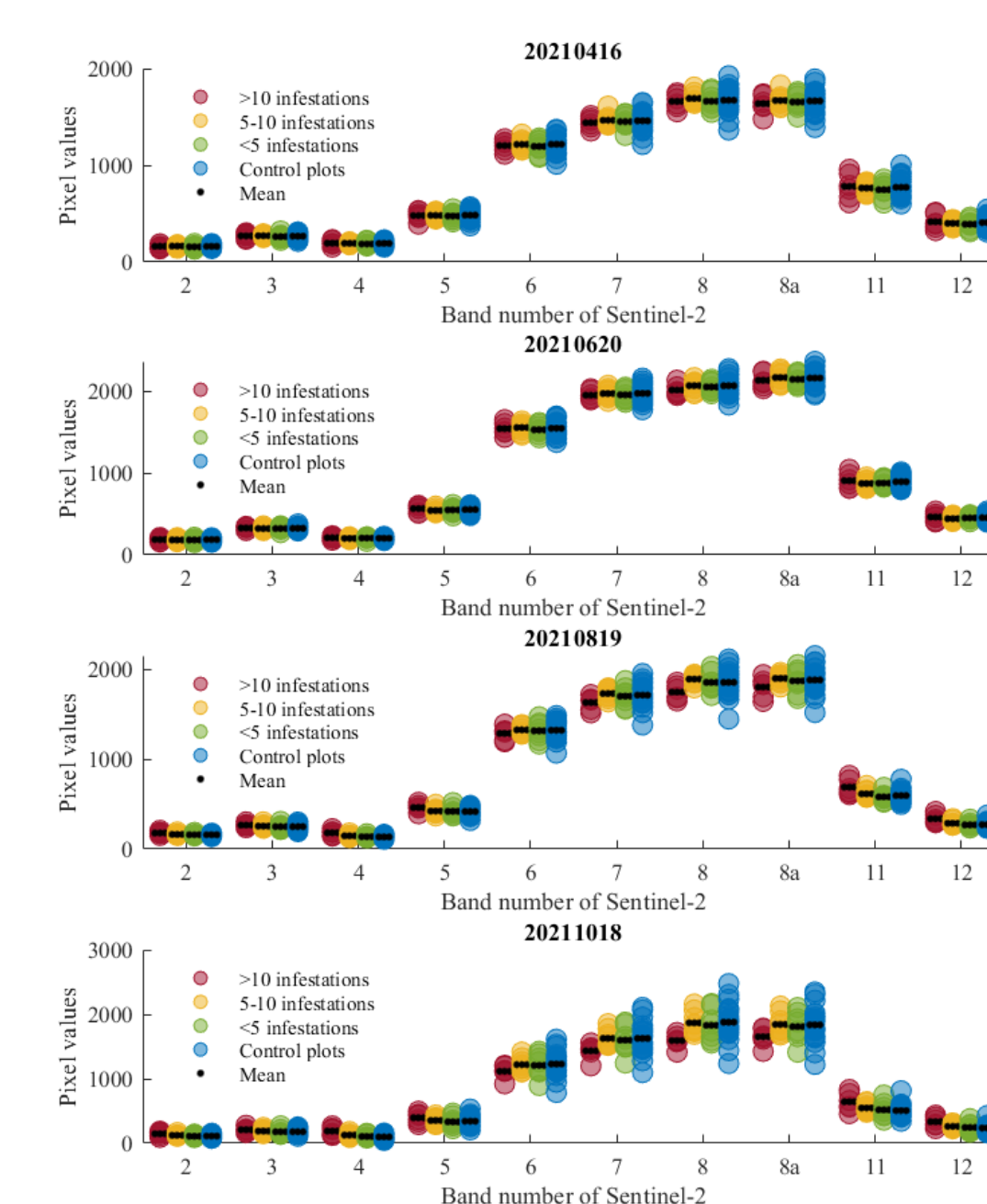
- No significant differences in **April and June**
- Bands showed significant differences since **August**: blue, red, red-edge (band 5), SWIR bands

#### Moderate attacks V.S. control plots

- No significant differences in **April and June**.
- Only the red band showed significant differences since **August**.
- The **SWIR** bands showed significant difference since **September**.

#### Mild attacks V.S. control plots

- No significant differences in any seasons



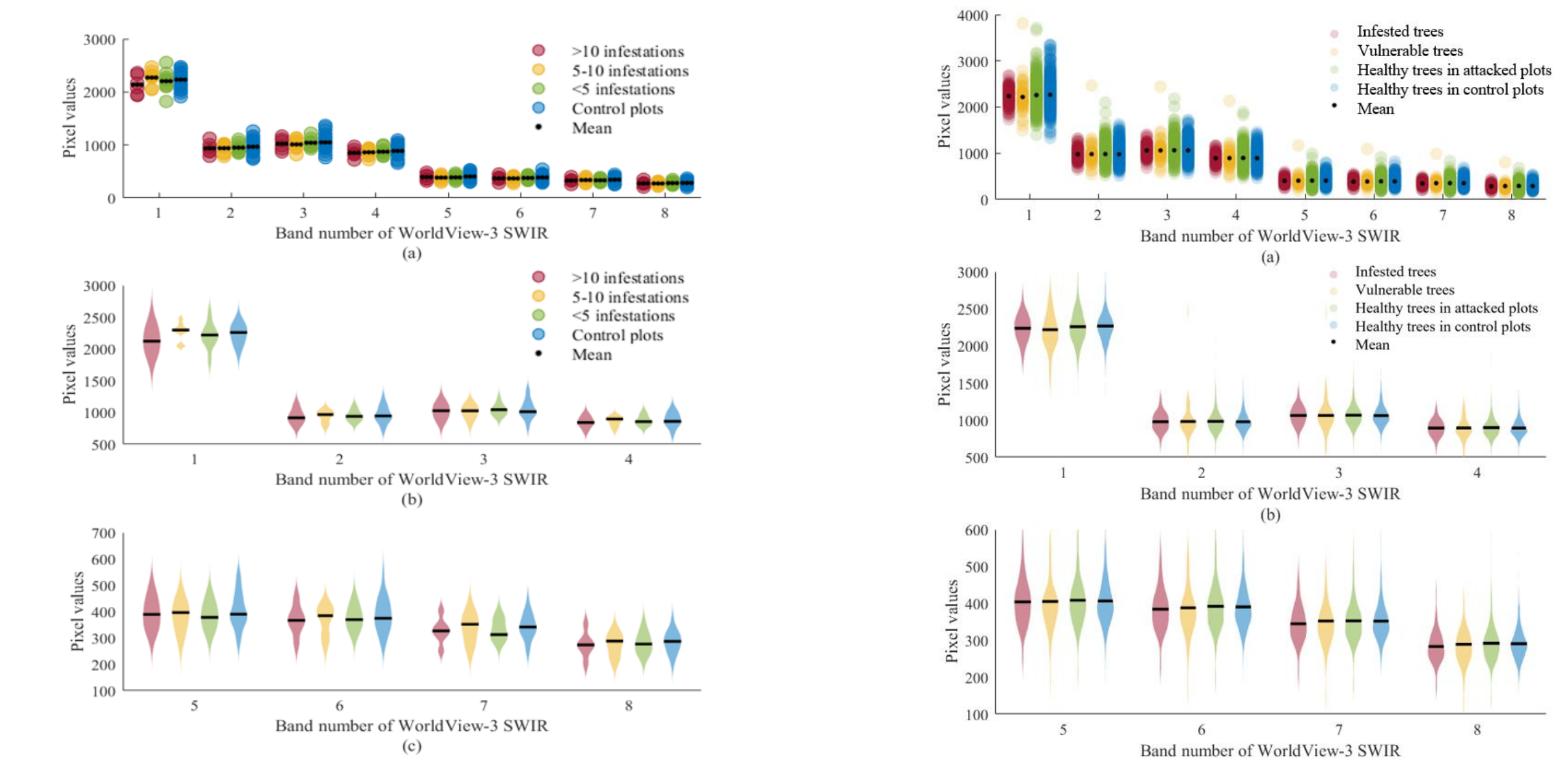
Mean pixel values from Sentinel-2

Timing of spectral differences for tree groups

Number of attacked trees	Time of significant spectral differences	Sensitive bands
< 5	None	None
5 – 10	September	Red, SWIR
10 – 20	August	Blue, red, red-edge (band 5), SWIR bands

### WorldView-3

No significant differences between any plot groups or tree groups



Mean pixel values from the WorldView-3 SWIR image at the plot and single tree level

## CONCLUSIONS

- No spectral difference was identified between green-attacked and healthy forests when the differences do not exist before the attacks.
- The number of trees limits the sensitivity.



Langning Huo  
Researcher  
Langning.huo@slu.se



Eva Lindberg  
Senior Lecturer  
Eva.lindberg@slu.se



Henrik Persson  
Associate Professor  
Henrik.persson@slu.se



Johan Fransson  
Professor  
Johan.fransson@lnu.se