ForForest Damage – Bark Beetle Identification With the Help of Remote Sensing in Latvian Territories

Illustrations
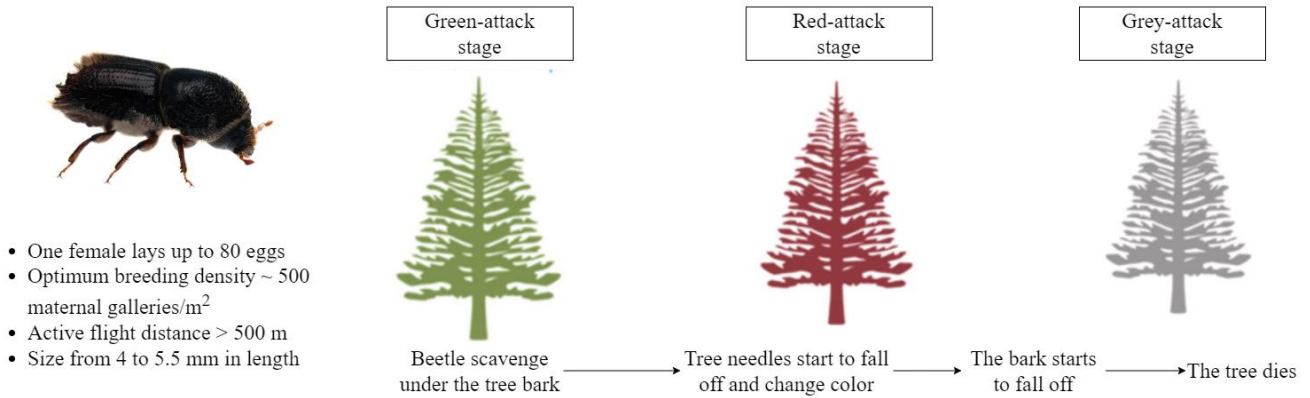
Green-attack stage	Red-attack stage	Grey-attack stage

- One female lays up to 80 eggs
- Optimum breeding density ~ 500 maternal galleries/m^2
- Active flight distance > 500 m
- Size from 4 to 5.5 mm in length

Beetle scavenge under the tree bark ⟶ Tree needles start to fall off and change color ⟶ The bark starts to fall off ⟶ The tree dies

Figure 1.1. **Flowchart of the evolution of the bark beetle attack.**

Simplified representation of a random forest

dataset

Tree-1 ⟹ Class A
Tree-2 ⟹ Class B
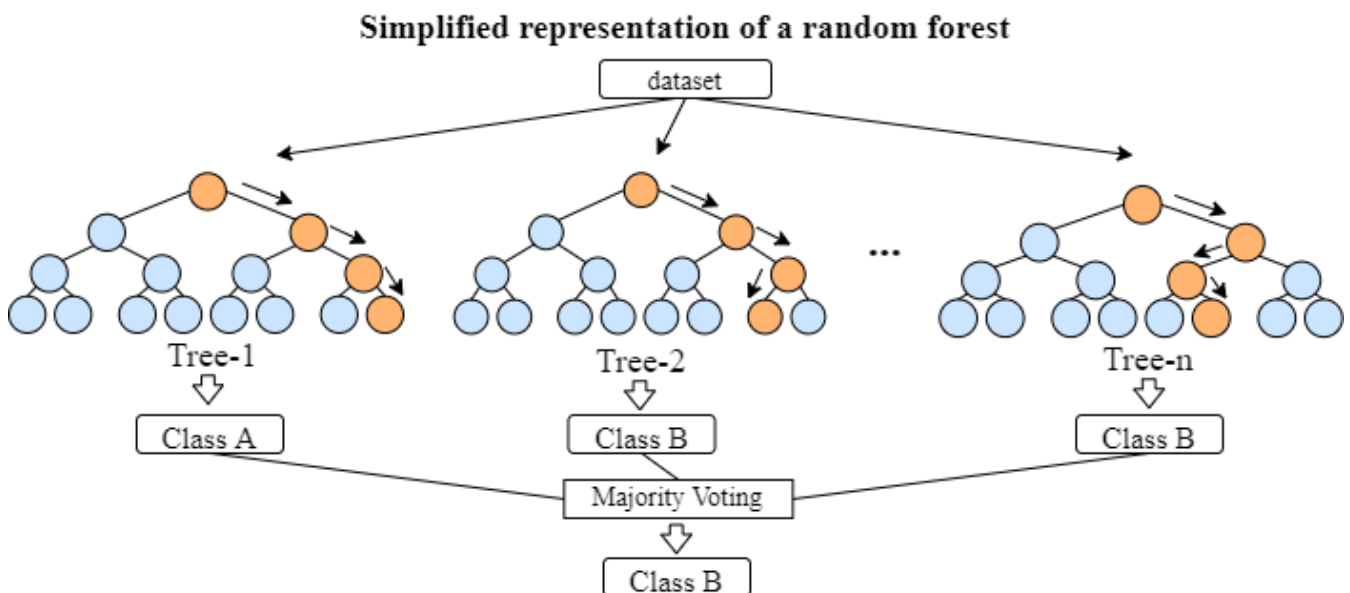Tree-n ⟹ Class B

Majority Voting ⟹ Class B

Figure 1.2. **Simplified representation of a random forest.**

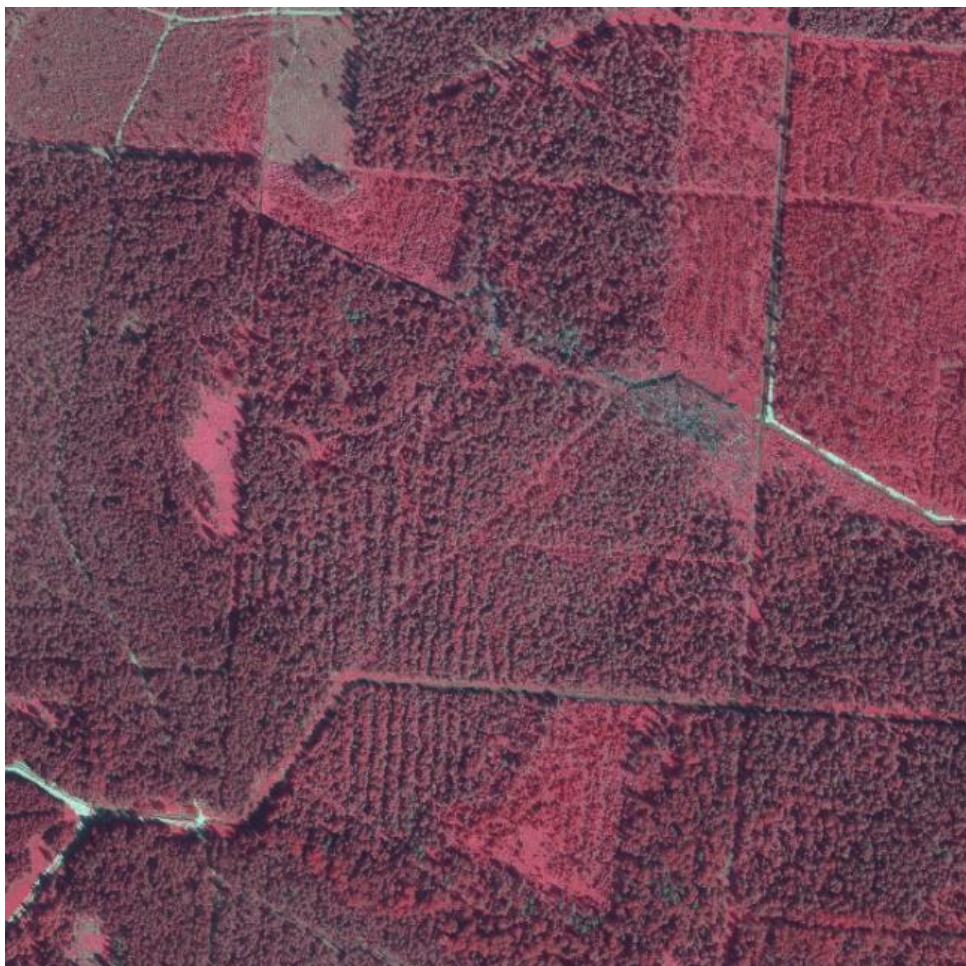*Figure 2.1.* © **LGIA 7th cycle RGB image with surveyed bark beetle damage areas (yellow).**

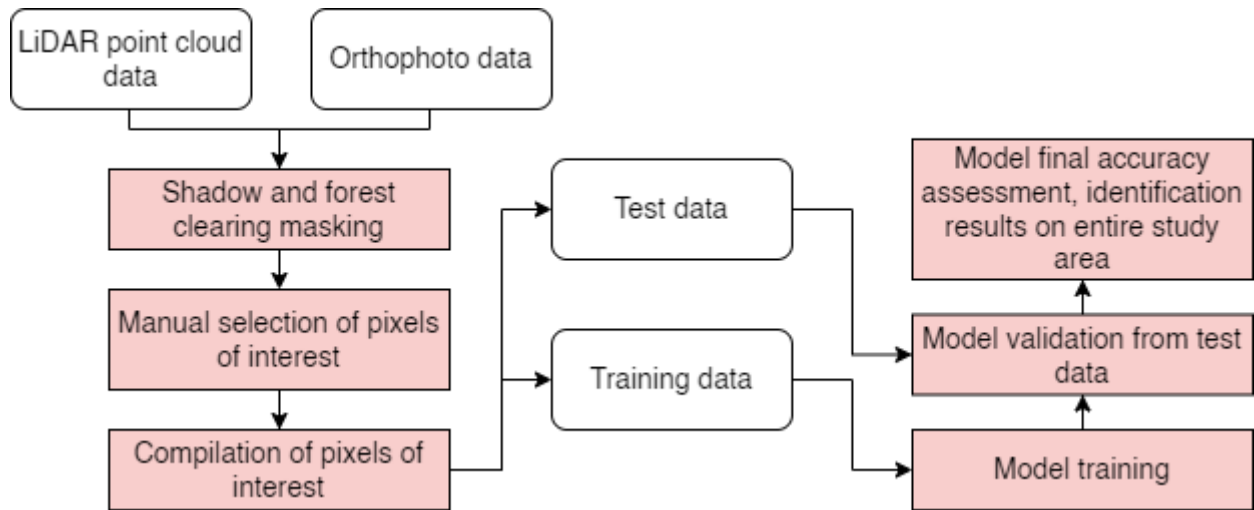*Figure 2.2.* © **LGIA 7th cycle CIR image.**

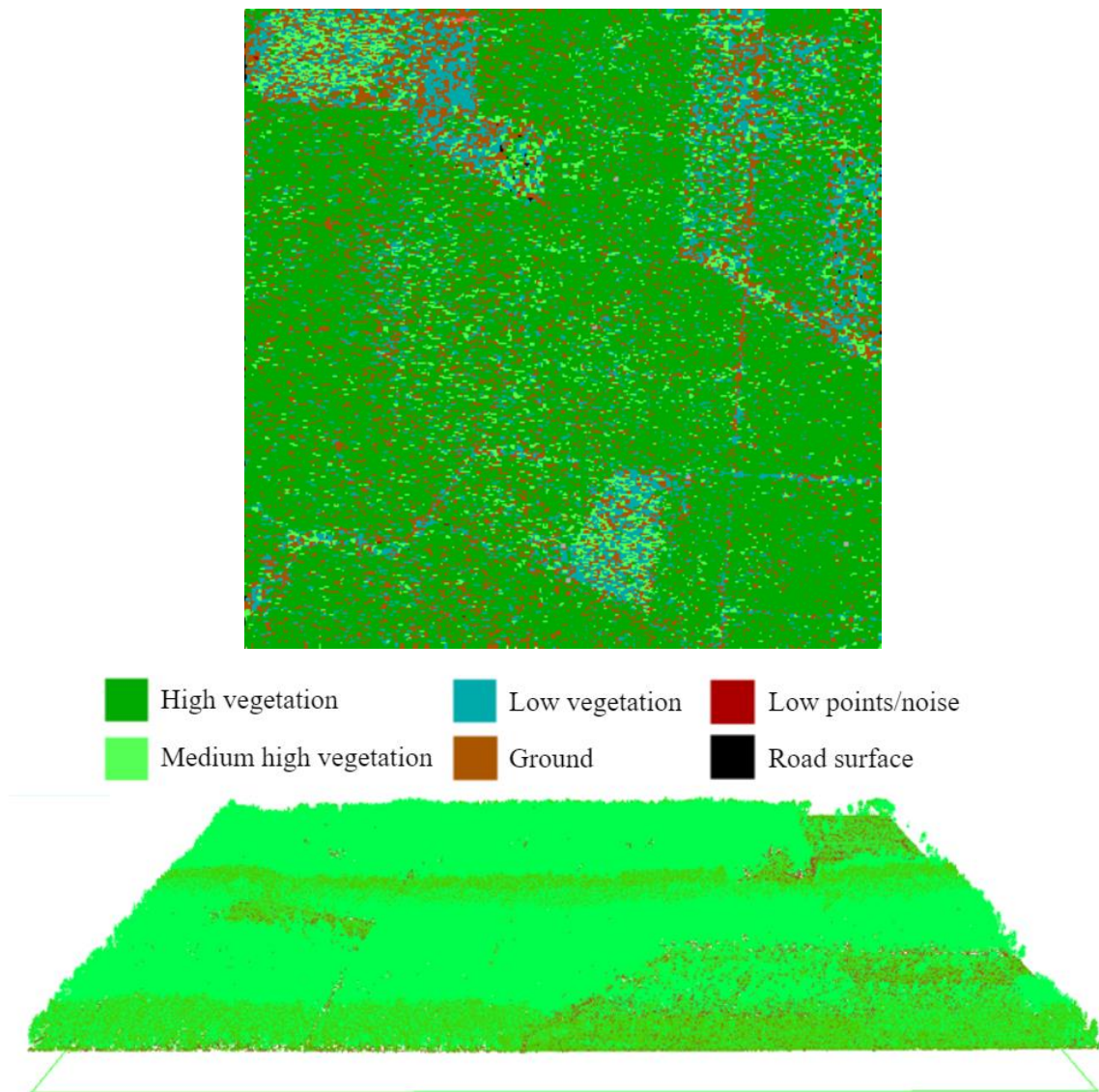*Figure 3.1.* **Workflow of the methods used in the study.**

■ High vegetation	■ Low vegetation	■ Low points/noise
■ Medium high vegetation	■ Ground	■ Road surface

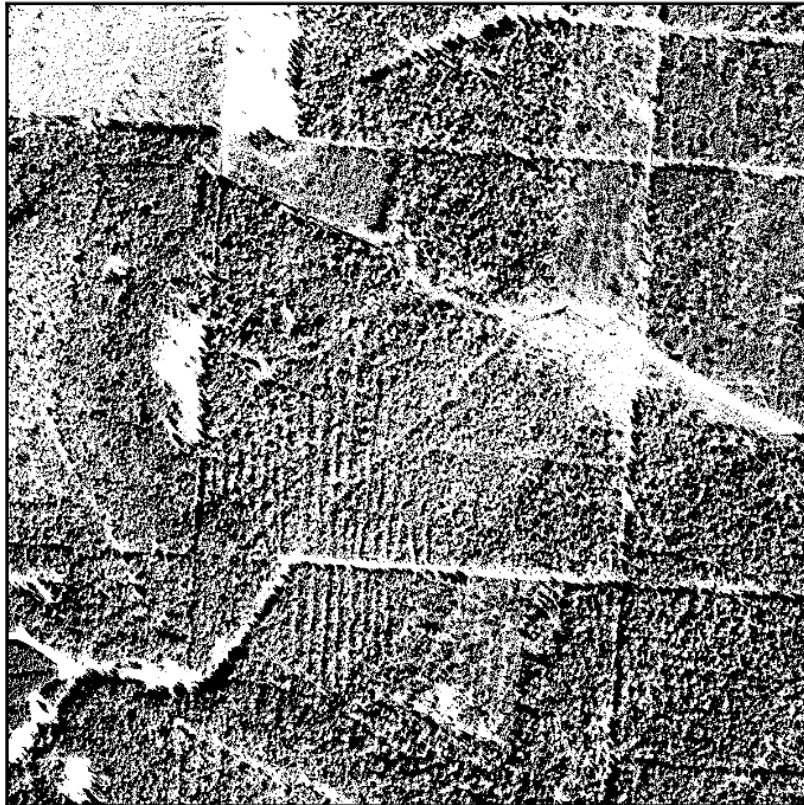*Figure 3.2.* **Overhead and 3D representation of the LiDAR point cloud data.**

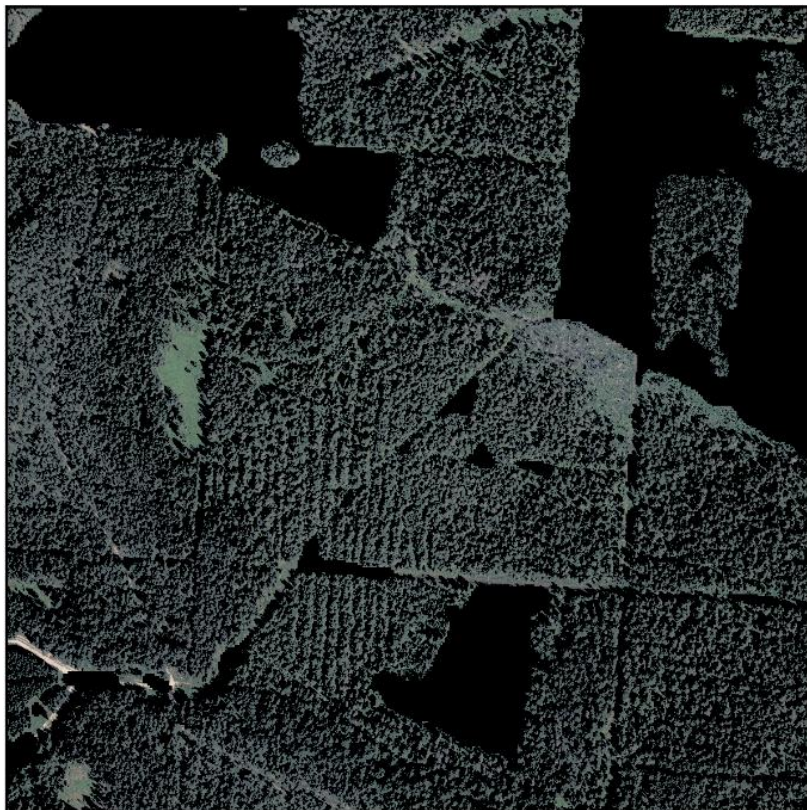*Figure 3.3.* **Shadow mask of the study area (pixels in black are masked).**

Figure 3.4. **Overall mask of the study area (pixels in black are masked).**
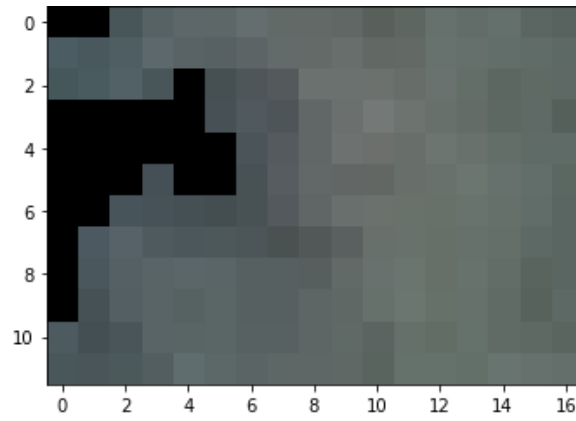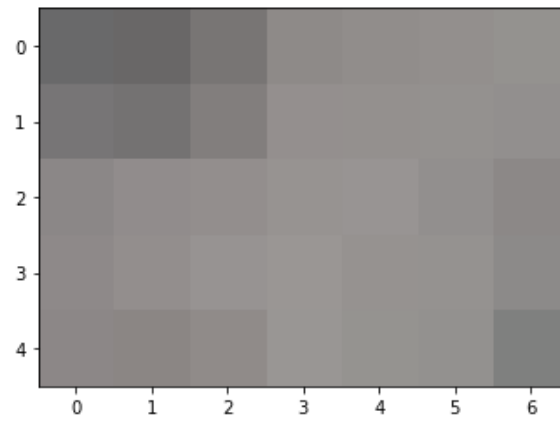
Figure 3.5. **Healthy region of interest**

Figure 3.6. **Infested region of interest**

ID	Category	Red	Green	Blue	NIR
1	Healthy	96	108	108	125
2	Healthy	102	114	112	124
...	...	...	...	...	...
24831	Healthy	77	88	86	146
24832	Infested	110	114	118	103
...	...	...	...	...	...
39577	Infested	142	152	144	176

Table 3.1. **Spectral band pixel intensities for categories: Healthy, Infested.**
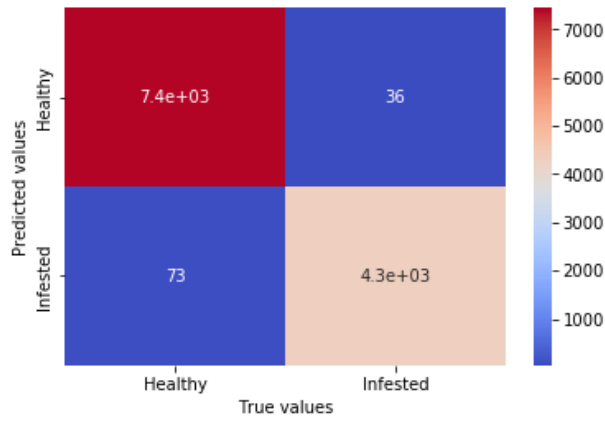
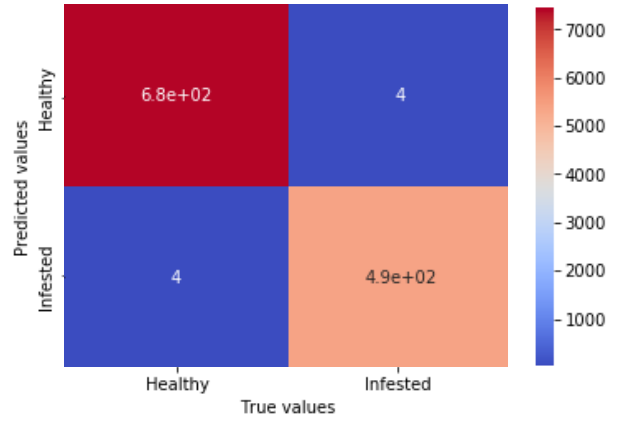*Figure 4.1.* **Confusion matrix of the resulting model.**

Figure 4.2. **Confusion matrix of the resulting model using data from validation area**
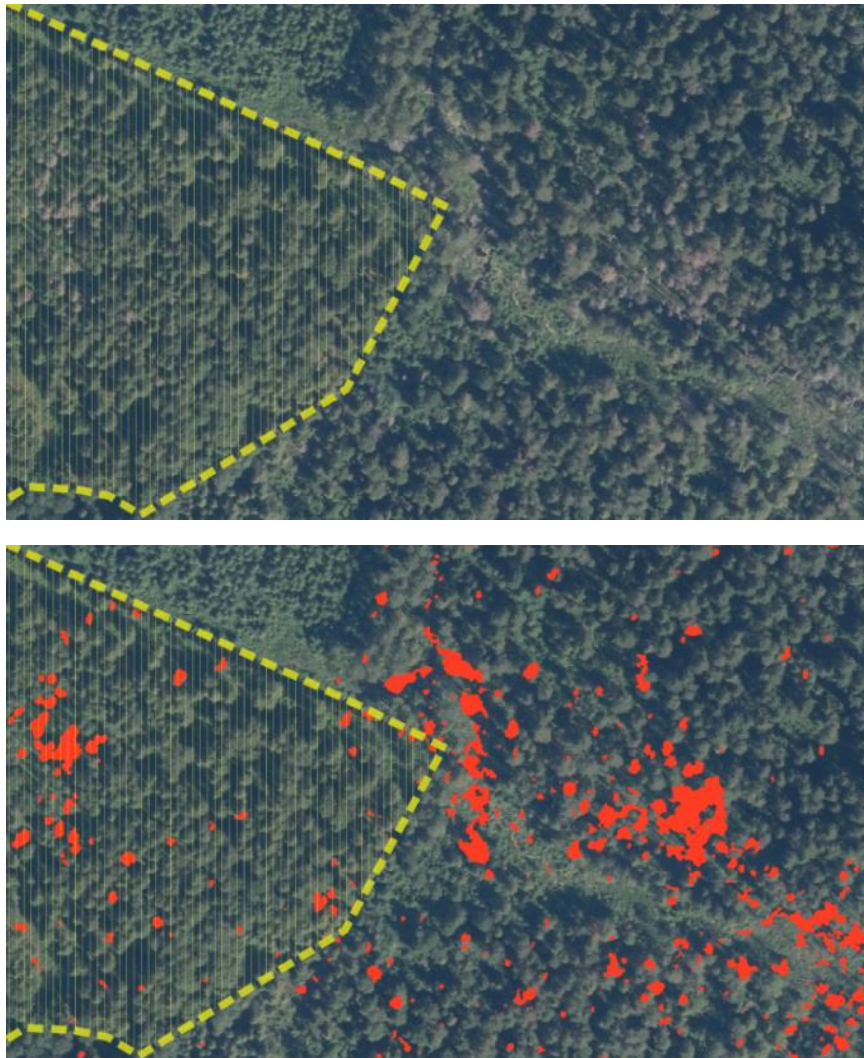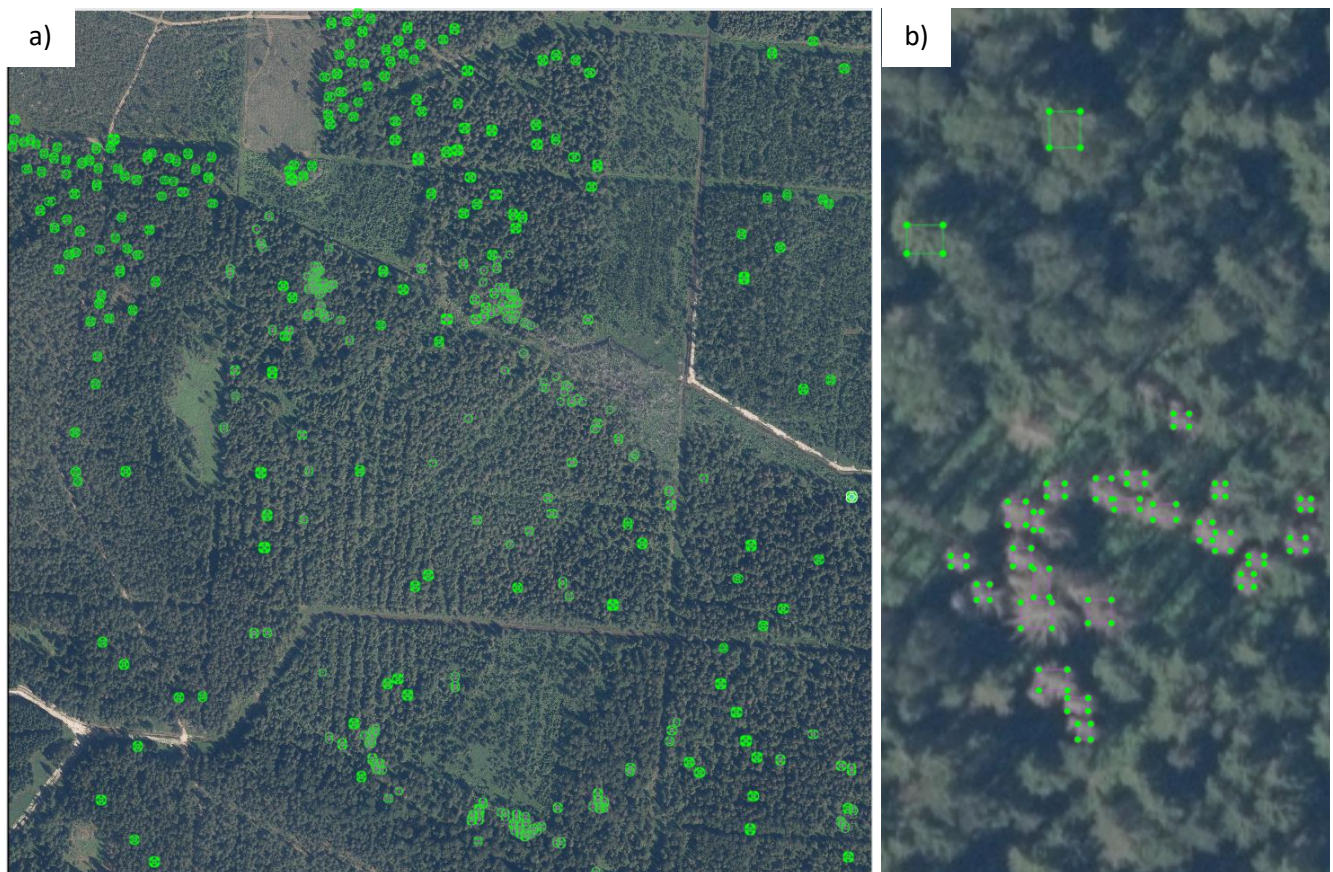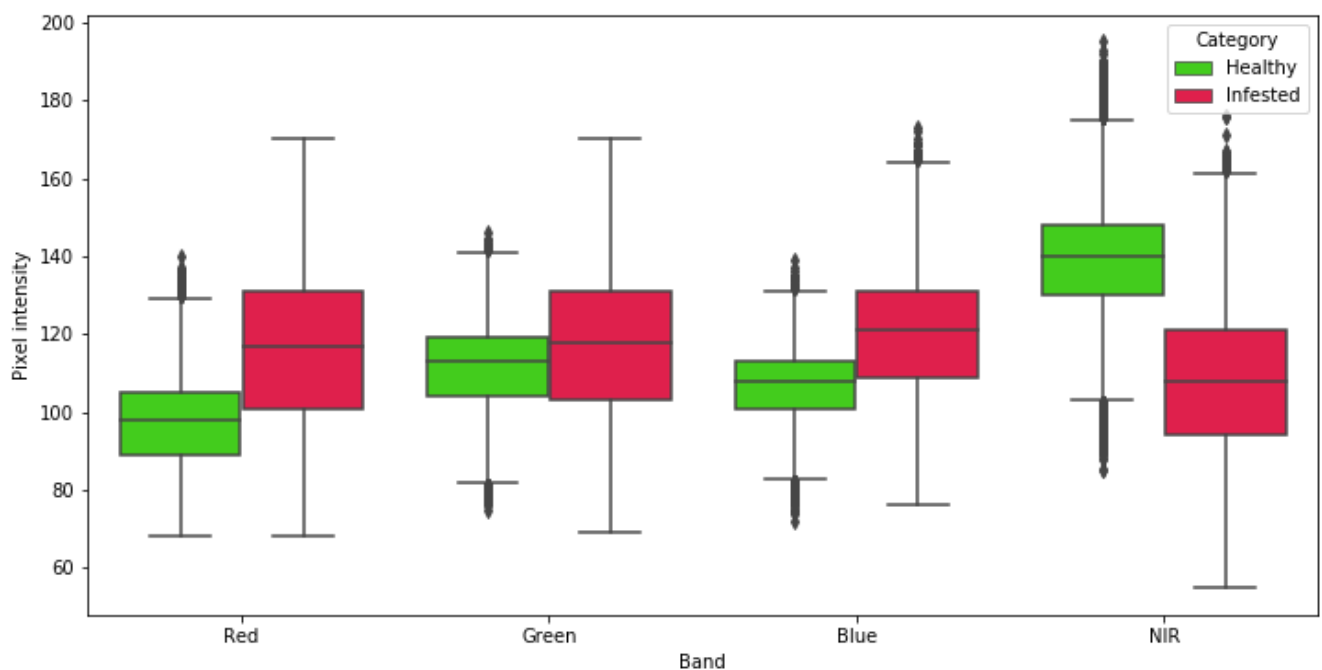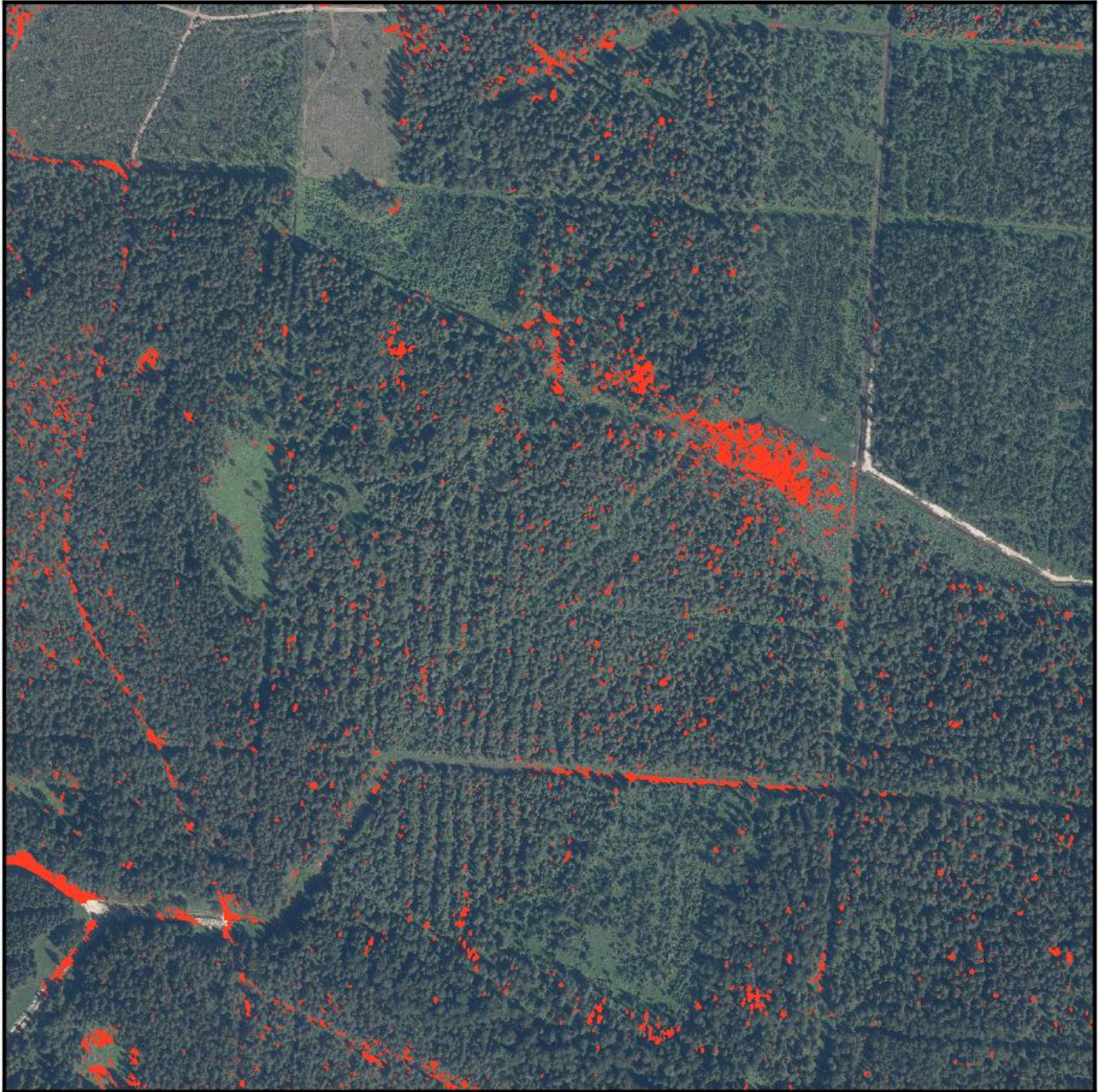

Figure 4.3. **Close up of a specific region of the study area, showing the surveyed bark beetle damage areas (yellow dotted line) and the bark beetle red-attack areas identified by the model (red).**

Annex 1. **a) Selected regions of interest throughout the study area (green). b) A close up of the study area with infested (light purple) and healthy (green) selected regions.**

Annex 2. **Box plots of pixel intensities for healthy and infested pixels in the red, green, blue and near-infrared (NIR) bands, respectively.**

Annex 3. **Model-identified forest damage – bark beetle red-attack
stage areas (red) in the study area.**