



German Remote Sensing Data Center (DFD)

Characterizing Forest Fragmentation in Bavaria Through Canopy Cover Loss Analysis Based on Earth Observation Data

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MOTIVATION



Figure 1. Disturbances from bark beetle account for some of the forest loss and fragmentation in Bavaria.

- Forests characterize more than **one-third of the land surface** in Bavaria and are comprised of **predominantly Norway spruce** which are **highly susceptible to infestations** by the European spruce bark beetle (Fig. 1).
- In 2022, Thonfeld et al.[1] reported over **500,000 hectares of forest loss** across Germany for the study period 2017-2021.
- Increasing climatic pressures can weaken trees and diminish the **climate buffering** capacities of forests.

APPROACH

Research Question:

What is the current status of forests in Bavaria in the context of fragmentation metrics?

Aim:

Assess the patterns of forest patch distribution by measuring the area of the core forest, edge zones, perforations and proximity to neighboring forests.

- Fragmentation analysis is a method for quantifying **spatial patterns** among patches of a particular habitat within a defined landscape (Fig. 2).
- **Administrative units** were used to delineate **landscapes**.
- Metrics were selected based on **FRAGSTATS**[2] definitions and calculated independently using Python.

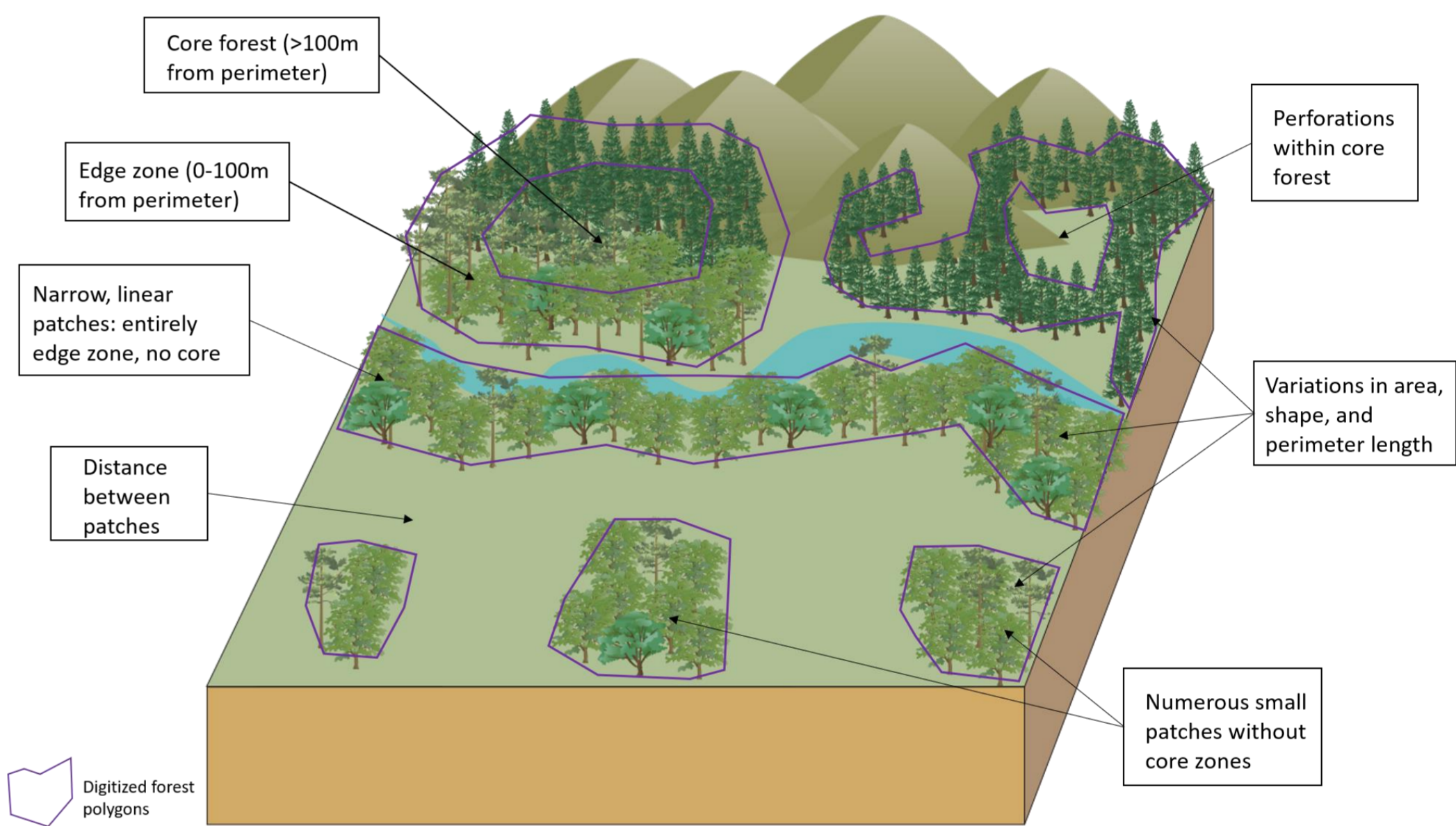


Figure 2. Examples of spatial patterns quantified in fragmentation analysis.

SELECTED RESULTS

- Results organized by **fragment size** (XS, S, M, L, XL) (Fig. 3).
- **83,253 patches** cover **2.384 million hectares**.
- Nearly **71% edge zone** and **29% core zone**.
- **XS and XL patches had longest perimeter** lengths (~83.6 and ~84.2 million m).
- **93%** of forest patches in Bavaria are **XS** (< 25 ha) with an **average size of 2.5 ha**.
- Among XS patches the **edge zone constitutes 99.8%** of forest.
- XL forest patches contain an average of **38.2% core area**.
- Largest forest patches were distributed at the **highest elevations**.

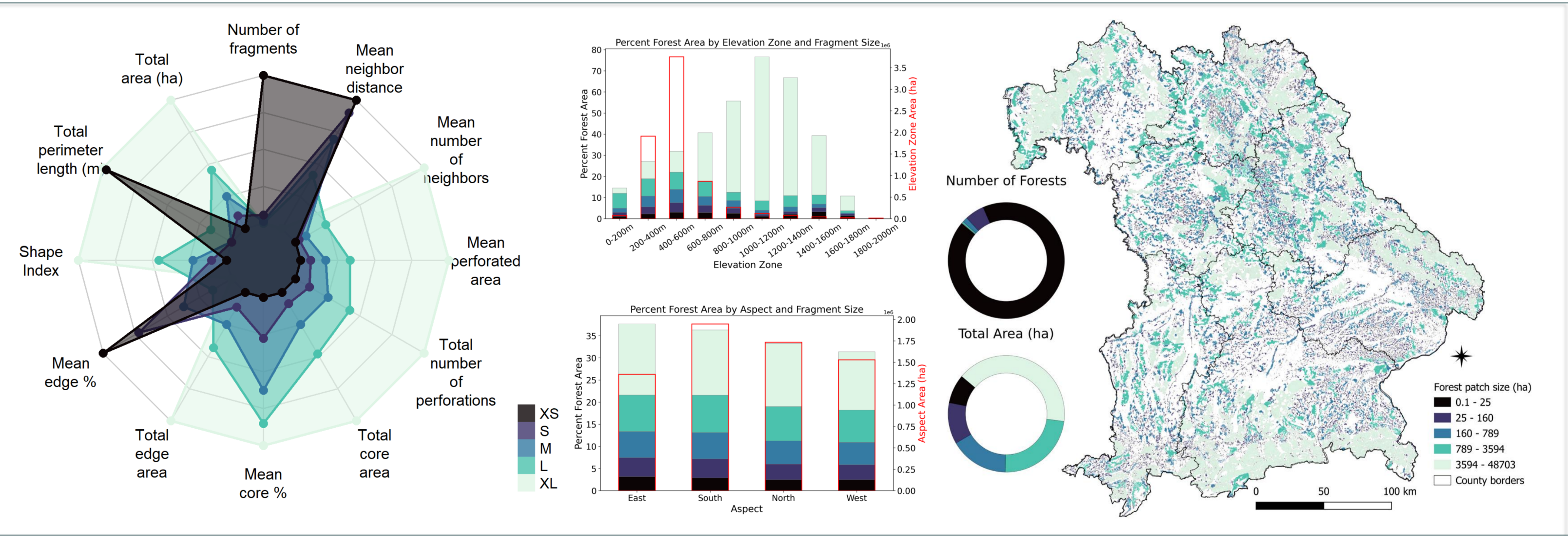


Figure 3. Selected results based on fragment size (0.1-25ha = XS, 25-160ha = S, 160-789ha = M, 789-3594ha = L, >3594ha = XL).

IMPLICATIONS

- Districts with a high number of patches relative to forest area are **highly fragmented** (Fig.4).
- A high proportion of perimeter and perforations within a landscape results in greater **edge effects**.
- Patches with few or distant neighboring forests are more **isolated**.

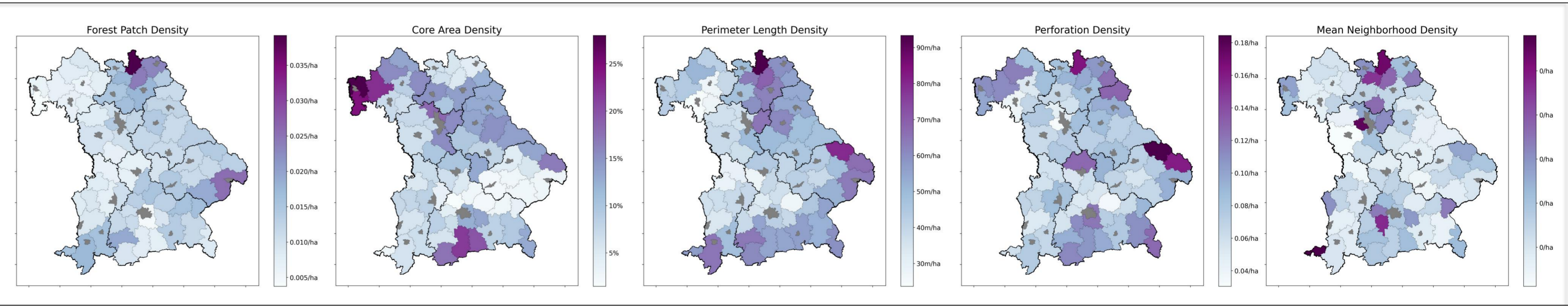


Figure 4. Metric aggregations by district illustrate fragmentation spatial patterns.

[1] Thonfeld, Frank, et al. "A first assessment of canopy cover loss in Germany's forests after the 2018-2020 drought years." Remote Sensing 14.3 (2022): 562.
[2] McGarigal, Kevin. FRAGSTATS: spatial pattern analysis program for quantifying landscape structure. Vol. 351. US Department of Agriculture, Forest Service, Pacific Northwest Research Station, 1995.



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