

Emulating Natural Disturbances with Fire: Practices in Estonia and Canada

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Abstract

A comparison of forestry practices in Estonia and Canada in regards to the practice of Emulation of Natural Disturbances through the use of morphological spatial pattern analysis (MSPA) was completed to better understand the characteristics of burns to be emulated, including connectivity and size, and the impacts of MSPA parameters upon output. Landsat 8 imagery of Estonia was classified, and the Ontario Land Cover Data Base was used in order to compare the spatial patterns of forest fires in Estonia and Canada in terms of area and frequency. Classification attempts of Estonian imagery revealed that disturbances were too small to be recognized without pixel confusion because of the spatial resolution of available Landsat imagery. Comparison of Canadian and Estonian disturbances through MSPA classification of Ontario fires and Estonian fires through statistical analysis, including frequency and median area, showed differences in disturbance patterns in the two areas. While the composition of forests was similar in terms of tree species and canopy layers, the size of Estonia disturbances were limited due to the small area of the nation and the common suppression of fires.

Introduction

This study attempts to answer the following research questions:

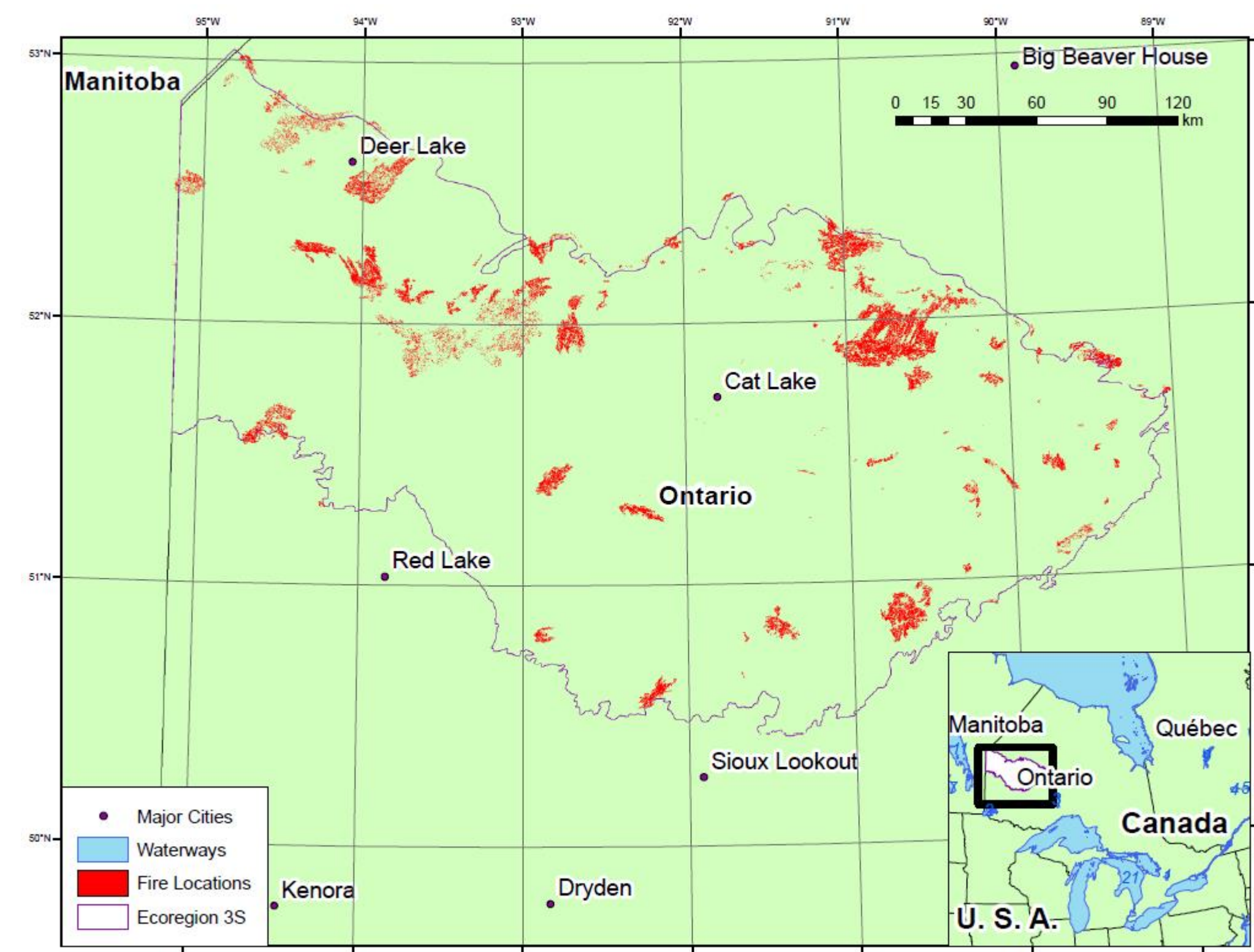
- 1) Are there significant differences in the morphologies of Canadian and Estonian fires?
 - a. Are there differences in the sizes of fires?
 - b. Are all classes present within MSPA classifications, and which are the most prevalent?
- 2) Do the parameters chosen when using GUIDOS Toolbox have a significant impact on pixel classification?

Overall, this study attempted to better describe natural disturbances within each nation in order to better inform END practices.

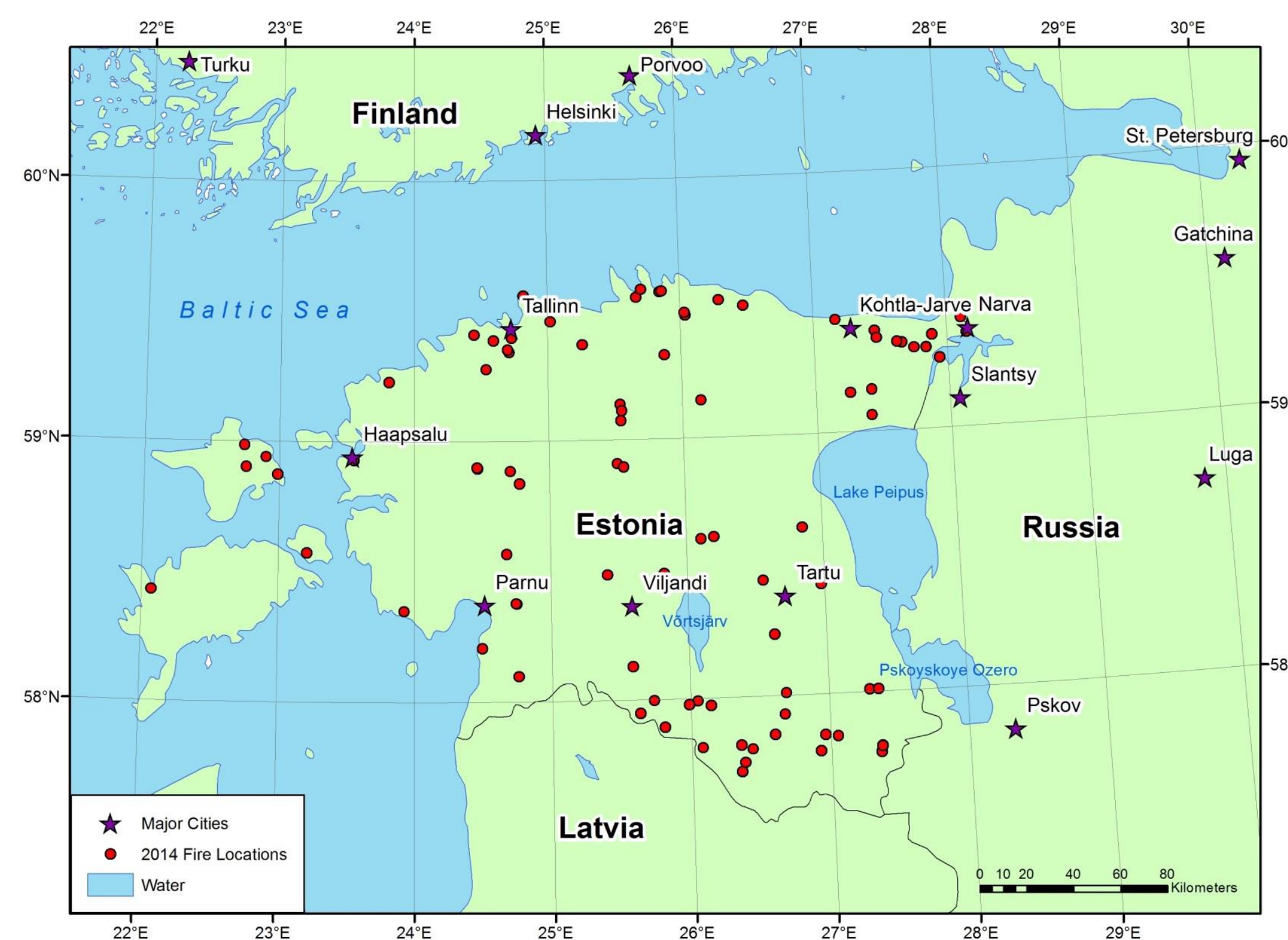
Methods

This study utilized both medium and fine resolution data, collected via Landsat 7 of the Landsat series of satellites for Ontario forest pattern examination. Multiple image analysis programs, including PCI Geomatica, ESRI's ArcMap, and the MSPA function of the GUIDOS toolbox have been utilized in order to gain a better understanding of disturbance in both qualitative and quantitative characteristics.

Study Areas



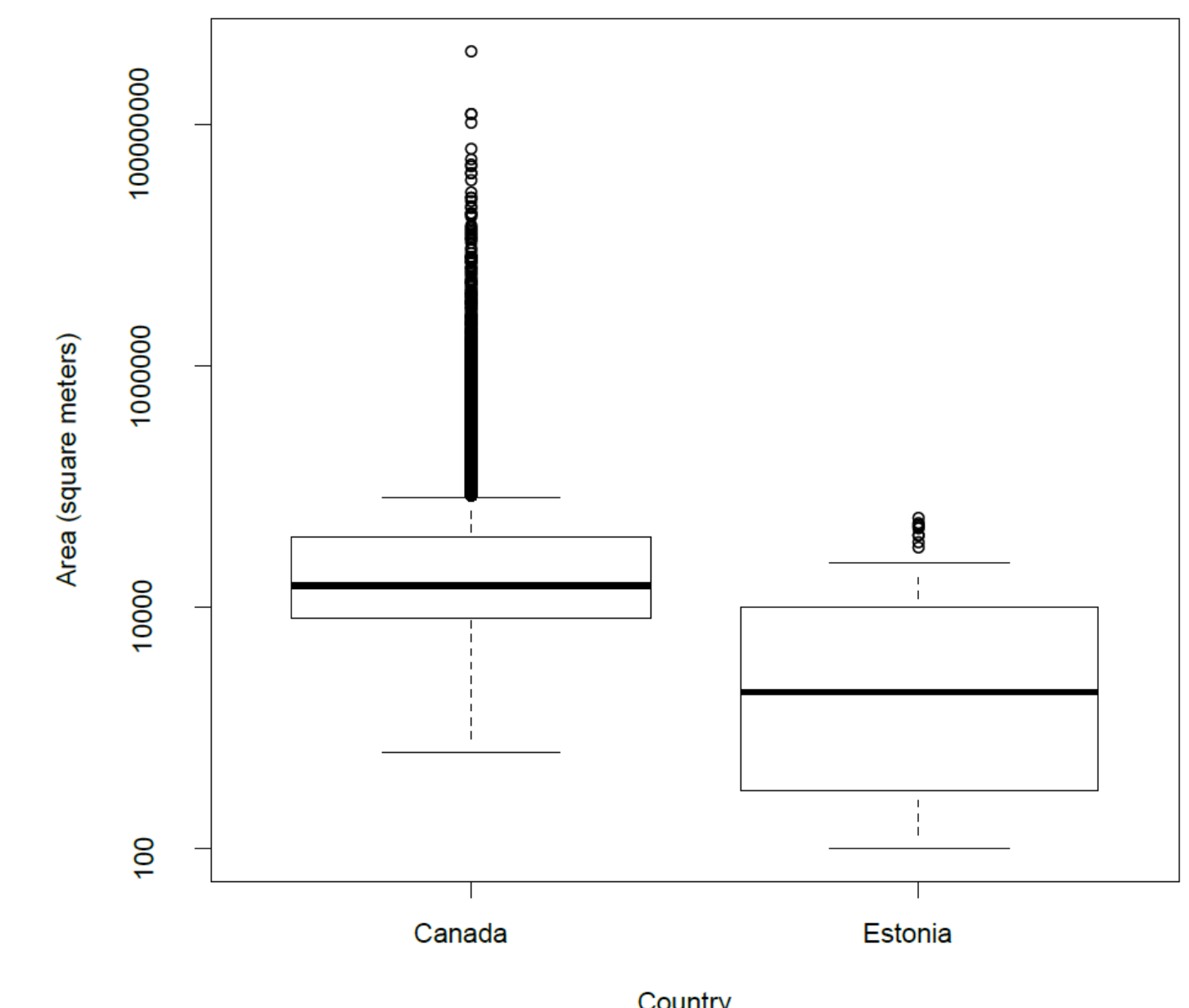
Ontario fire size and distribution in Ecozone 3S



Map showing the distribution of Estonian fires in 2014

Results & Discussion

A chi-squared test of goodness-of-fit was performed to determine whether the four variations of MSPA classification based on different parameters were significantly different. There was found to be a significant difference in the distribution of pixels into the different classes $\chi^2(18, N = 4) = 28.869, p < .05$. The t-test compared the area of fires in Estonia ($M = 8545.05, SD = 13475.68$) and Canada ($M = 192504.98, SD = 4242464.24$), and found that there was a significant difference in the areas of fires between the two nations $t(12833) = 4.90, p = 0.00$.



Boxplot comparing the areas of fires in Canada and Estonia

Conclusions

The morphologies of natural disturbances found in Canada and Estonia are significantly different, especially in terms of size. The presence of perforations within the core class of fires also shows that residuals are often found within naturally occurring disturbances, and that these should therefore be present in the emulated landscapes of current harvesting sites. Results also showed that there was a significant difference in the outcomes of MSPA classifications based on the parameters used to run the classification. Therefore, it is important to consider the impacts of the chosen settings for MSPA classification when utilizing it for research purposes, as the chosen parameters can significantly impact results.