In July of 2022 I travelled to Satakunta in southwest Finland with my supervisor, Professor Julia Koricheva, to visit some trees that she had planted there over 20 years ago. The trees were part of a carefully planned tree diversity experiment, where boreal tree species had been planted in a series of monoculture or species mixture plots to see how species diversity in forests can impact tree growth, health, and resilience to climate change. My plan was to use the experiment to study how pine and spruce trees differed in their chemical defences when growing in monocultures or species mixtures, and whether these differences might influence resilience to insect pests.

Boreal forests, such as those found in Finland, contribute to 30% of all global tree cover, and are vital $CO_2$ sinks and refuges for wildlife. Finnish forests also provide important economic and social benefits including timber, mushrooms, berries, and recreational spaces. Most of the forests in Finland are planted as single species monocultures to maximise efficiency in establishment and the harvesting of timber. However, monocultures come at the risk of increased damage from insect pests such as the bark beetle, which have wiped out huge swathes of coniferous woodlands in Europe in recent years.

One way to minimise pest damage to trees, and to protect boreal forests and the benefits they provide, is to plant species mixtures, which ecologists have shown have greater resilience to insect pests than monocultures. The mechanisms by which this resilience occurs are still poorly understood and is an area that I am focusing on during my PhD.

Pine and spruce needles are rich in volatile compounds called terpenes, which are responsible for the pleasing ‘fresh pine’ aroma of coniferous woodlands. Terpenes don’t just smell good, but also serve important roles in tree defence by directly repelling insects and attracting natural enemies such as parasitic wasps which feed on herbivores. The effectiveness of terpenes in plant defence varies with their concentration and relative composition, which in turn can be influenced by environmental factors and the neighbourhood in which a tree is growing in. It is therefore possible that neighbourhood diversity can alter terpene profiles in coniferous trees, so that trees growing in monocultures have worse or better defences against insect pests than those in mixed forests.

To investigate this, I harvested needles from spruce and pine trees in the tree diversity experiment in Satakunta. I focused on monocultures, 2, and 3-species mixtures containing pine, spruce, and birch, as these are the three most common trees in Finland. I dried the gathered needles in silica and posted them to my lab, where I will use techniques in analytical chemistry to measure and compare the terpene profiles of trees from monoculture and species mixtures.

If all goes to plan, this work will not only show whether terpene profiles differ for coniferous trees growing in monocultures and species mixtures, but also show the effect of specific neighbours (e.g., what differences are there in the terpenes profiles for spruce growing next to pine vs. spruce growing next to birch). Hopefully, this will help inform foresters what species of trees are best planted together in boreal forests to increase natural resistance to insect pests.

I would like to express my gratitude and thanks to the Doctoral School for the travel award I was granted, without which my trip to Satakunta would not have been possible. As well as gathering precious data and samples for the final chapters of my PhD, I was also able to partake in some typical Finnish pastimes, including lake swims, saunas, and mushroom foraging, which made me really appreciate the part of the world I was visiting, and the importance of the boreal forests that my work will hopefully help to protect.

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