Climate-aware Volunteering with Neroche Woodlanders

2: Trees and Carbon

During the COP26 Glasgow conference there was much talk about trees and forests. There was a new global commitment to stop deforestation, because of the importance of our remaining forests in storing and absorbing carbon from the atmosphere. Meanwhile planting a huge number of trees is seen as a major - albeit long term - way of sucking carbon dioxide (CO_2) out of the atmosphere.

As you walk through a woodland, in the aftermath of all this climate talk, you might find yourself wondering: just how much CO_2 are all those trees actually taking in?

The metabolism of trees, which allows them to absorb carbon, is based on photosynthesis. Plants absorb water and minerals through their roots to make sap, and the sap travels up through the tree to the leaves. The leaves absorb carbon dioxide and light, and use chlorophyll and the sun's energy to convert the CO_2 and the water into glucose. Oxygen is released in this process, and the glucose is transported off in the sap to nourish the tree.

On average, 50% of a tree's weight is water, and the other 50% is dry mass. 47.5% of that dry matter is carbon. A 25 metre tall oak tree with a trunk diameter of 60cm weighs around 9 metric tonnes. 4.5 tonnes of that weight is water, and 4.5 tonnes is dry mass, so it contains 2.1 tonnes (2100 kg) of carbon.

It takes 3.67 kg of CO_2 to lay down 1 kg of carbon in the tree. So for the example above, the oak tree has absorbed 2100 x 3.67 = 7707 kg (or 7.7 metric tonnes) of CO_2. If we assume the tree is 100 years old, then on average it has been absorbing 77 kg of CO_2 per year throughout its life.

But does it absorb more when it's young than when it's older? In their youth, trees grow faster and so absorb CO_2 more quickly, but in older age their density is much greater, and so they can absorb proportionately more CO_2.

Softwoods tend to grow much faster than most hardwoods, so they can absorb more CO_2. However because they also live shorter lives, they ultimately store less carbon over their lifetime than a long-lived hardwood. So there is a dilemma: planting conifers will make for faster absorption, but the trees will be harvested sooner, and may become carbon sources rather than sinks (unless all their timber is used in construction, in which case the carbon remains locked up). Mixed woodlands may be the best compromise – and a diverse structure with lots of different ages of tree within a given woodland, is better still.

Carbon dioxide makes up only a small proportion of the volume of air (despite its disproportionate impact on our climate), and so in the process of growing by one cubic metre, a tree will purify nearly one million cubic metres of air of its CO_2.

After you've spent time in the woods, if you have driven there you'll get back in your car to drive home. Assuming your car runs on an internal combustion engine, on average it will emit around 112 grams of CO_2 per kilometre. That means that by the time you have driven 690 km (430 miles) you will have emitted as much CO_2 as our example oak tree can absorb in a year. If you drive 10,000 miles a year, you need twenty three big oak trees to be working just for you, throughout the year, to deal with the CO_2 from your car travel alone.

Trees work hard for us, and do us good in so many ways – and we need more of them.