## Field Visit 2012

During the day, the delegates were shown round one of the silvopastoral agroforestry experiments at Henfaes by Fergus Sinclair and John Healey (Bangor University).

The site is part of the **UK Silvopastoral Network** (with other sites at Glensaugh (an upland site at The James Hutton Institute, near Aberdeen), two sites in Northern Ireland (one upland site at Broughshane, DANI, and one lowland site at Loughgall, DANI), one site in the Brecon Beacons in south Wales (Bronydd Mawr, IGER) and a lowland site in Devon (North Wyke, IGER). The Bangor site is a lowland site, albeit one exposed to strong winds.

The main tree species present is sycamore (*Acer pseudoplatanus*), chosen as a reference species because of its perceived suitability for all of the sites in the network. At Henfaes we also saw red alder (*Alnus rubra*). This species was chosen for Henfaes because of its nitrogen-fixing ability, but also as it is a quicker-growing species than *Alnus glutinosa*.

Before planting (in 1992) the site was a productive pasture, with good soil fertility. One of the treatments imposed on the site was to supply 160 kg N ha<sup>-1</sup> yr<sup>-1</sup> to maintain this fertility, and to give a control value for pasture land. The site was originally grazed by sheep, using sward height to equalize grazing across the experiment, but is now in a resting phase (although tree pruning and grazing is still carried out). This ensured that there was the same grazing intensity, irrespective of treatment. The replicated blocks were large enough that a sufficiently large flock of sheep could be grazed on them to ensure normal grazing behaviour of the animals. Tree growth rate and lamb growth rate were measured.



Sycamore trees at 200 stems ha<sup>-1</sup> in the Henfaes agroforestry experiment (Paul Burgess)

The sycamore trees were planted at a density of 2500, 400 and 100 stems ha<sup>-1</sup>. The 400 stems ha<sup>-1</sup> density has subsequently been reduced to 200 stems ha<sup>-1</sup> by thinning. A fourth treatment was sycamore planted at 400 stems ha<sup>-1</sup>, but in clumps of 13 trees. This provides large gaps of sward between the clumps, and in practical agroforestry would lower the costs of tree protection if clumps were fenced rather than individual trees (at the Henfaes site the fencing is much more elaborate, and expensive, than would be the case in a commercial site

as it was important to ensure that trees were not damaged at all by grazing sheep. The robust fencing still persists some 20 years on). The clumps give a more traditional landscape feature, they theoretically increase biodiversity by giving small areas of woodland, and they protect each other from the wind. However, the outer trees have grown noticeably faster than the inner trees in the clumps, because of the distribution of light availability across the clump, and this will have affected their timber quality. As 8 out of the 13 trees are in effect 'edge' trees and therefore of poorer form, some consideration could be given to making clumps of larger numbers of trees in a commercial planting.



Sycamore trees grown in a clump at Henfaes. Note the differences in form of the outer and inner trees (Jo Smith)

Red alder trees were planted at a density of 400 stems ha-1, now thinned to 200 stems ha-1.

Tree growth was compared with trees in control blocks, and lamb growth rate was compared with lambs in pasture control plots. For the first ten years of the experiment lamb growth rate was not affected by the presence of trees. Enough is now known about the system from the experimental results that it would be possible to manage the site more for the growth of trees or for the growth of lambs. It was emphasised that regular pruning of the trees is required to maintain sward quality, and it was noted that with hindsight the pruning should have been more aggressive early in the experiment.



Delegates amongst the clumped sycamore trees at Henfaes (Paul Burgess)

It has been suggested that introducing trees on grassland might increase soil carbon stocks. That has not been seen here. Many lowland sites have high soil C under pasture anyway, so the evidence indicates that introducing trees to lowland sites, whilst having various other benefits to ecosystem services, may not increase C sequestration other than in the tree biomass itself. It was found, however, that in the forest control plots there was a higher rate of water infiltration than in the pasture control plots, with less compaction in the top 2 cm of soil, and in the agroforestry there was also a higher infiltration rate despite the grazing pressure under the trees. This demonstrates the potential of farm woodlands in helping regulate water flow, and minimise the risk of flood events. The red alder trees appear to have had a beneficial effect in terms of nitrogen fixation, as the production in the alder plots was as high as in the pasture control plots with 160 kg N ha<sup>-1</sup> yr<sup>-1</sup> applied. Future work could consider nitrous oxide emissions from the plots. It is sometimes considered that the use of legumes, or alder, to fix N rather than supplying it in inorganic fertilisers should lower nitrous oxide emissions. However, this is not the case as it is the level of N input and soil conditions that give rise to nitrous oxide, not the way in which the N is supplied. Future work could also be carried out on finding shade-tolerant grass species for growth under the trees at 200 stems ha<sup>-1</sup>.

Further details of the site can be seen on:

## http://pages.bangor.ac.uk/~afs032/Henfaes/Henfaes.htm

The delegates were briefly shown a second experiment adjacent to the silvopastoral site, an experiment on poplars and with biochar incorporated into the soil. The motivation of the experiment was because biochar is deemed to be a long-term soil C store. So far the experiment has not shown any of the other proposed benefits of biochar in soils (e.g. increased soil fertility, better water-holding capacity). The pasture land at Henfaes has a high soil carbon content anyway, and these benefits of biochar may possibly only occur on degraded soils.

On 25<sup>th</sup> May the delegates visited the forest enterprise at **Esgair Timber Company Ltd**, Esgair Forest, Machynlleth.

Esgair forest is a 200 hectare forest in mid Wales, where the emphasis is on sustainability and increasing the value of the timber by converting the wood to higher value products before sale. Most of the products are sold locally, within a 40 mile radius of the forest.

The forest is situated at about 350 m altitude in an area of high rainfall (approximately 2 metres per year), and on acid soil. It was planted between 1945 to 1965, having previously been sheep walk. It comprises a complete catchment, being bounded on two sides by rivers (and hence having a warm side and a cold side).

The forest is a mixed coniferous/broad-leaved wood, comprising European larch (Larix deciduas), Douglas-fir (Pseudotsuga menziesii), grand fir (Abies grandis), noble fir (Abies procera), Sitka spruce (Picea sitchensis), Norway spruce (Picea abies), Western Redcedar (Thuja plicata), Lawson's cypress (Chamaecyperis lawsoniana), western hemlock (Tsuga heterophylla), sessile oak (Quercus petraea), ash (Fraxinus excelsior), silver birch (Betula pendula), beech (Fagus sylvatica), two types of Chilean beech (Northofagus sp.) and chestnut (Castanea sativa). The original owners of the site at the time of planting were from the south of England, so not all of the species are well suited to the environmental conditions of the site. For example, the Chilean beech trees grow fast, and also tend to coppice, which is good for producing biomass but the timber tends to crack with tension during felling. The western hemlock produces good biomass, but it not otherwise easily marketable, and the owner is intending to remove them before the trees get large enough to start producing seed (which they start to do at around 20 years). We also observed some holly (*llex aquifolium*), mountain ash (Sorbus aucuparia) and sycamore (Acer pseudoplatanus) trees during our visit. Under the older coniferous plantations there was little understorey, but elsewhere there was a mixture of grasses, herbaceous plants and shrubs, such as greater stitchwort (Stellaria holostea), yellow pimpernel (Lysimachia nemorum), bluebells (Hyacinthoides non-scripta) and gorse (Ulex europaeus) in flower, foxgloves (Digitalis purpurea) coming up to flowering, bilberry (Vaccinium myrtillus), brambles (Rubus fruticosus), bracken (Pteridium aquilinum) and clumps of male fern (Dryopteris filix-mas).

The current owners took over in 2007, and have been changing the operations on the site since. They decided to process the timber rather than just rely on income from felled wood, and that required construction of a shed. This is a stunning timber structure made from their own timber sourced from within 150m of the shed, and to their own design, and is in effect a sales demonstration tool as well as a centre for operations. It incorporates 12 Belfast trusses, covered with a tensioned recyclable polyester roofing material, and is equipped with saw milling machinery, planer, kiln, dry fuel wood storage and conditioning area and other fuel-wood machinery plus an office and staff mess area. The design makes much use of natural lighting, and some of the bays are left opened (covered only with mesh) to enhance air flow.

The nature of the business is bespoke timber products, mainly for the building industry, and woodfuel. It uses almost entirely wood grown in the forest, with only a small amount of large diameter timber (Douglas-fir) bought in. The wood fuel products include dry logs, wood chip and briquettes. The key feature of the wood chip is that it is of a very consistent quality. Timber is stacked by the roadsides immediately after cutting, and is covered with tarpaulins. This enables natural drying to occur, down to 25-30% moisture content, and the product is sold at G30 standard (although it is actually finer). The consistency of the wood chip enables it to be sold at a premium price, although this is still cheaper for the purchaser than using fossil fuel. The company also markets super-dry chips, as gasifiers require a moisture content of less than 20%. The owners are currently planning to build a new building near the entry road to the site, which will house a Combined Heat and Power gasifier unit. Currently the saw mill runs on electricity from a diesel generator, but when the gasifier is installed a power line will be run to the sawmill to operate the milling machinery and the kiln.

The workers had recently been thinning Sitka spruce, and these were destined for chipping, except for the bottom 2-2.5 metres of the trunks that could be split into logs for stoves. The timber will be stacked and covered to dry, and by the time water content has fallen sufficiently

the needles will have been dropped. This is beneficial to the final chipped product as the high chloride content of needles tends to corrode boilers.



Inside the sawmill at Esgair Forest (Jo Smith)

Overall production works out at about 2000 green tonnes of timber per year and the owners are introducing new production concepts. They currently spread green waste on to the track verges from a feeder wagon in order to restore some of the fertility lost in the timber removed, and as bilberries grow on these verges they are intending to grow and harvest blueberries in future. They have recently planted a small orchard of apples, pears, crab apples, medlar and wild raspberry.

The owners have also introduced animal production to the forest. This started with guinea fowl which did an impressive job of eating bark beetles, but the birds were eaten by goshawks. Even second generation guinea fowl were vulnerable, so this was discontinued. We did not see any goshawks during our visit, but the abundant birdlife that we did see or hear included swallows, chaffinches, pied wagtail, redstart, crossbill, red polls, spotted flycatcher and chiffchaff.

Currently some areas of woodland (comprising young silver birch, mountain ash, larch, sessile oak, Sitka spruce, sycamore and Chilean beech) are home to geese and pigs in summer months. The area is fenced, with fencing that was put in position with a forklift truck, and is stocked with large black x Welsh cross pigs. It is estimated that there will have been 20 generations of piglets sold from the site by the time that the fencing will need to be moved.

It was important to find a type of pig that did not root too much, but those stocked seem to be ideal. They do not damage the trees, but they control some of the weeds (including bracken) and as they are only kept in summer the piglets put on weight quickly.



Piglets amongst spruce trees at Esgair Forest (David Pilbeam)

The forest was formerly fully certified by the Soil Association, and was the first certified organic forest in the UK. It is currently run to a standard higher than the Forest Stewardship Council standards.

Our thanks are due to Peter and Sarah Bottoms for making us so welcome to the site, and we wish them every success with their business.

## http://esgair.wordpress.com/

During the meeting tribute was paid to Dr Lynton Incoll, former Chairman of the Farm Woodland Forum (Agroforestry Forum) who passed away earlier in the year. Lynton was an enthusiastic proponent of agroforestry, and a good friend to many of the participants.

Reporter: David Pilbeam, Institute of Integrative and Comparative Biology, University of Leeds