Back On Our Map

Aspen Survey, Propagation and Reintroduction Methods

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1. Introduction to BOOM

Back on Our Map (BOOM) aimed to engage communities in South Cumbria with their natural environment, by restoring the landscape and reintroducing and reinforcing locally threatened or extinct native species. National Lottery players supported the £2m project, alongside several other public, private and charitable sector organisations. Led by the University of Cumbria, BOOM worked closely in partnership with Morecambe Bay Partnership, and lead partners Cumbria Wildlife Trust, Natural England and Forestry England.

The project a network of protected areas including Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs) and Arnside and Silverdale Area of Outstanding Natural Beauty (AONB). It covered an area of 600km2, extending along the lowlands of Morecambe Bay from Barrow-in-Furness in the west to Arnside and Silverdale in the east and Ambleside in the north (Fig 1.1).

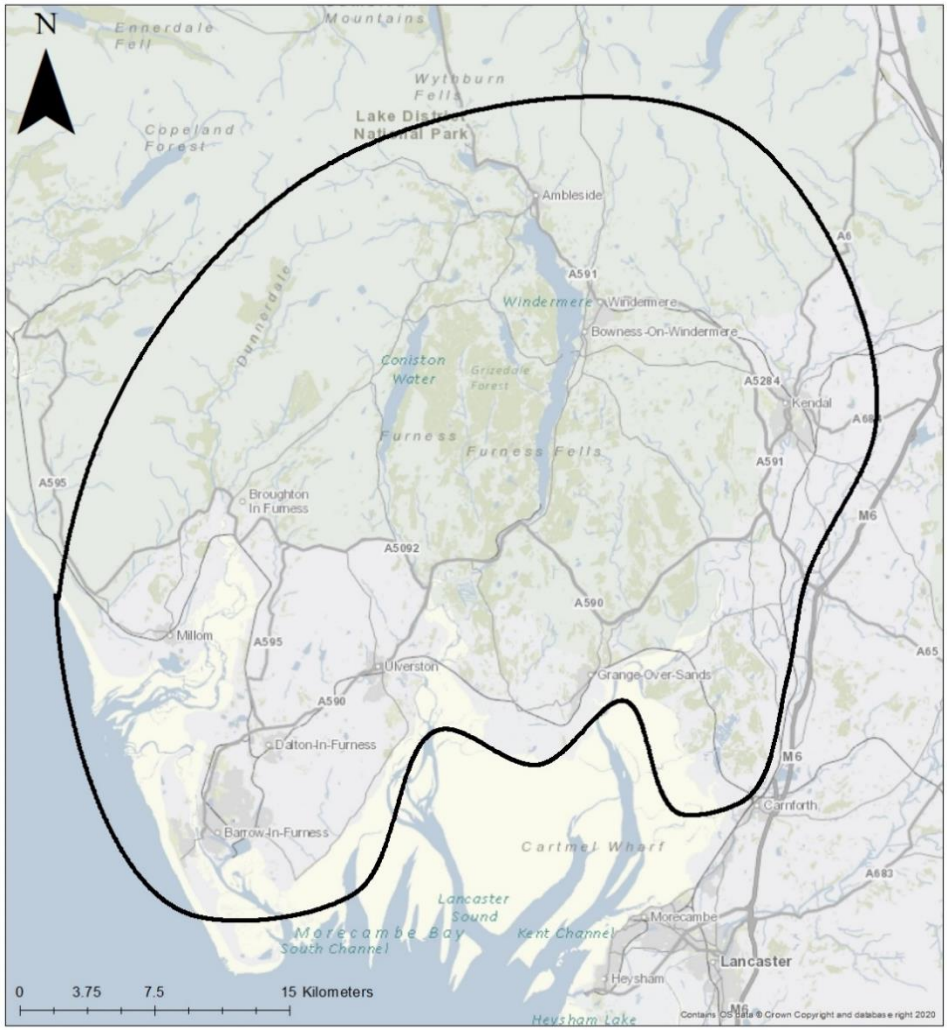

Figure 1.1: Map of the BOOM working area.

BOOM reintroduced and expanded the range of the hazel dormouse, small blue butterfly, goldilocks aster, great and oblong-leaved sundew, green-winged orchid, maidenhair fern, spiked speedwell, and aspen (table 1.1). A reinforcement of a Duke of Burgandy population was carried out on the Graythwaite Estate. The pine marten community-based feasibility study identified suitable locations for future reinforcement. For the Corncrake, public engagement sound walks raised awareness of the species.

Table 1.1: Species included in the BOOM project.

Common Names	Scientific Name	BOOM Objectives
Aspen	*Populus tremula*	Reintroduction
Corncrake	*Crex crex*	Public Engagement and Interpretation
Duke of Burgundy	*Hamearis lucina*	Reinforcement
Goldilocks Aster	*Galatella linosyris*	Reintroduction
Great Sundew	*Drosera anglica*	Reintroduction
Green-winged Orchid	*Anacamptis morio*	Reintroduction
Hazel Dormice	*Muscardinus avellanarius*	Reintroduction
Maidenhair Fern	*Adiantum capillus-veneris*	Reintroduction
Oblong-leaved Sundew	*Drosera intermedia*	Reintroduction
Pine Marten	*Martes martes*	Feasibility Study
Small Blue	*Cupido minimus*	Reintroduction
Spiked Speedwell	*Veronica spicata*	Reintroduction

Across south Cumbria, the project engaged a wide range of community groups, volunteers and members of the public. Social activities and training events helped communities get involved with the BOOM species reintroductions.

This document covers the work BOOM did on Aspen, including the propagation techniques, reintroduction methods and community engagement events.

2. Species Background

Aspen (*Populus tremula*) holds a special place within the British countryside, providing more benefits for biodiversity than any other native British tree (Woodland Trust, n.d.) Although once considered to be widespread across the British Isles, aspen has suffered the plight of ancient woodland destruction and is now only common in the Scottish Highlands. As one of the first trees to recolonise Britain after the last ice age, aspen should be valued for its steadfast resilience and ability to persist as a species since the early woodlands of post glacial Britain.

However, despite its ability to endure a wide range of soil types and harsh environmental conditions, aspen is now scarce and fragmented within the landscape (Worrell, 1995), often only appearing as a single tree or in discrete clonal stands. Unfortunately, the fragmentation of aspen has accelerated its decline. As a dioecious species, aspen has independent male and female trees and needs both to reproduce. The scattered nature of aspen's distribution along with the rarity in which either sex produces flowers, means a successful pollination is inevitably unlikely.

However, aspen have a special ability to spread vegetatively, sending up saplings known as suckers from their sprawling root systems with shoots sometimes appearing up to 40m away from the parent tree. (Jobling, 1990). These suckers are genetically identical to the parent plant and form a collection of trees known as a clonal stand. Aspen suckers contain high sugar content and are very palatable to deer, resulting in many suckers not growing into full sized trees and further limiting their distribution (Shepperd et al., n.d.). However, when sapling predation pressure is relaxed aspen has substantial potential to spread in space and time. with some clones known to be 107 acres wide and thousands of years old (Henningson, 2012). Even after the death of a parent tree, from fire or felling, the roots of an aspen tree may live underground indefinitely, sending up new successive suckers when the conditions are right (Rackham, 2020). Although most textbooks quote aspen as being a short-lived broadleaf tree (Worrell, 1995), the complex ecology surrounding it and its immortal root system makes the act of aging trees challenging as one is only measuring the age of the trunk. For all we know we may be in the presence of aspen trees whose roots first formed in the wake of a retreating glacier after the last ice age.

The Latin name for aspen is *Populus tremula* which translates as the trembling poplar relates to the distinctive way the leaves flutter and rustle in the wind. This trembling effect is due to the leaf stalk being slightly flattened, rather than round like in other tree species (Colbourn, 1900). Aspen is rare and unique, making it one of the most intriguing of all British native trees. It glows golden in autumn, whispers in a gentle breeze and clings heroically on to cliff edges, peaks of mountain ranges or nutrient poor wastelands.

3. Reintroduction Objectives

The aim of the BOOM project was to raise awareness of and reinforce aspen populations in south Cumbria. The project did this by:

- Discovering and mapping known aspen stands
- Harvesting roots of aspen stands for propagation of new trees for reintroduction
- Working with partners such as Art Gene and HMP Haverigg to teach them aspen propagation techniques.
- Raising awareness of aspen at community talks, conferences, and social media posts
- Planting 4000 aspen, provided by Eadha Enterprises, into south Cumbria to ensure the project was planting both male and female trees for the long-term survival of this species.
- Involving landowners and farmers and encouraging them to plant aspen on their land and to provide aftercare when the BOOM project finished.

3.1. Project Locations

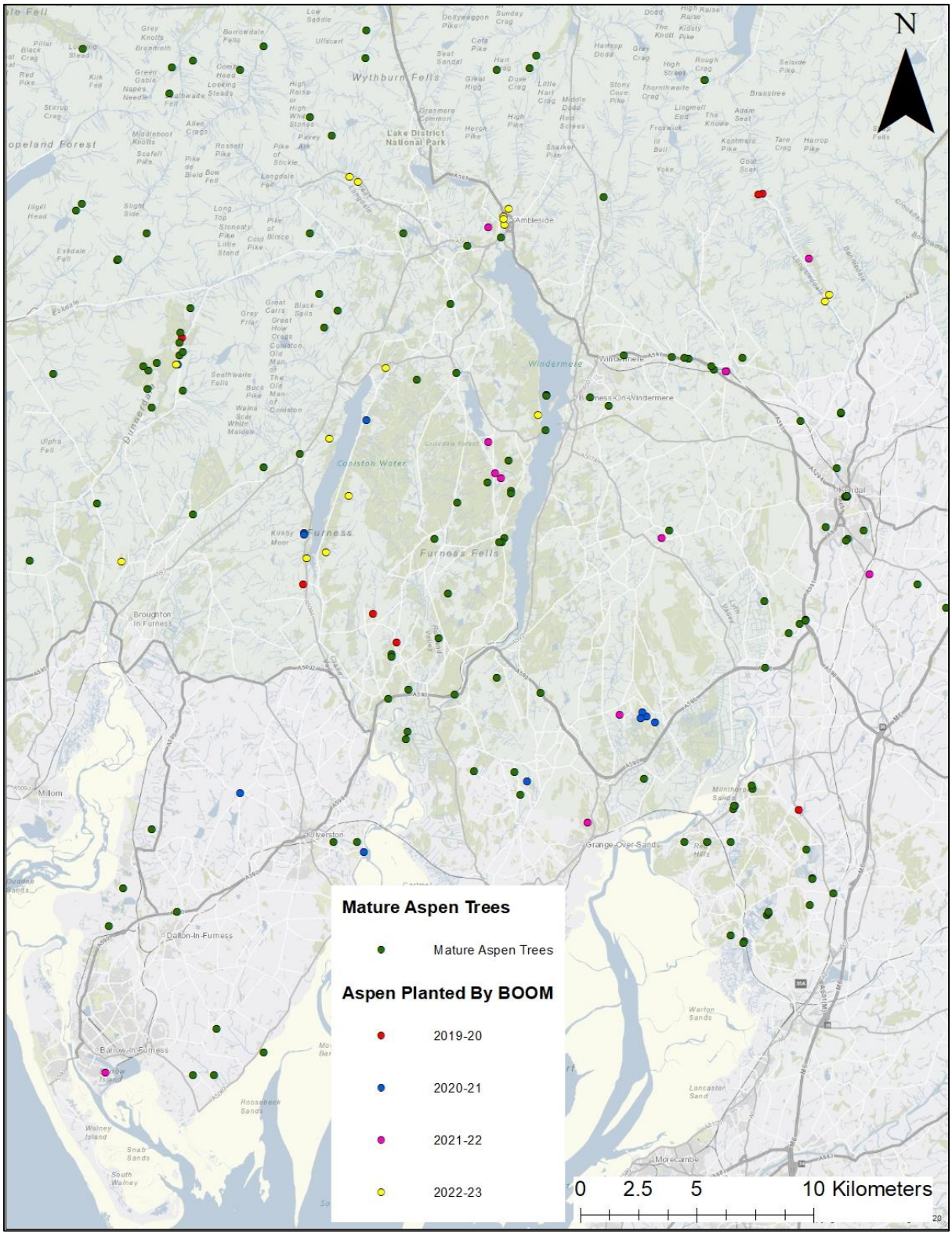

Figure 3.1: Mature Aspen Trees and BOOM Reintroduction sites

Donor Sites

The project collected root material from 22 trees across south Cumbria (Table 3.1). During the project, known aspen trees were investigated to see if they were suitable for root collection (see section 3.3). If a tree was identified as female during this initial investigation, then they were prioritised for root harvesting; as many trees in Cumbria, where the gender is known, are male. Six trees were identified as female (**Bold** in Table 3.1).

Trees that were accessible via a road or track were ideal for collecting roots from with volunteer groups such as Mind in Furness and HMP Haverigg due to certain mobility issues.

It was requested by Eadha Enterprises that we collected roots from the Dovedale Beck tree. This tree was identified as a potential triploid aspen and after collecting roots, BOOM sent some genetic material to Kew Gardens who confirmed the tree to be triploid.

Table 3.1: Locations of aspen trees whose roots were harvested during BOOM.

Location	Grid Reference	Year Collected
Bouth - Car Park	SD 325860	2020
Bouth - Far End	SD 325859	2020
Carr Bank	SD 47183 79523	2020
Carr Bank Garden Centre	SD 47156 79534	2020
Roudsea Wood NNR northeast	SD 33156 82687	2020
Storth	SD 479804	2020 + 2021
White Moss 2	SD 50497 76454	2020 + 2021
Askam in Furness	SD 22215 78532	2021
Hale Moss	SD 50247 77672	2021
Borrowdale	NY 27258 13707	2021
Thirlmere	NY 32404 12951	2021
Leighton Moss - Lower Hide	SD 48637 74993	2022
Leighton Moss - Saltmarsh	SD 47523 73662	2022
Windermere	SD3906895601	2022
Little Spring Wood	SD 353 925	2022
Graythwaite - Boathouse	SD 373 910	2022
Graythwaite - Colonels Drive	SD 376 930	2022
Sizergh Fell	SD 49943 87314	2023
Sizergh Barn - Roadside	SD 50219 87476	2023
Sizergh Barn - Woodland	SD 50206 87446	2023
Dovedale Beck	NY 38683 11630	2022
Cinderbarrow Picnic Site	SD 514758	2023

Reintroduction Sites

There was a total of 47 reintroduction sites for aspen across south Cumbria (see Appendix 2). The location of the sites was determined by the landowners and project partners who contacted BOOM to see if they could plant aspen. BOOM project officers visited the site to determine if their land was suitable for aspen and to advise on how many trees to plant, using the required tree guards.

In addition to this, South Cumbria Rivers Trust, Graythwaite Estate, and groups of volunteers were given aspen trees which they were able to incorporate into their proposed planting schemes.

3.2. Partners and Consents

BOOM worked with a wide variety of partners during the propagation and reintroduction of aspen (Table 3.2). Many of the trees were on private land or land belonging to a charity and permission was acquired to access their land to assess the trees. A mix of private landowners and charities, such as the National Trust, granted BOOM permission to plant aspen on their land and in most cases, assisted with the tree planting sessions.

The main partner was Eadha Enterprises, which is an aspen charity in Scotland founded by Peter Livingstone. Peter trained the BOOM staff on how to propagate the aspen, provided 4000 aspen trees for the BOOM project and donated some small stock trees to the project to get started with root cuttings. BOOM staff visited Peter in November 2021 where he showed us the areas he had been planting in, including the aspen classroom, and the aspen nursery.

BOOM worked with Art Gene at their Allotment Soup on Walney Island. Art Gene is a charity that is based in Barrow-in-Furness and runs art-based events and projects n the local area. They have a community allotment on Walney Island for their nature-based projects, called Allotment Soup. The small stock trees that were supplied by Eadha Enterprises were kept here and aspen root cuttings were planted in boxes and propagated here using the methods in section 3.5. Training, provided by Peter was carried out here in February 2020.

Table 3.2: Summary of partners involved with the aspen reintroductions.

Partner	Person	Consent or Training Given	Role
Eadha Enterprises	Peter Livingstone	Training	Provided training on how to propagate aspen by softwood cuttings. Was also able to supply 4000 aspen trees for additional planting schemes.
Art Gene	Maddi Nicholson	--	Propagated aspen at Art Gene's Allotment Soup on Walney Island. Have ran training events and volunteer sessions here.
HMP Haverigg	Brendan Ashton	--	Residents have assisted in root collection, propagation and planting activities

3.3. Site Surveying

Investigating Aspen Trees

Records of known trees were obtained from the Cumbria Biodiversity Data Centre (CBDC) at the beginning of the project. During the project, further trees were found by volunteers, students, and project staff. Currently there are 143 known aspen stands in south Cumbria.

58 of the known trees were then investigated to determine whether they were suitable for root collection and to identify the sex of the tree. Trees that had produced lots of suckers were ideal as it was easier to find the roots and know they had good growth potential.

The trees were checked in late April/early May for catkins to determine their sex as the gender can only be identified by the different flowers they produce on the catkins. Five trees were identified as female during this project and therefore they were prioritised for root collection and propagation.

Mapping

Using the initial records from CBDC and adding the trees that were identified through the BOOM project, a comprehensive database was created. The location name, sex (if known), grid reference, and if BOOM had collected roots, for each tree was recorded. This data could then be uploaded to ArcGIS to produce a map of all the known trees in south Cumbria (Fig 3.1).

Recommendations

- Checking the trees in April/May enables root cuttings and catkin checks to be carried out simultaneously.
- The catkins develop before the leaves and so the catkins can be checked using a pair of binoculars.
- Most of the catkins grow at the top of the tree so ensure to check thoroughly.

3.4. Seed/Material Collection

Root Collection

Collecting sections of root for softwood cuttings is the most common way to propagate aspen. Roots can be collected between February and June, but BOOM found it was easier to take cuttings earlier in the year before the ground flora grew too large. It is easy to identify where the roots are growing using the new sucker growth as guidance to their location.

Using a spade, it was possible to dig next to the sucker and find a root. After chopping through the root with loppers (leaving the sucker in place), the rest of the root could be dug out using trowels and spades. Where the root crossed under another, the section of root was that was currently being uprooted was cut (Fig 3.2) and placed into a bin bag to retain moisture. It was then possible to continue finding other roots and collect them.

Figure 3.2: A section of root collected at Roudsea Wood.

BOOM found that collecting thinner roots (< 3cm in width) was easier to uproot and were more prolific when using them for softwood cuttings. This size is also easier to cut using loppers as it was difficult to use saws at the angle required when the roots were still in the ground.

The roots were then taken to the growing area (University of Cumbria campus, Art Gene allotment, HMP Haverigg) in plastic bags. They could remain in the plastic bags with compost for up to 3 weeks, however, getting them settled into their growing area as early as possible was better as they have longer to grow their softwood shoots. The roots were placed into old fish crates on a bed of compost (Fig 3.3). They were then covered over with another thin layer of compost and left to grow the new suckers.

Figure 3.3: Aspen roots in fish crates

Seed Collection

Aspen very rarely produce seed, especially in Cumbria, because the clonal stands are too isolated to cross pollinate. However, in April 2022, when checking the Cinderbarrow aspen tree for catkins, birds were eating the catkins and fluff was falling onto the ground. The fluff was checked and inside was tiny aspen seed (Fig 3.4). This was confirmed by Trees For Life. Trees for Life is a landscape scale project aiming to rewild the Scottish Highlands. They have a tree nursery where they have been growing aspen from seed. One week later, a professional tree climber, climbed the tree and shook the branches to drop the catkins to the ground. These also contained viable seed which was separated from the fluff using tweezers to pull the seeds free. This was time consuming, and aspen seeds only remain viable for up to one month.

Figure 3.4: Viable aspen seed

In 2023, catkins were collected from the same tree and had produced viable seed. This time the catkins were sorted using a hoover and soil sifting pans using the methodology below:

Aspen Seed Sorting

1. The aspen catkins were left in seed collecting bag for 24 hours after collection to allow them to dry.
2. A 2 micron, 1 micron, 0.5 micron and 0.25 micron soil sifting pans were obtained from the university laboratories.
3. The hoover which was used to separate the aspen seeds was clean thoroughly.
4. The catkins were placed in the 2 micron soil pan and the hose of the hoover was used to suck the fluff and the aspen seeds through the sieve and into the hoover. Larger parts of the catkins were also pulled through and removed later. This was continued until all the catkins were bare.
5. The contents were then emptied into the 1 micron pan.
6. Step 4 was repeated using the 1 micron pan. The seeds and fluff was still pulled through, but larger debris was discarded.
7. In the hoover, the fluff separated from the seeds. The fluff was pulled out and discarded.
8. The seeds and rest of the catkins were placed into the 0.5 micron sieve with the 0.25 micron sieve stacked underneath.
9. A gentle shake sent the unviable and small husks from the catkins into the 0.25 micron sieve.

10. The viable seed remained in the 0.5 micron sieve and was ready to be planted.

Recommendations

- Collect roots earlier (Feb/Mar) before ground vegetation takes over.
- Collect roots that are smaller than 3cm in width because you can chop them with loppers and the roots sections produce more softwood cuttings.
- Leave the catkins to dry in a tote bag for 24 hours so that the fluff expands, and the seeds are easier to remove.
- Use a clean hoover to avoid cross contamination when sorting seeds.

3.5. Propagation

Softwood Cuttings

Softwood cuttings is the main way to propagate aspen. This is because it is relatively easy to collect roots and take softwood cuttings. Once the roots were in the compost, they started growing new suckers in late spring and over summer (Fig 3.5a). These new green shoots could be cut off the root using a sharp knife. The fresh end of the step was cut to a 45º angle and all the leaves except the terminal leaf were removed. The cut stem was dipped in rooting powder and then planted into a mix of compost and perlite (vermiculite and gravel could be used instead of perlite) in a gravel tray (Fig 3.5b). A clear seed propagation lid was then placed on top of the tray which was left in a shaded and covered spot. The cuttings then grew roots and became self sufficient as small trees. A gravel tray was better than a seed tray with holes as it retained the water. This is important because the aspen do not get watered whilst they are growing their roots. The trays also needed to be sheltered from rain, so they did not get flooded.

Figure 3.5: a) Softwood cuttings ready to be taken; b) cuttings planted in the gravel trays

The cuttings could be left with the lid on for 6 weeks as they were susceptible to changes in humidity. They needed a level of humidity so they wouldn't evapotranspire and lose excess

water, which they couldn't regain with the lack of roots. Once the roots had developed, they could be moved into root trainers (Fig 3.6) or into the raised bed.

Figure 3.6: Softwood cutting that has developed a full root system.

Propagation Equipment

At the beginning of the BOOM project cheaper plastic propagation lids were placed over root trainers to cover the fresh softwood cuttings. These were not successful as they didn't provide the enclosed sealed environment to retain humidity and they often blew off in certain environments. Later, BOOM trialled sturdier lids and gravel trays from B&Q which were compatible and created the enclosed environment. The success rate was vastly increased.

Growing From Seed

The seeds collected in 2022 were spread on top of compost in a seed tray and covered with a clear propagation lid. They germinated within 48 hours and grew quickly into seedlings in four weeks (Fig 3.7a). They were then transferred into root trainers in June 2022 and left to grow for nine months (Fig 3.7b).

Figure 3.7: a) Seedlings in the seed tray; b) Seedlings after being transferred to root trainers.

During the dormancy stage in winter (March 2023), the seedlings were transferred into raised beds on campus to allow further room for them to continue growing. They were ready to be planted in winter 2023.

The seeds collected in May 2023 were sown using the same method, however, they were left in the seed trays until they were slightly larger and then transferred into the root trainers in August 2023. This increased the survival rate of the trees when they were being transferred.

Recommendations

- When taking the softwood cuttings, keep them in water so they do not dry out before you remove the leaves and plant them in compost.
- Dip the bottom of the shoot into water, then into rooting powder, before planting into compost.
- Once the propagator lid has covered the cuttings, leave on for at least six weeks in a shady spot and do not water.
- Sow the seeds away from direct sunlight.
- Leave the seeds to germinate for three to four months before transferring them to root trainers.
- The trees should be ready for planting the year after the seeds were collected.

3.6. Reintroduction Methods

Surveying

When a landowner got in touch regarding tree planting, a site visit was undertaken. This was usually done in October time as the tree planting season got closer. A project officer would visit the site to check suitability and to determine how many trees could be planted. The site would be assessed for soil type and depth using a spade to ensure the soil was deep enough for planting; it had to be at least the depth of the spades blade deep. Overhead would be

assessed for power and telephone lines and the landowner was asked what facilities run underground. Access to the site was assessed for the suitability of volunteer ionvolvement to determine who would be ideal volunteers to help with the planting: e.g., Rothay Park was easily accessible and therefore suitable for Mind in Furness.

Planting

Throughout BOOM the tree planting was always done over four months in winter between the 1st December to the 31st March the following year. Sessions were always done with volunteers (see section 4); therefore, a tool talk and planting demonstration was done before they got started. Once the tree had been planted, it was covered by a tree guard, or a fence was constructed around the planting area, to protect them from deer, rabbits, and livestock.

For certain sites, number tags (Fig 3.8) were stapled to the tree tube. The height of the tree was recorded (and clone if it had been grown as part of BOOM), and these trees became part of the monitoring scheme that was set up to determine the growth and survival rate at different sites (see section 3.7).

Figure 3.8: Number tag on a tree guard

Tree Protection

The project used a variety of methods to protect the aspen trees, including;

- Fencing off an area
- 1.2m tubex
- 0.6m rabbit spirals
- 0.5m cardboard tubes

Hardknott Forest

In March 2021, 137 aspen trees were planted at Hardknott Forest as part of a tree protection trial. The four different types of treatment plot included a 10x10m fenced enclosure, 10x10m unfenced area, 0.6m cardboard tube and 1.2m deer tubes (Fig 3.9). Nine trees were planted in each of the fenced and unfenced enclosures, in 3 x 3 metre rows. The deer tubes and guards were labelled with tree tags for identification when monitoring. All the trees were measured after planting and then remeasured the following two years as part of the monitoring scheme (section 3.7).

Figure 3.9: A map of the tree planting at Hardknott Forest

Crosthwaite Primary School

In February 2022, BOOM planted 104 aspen trees with Crosthwaite Primary School. The trees were planted as part of an “Aspen Classroom” which was suggested by Eadha Enterprises. Figure 3.10a shows the layout and dimensions of the classroom. Each circle was planted by a different school year group; inner circle Y1 and Y2 (Fig 3.10b), middle circle Y3 and Y4 and outer circle Y5 and Y6. Each child was able to plant one tree each and they worked in pairs.

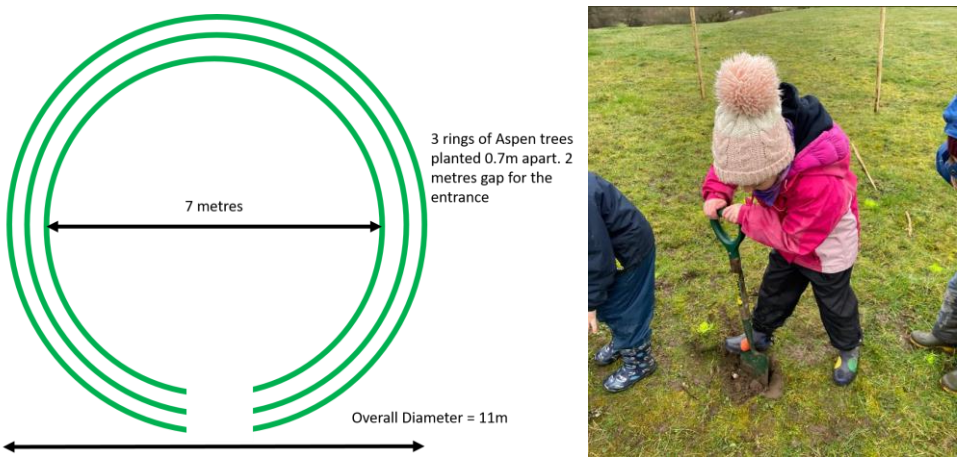

Figure 3.10: a) aspen classroom design; b) Crosthwaite student planting aspen

The plating location was on land adjacent to the school, owned by one of the school governors. The classroom was planted in the corner of a field which had gone into meadow management. This corner was fenced off to give the aspen time to establish and protect them from sheep, deer, and cattle.

Barrow Island

The Barrow Island Community and Sports Trust (BICS) had been in touch with BAE to supply trees to create a green barrier around the outside of their sports field. As BOOM had been in contact with BAE looking for land around Barrow to plant aspen, BOOM and BICS worked together to plant 800 trees (including 100 aspen) around the perimeter of the sports field. The aspen was supplied by BOOM and the 700 trees, plus guards were funded by a grant from BAE.

On the 26th March, 2022, a tree planting session was organised to plant the trees at BICS (Fig 3.11). The head trustee at BICS had advertised the planting session to local charities and families. The idea being that people could plant a tree in memory of a person, with plaques being made in memory of their loved ones. This resulted in nearly 200 people turning up to plant a tree. Not all the trees were planted on one day as some people planted just one and others did four or five.

Figure 3.11: Trees planted at BICS with labels on in memory of a loved one.

Another session was run at the sports trust where recent immigrants assisted with the planting of 200 (out of the 800) trees. The final few trees were planted by the BOOM staff.

All the trees were protected with 60cm rabbit spirals.

Recommendations

- Using taller guards is always recommended, either the 1.2m tubex or 1.2 metre fencing
- Plant in the right area for the right volunteers: e.g., Easily accessible areas with nearby toilet facilities for groups with mobility issues/disabilities.

3.7. Monitoring and Results

Monitoring has been carried out throughout BOOM to determine the survival and growth rates of the aspen that have been planted. Aspen trees that were tagged have been monitored yearly to assess survival rates and to measure their growth. Certain planting schemes, where the trees were planted but not tagged, have been counted to monitor survival rates. This depended on access to the site, however of the 31 number of sites that were planted by the end of March 2022, 18 have been monitored for survival rates with nine of these sites having additional growth rate data.

The trees were measured when they were planted and then again in the following years after they had gone into dormancy over winter. This allowed BOOM to measure the growth rate of each tree per growing season and calculate overall growth.

Tree Guard Results

Table 3.3 shows the success rates of the different tree guards used in the BOOM project. Cardboard tubes were found to be the least successful. They provided limited light to aspen and in most cases had rotted away within a year of Cumbrian rainfall. Whilst the 60cm rabbit spirals did let the light in and had a significantly better survival rate than the cardboard tubes, when the aspen grew above the 60cm they were vulnerable to deer browsing. In areas with high bramble density, the rabbit spirals were overgrown, and the tree died from the lack of light due to shading from the brambles.

Table 3.3: Survival rates of aspen in different tree guards

Tree Guard Types	Average Survival Rate (%)	Number Of Times Used in Planting Schemes
Deer Tube	92.8	13
Cardboard	13.0	5
Rabbit Spiral	81.7	3
Fenced	51.2	2
Unfenced	48.9	1

Fencing off a small area was a reliable method to keep the deer and livestock out. However, this could be costly, and BOOM did not cover the landowners for these expenses. The fencing, however, did not keep small voles out of one site and therefore the overall survival rate dropped to just 51.2% for the two sites (93.3% at Hardknott Forest and 9.4% at Capplebarrow). In future years where fencing was being erected by the landowner, BOOM used deer tubes as well as an extra protection for the trees (e.g., Woodhouse in Broughton).

The most common protection used during BOOM was the 1.2 Tubex guards. They were the cheapest to buy, lightweight to carry to site and provided most protection against deer. The sites with the highest survival rates were the sites where they were protected with deer tubes (e.g. Brown Howe level 1 and 2 had 90% survival after 3 years, Appendix 2). Whilst deer tubes were the most successful during BOOM, when the trees were in areas of high deer browsing, they often got nibbled down to the top of the deer tube.

Growth and Survival Results

Figure 3.12 shows the average growth of the aspen trees planted in the different types of tree guards. The deer tubes were the most successful in terms of overall survival, but also for encouraging the most growth. This could be due to them being able to offer most protection from deer and livestock, but also because design of the deer tube creates a small microclimate inside, in which the aspen can grow quickly unexposed to the elements.

Whilst it has already been established that cardboard tubes were least successful (13% survival), when the trees did survive, they quickly grew taller than the cardboard tube. This could be because the trees that did survive were robust, so had stronger genetics to grow larger and avoided being grazed or in areas with lower density of grazers.

On average, the smallest trees were planted in the rabbit spirals. However, the survival rate of the trees was high at 81.7%. This could have been due to two reasons:

1. Planting location bias. Rabbit spirals were often used in areas with an established woodland canopy which limits light reaching the aspen and slowing the growth rate.
2. The trees have grown to the top of the tree tube and are now exposed to browsing pressure from deer and livestock.

It is notable that trees planted in 1.2 metre deer tubes have an average overall growth of 122cm and the trees in the 0.6 metre rabbit spirals have an average height of 59cm.

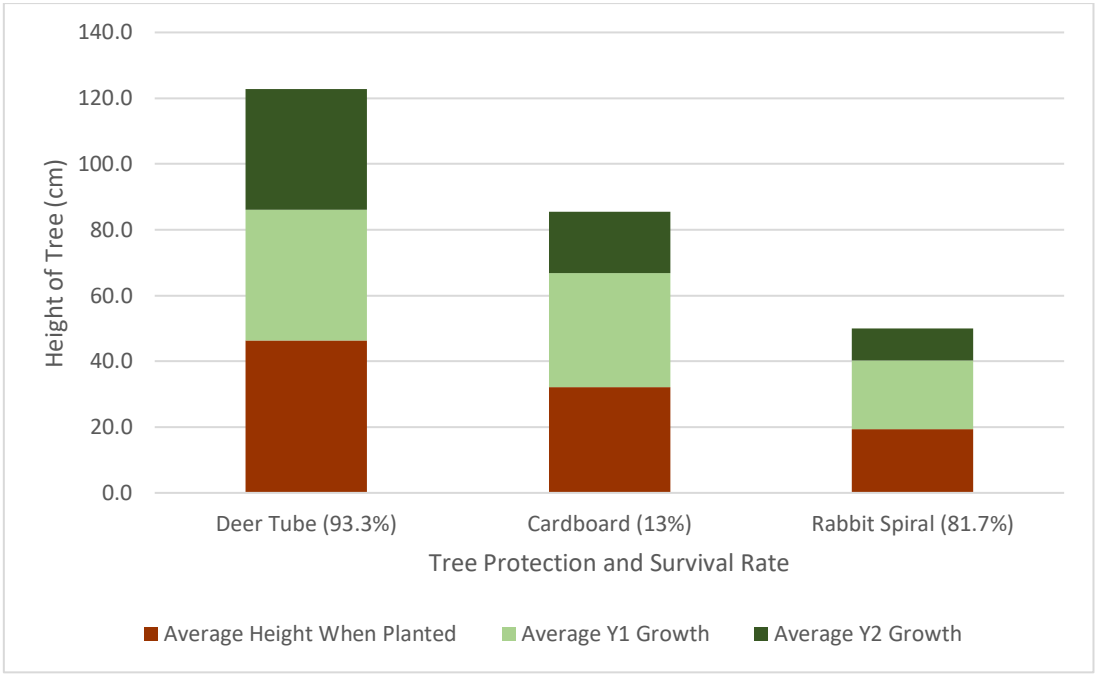

Figure 3.12: Average growth over 2 years in different tree guards

Hardknott Forest

Table 3.4 shows that deer tubes were the most successful for survival rate, with a 100% survival rate over the two years and having a higher growth rate than the unguarded trees in the fenced and unfenced areas. The cardboard tubes had the lowest success rate, despite having a good growth record when compared to the fenced/unfenced areas.

Table 3.4: Survival and growth rates of the aspen planted in the Hardknott Forest experiment

Plot	Number of Trees Survived	Survival Rate	Average Growth over 2 years (cm)
Fenced	42/45	93.3%	17.3
Unfenced	22/45	48.9%	11.0
0.6m Cardboard Tube	5/18	27.8%	39.2
1.2m Deer Tube	42/42	100%	38.2

There was a higher survival rate of trees in the fenced areas when compared with the unfenced areas, which could be attributed to the reduced browsing pressure from deer. Browsing could also explain why the growth rate in the unfenced areas is smaller than the fenced areas as the deer can nibble the new growth.

Whilst the growth rates in the deer tubes and cardboard tubes were higher than the fenced and unfenced areas, it is not a large growth rate when compared to other sites where aspen was planted during the BOOM project (the average of all other sites is 62cm of growth over two years). This is because the location is a peat bog and isn't suitable for tree planting. Some of the trees that died may have died due to the waterlogged nature of the site rather than because of the tree guard. The cardboard tubes would have been especially prone to getting soaked through and disintegrating due to the water held in the surrounding flora, as well as the rainfall.

Recommendations

- Always protect the trees with a substantial tree guard, such as a 1.2 metre deer tube.
- If possible, deer fence the area as well.
- Avoid planting in established woodlands.
- If planting in establish woodlands, use a tall tree guard, and control bracken and bramble growth.
- Do not plant on peat bogs.

4. Community Engagement Objectives

4.1. Public Engagement

Community engagement is a cornerstone of the BOOM species reintroduction project, a collaborative effort with community engagement and volunteering lead by Morecambe Bay Partnership. In this project, we recognised that the local community is vital to the successful restoration of aspen around Cumbria and beyond. We havecarried out extensive outreach initiatives and partnerships with local schools and other organisations with the aim to involve the community at every level. By doing so, we not only ensured that planting was aligned with the values and aspirations of people who live and work in the area, but also a sense of ownership and stewardship of the species. Together, we have not only put aspen back into our landscapes; we have revitalised a sense of shared responsibility and enthusiasm for this charismatic species.

Table 4.1: Summary of community engagement for aspen

Activity	Date	Number of Attendees
Aspen Training at Art Gene	21-02-2020	15
Aspen Presentation to John Muir Trust	24-03-2022	80
Aspen Propagation	2019-2023	19
Root Collecting	2019-2023	17
Aspen Planting	2019-2023	487
Aspen Monitoring *Includes checking catkins and identifying new trees as well as monitoring planted trees*	2019-2023	22
Total		**620**

Recommendations

- Get volunteers involved to contact you when they find an aspen tree increases the number of known aspens on the aspen map.
- Deliver public presentations raise awareness of aspen and in this project, this led to new planting sites being identified.
- Recruit volunteers early for aspen planting increased the number of volunteers attending.

4.2. Propagation and Planting

Mind In Furness

The BOOM project joined forces with Mind in Furness, forging a powerful partnership centred on the meaningful act of planting aspen. This collaboration has been emblematic of the project's commitment to fostering community engagement and environmental restoration. Working hand in hand with Mind in Furness, we recognised the therapeutic and transformative potential of planting trees, particularly for individuals dealing with mental health challenges. The act of planting a tree not only contributes to the reforestation of our natural landscapes, but also serves as a therapeutic outlet, promoting mental well-being and emotional healing. It has offered participants a sense of purpose, accomplishment, and a profound connection to nature. Our group of volunteers from Mind in Furness has grown from three to 15 individuals and tree planting and aspen root cutting has been a popular activity throughout the course of the project. We focussed on delivering planting for Mind in areas that had good accessibility and facilities (such as Rothay Park, Fig 4.1).

Figure 4.1: Mind session at Rothay Park, Ambleside

HMP Haverigg

The BOOM team embarked on a unique collaboration with Haverigg prison, aimed at carrying out aspen tree planting and root cutting, as well as involvement in other BOOM species. This innovative partnership not only contributed to the landscape restoration but also promoted rehabilitation and reintegration within the prison community. Working closely with inmates, we supported 18 men through the John Muir Award, and ten through Level One horticulture. The Queen's Green Canopy, a nationwide project, encouraging the planting of trees to celebrate

Her Majesty's Platinum Jubilee and enhance green spaces was another way in which the BOOM team engaged men from the prison in tree planting as part of BOOM. Over ten sessions of tree planting and root cutting where delivered as part of this project, and Haverigg prison itself became a planting site for aspen. As well as helping the BOOM team plant aspen at the prison, we also ran planting sessions at other sites around Cumbria (Hardknott Forest). This required the men to be Release On Temporary Licence (ROTL) cleared, so our whole volunteering group couldn't always attend these sessions. As part of Level One horticulture the project staff also taught the men to take aspen root cuttings, and an area of the prison has been dedicated to growing aspen root cuttings for the project. The nature reserve within the prison boundary, which had very few trees, is now home to a thriving aspen population. As well as high level support from the management team at HMP Haverigg, BOOM also partnered with "Greener on the Outside of Prisons" (or GOOP), which is a pioneering initiative that seeks to transform the spaces surrounding correctional facilities into thriving, environmentally conscious landscapes. Led by a passionate team of environmental and social reform advocates, GOOP focuses on the idea that the physical environment plays a crucial role in the rehabilitation and reintegration of incarcerated individuals. By aiming to green the outer areas of prisons with initiatives such as tree planting and community gardens, the strategies of GOOP and BOOM aligned and meant support, advise and ideas where shared between both organisations.

Beaumont College

One of the aims of BOOM was to involve young people with learning disabilities in our species reintroduction work, which was done by fostering a partnership with Beaumont College, a specialist college for young people aged 18-25 with complex learning disabilities. Over the course of year, we worked with one class of young people who we supported through their John Muir award by providing accessible and tailored outdoor experiences that gave them hands on conservation experience. Beaumont College had historically struggled to find conservation volunteering opportunities for the young people due to the complex accessibility needs. The BOOM team initially joined in with classes on campus so we could get to know the students and to aid in our future planning of events. Tree planting became a firm favourite for the class, and we ran two days of aspen planting in Ambleside and in the Langdale Valley (Fig 4.2). The task of tree planting was a great way of getting the young people involved in the BOOM project as it could be done simply with the support from tutors. Feedback from the tutors was the opportunity to plant trees helped skills development, social connection, and teamwork, as well as fostering environmental awareness and sense of achievement. One of the young people we have worked with has subsequently got a job working in a local park.

Some of the challenges of planting trees alongside young people with complex learning disabilities was managing events with adverse weather conditions in winter when tree planting needs to be carried out. We would recommend planning sessions near indoor areas and facilities wherever possible which allowed the young people to have some “time out” from the cold and conditions, as well as providing kneel pads and ensuring adequate footwear. The young people really benefited from seeing the same project staff at each event, and really became more relaxed once they had got to know the team.

Figure 4.2: Beaumont student Kerry planting aspen in the Langdale Valley.

University of Cumbria Students

BOOM took a proactive approach to engage students from the University of Cumbria in aspen tree planting events. These events represent a dynamic fusion of education, community involvement and ecological restoration. As part of our commitment to fostering a sense of environmental stewardship and hands-on learning, tree planting provided students with the opportunity to contribute to the restoration of aspen tree population in Cumbria (Fig 4.3), as well as gain valuable work experience.

Figure 4.3: Student planting at Hoathwaite Farm with the National Trust

Recommendations

- When planting with groups with special educational needs or health difficulties, ensure the site is within reasonable walking distance from the car/minibus and near public facilities.
- Assess the number of trees to volunteer ratio. Having too many trees to plant takes away from the enjoyment for the volunteers, whilst too few results in volunteers wondering if it was worth coming.
- When working with certain groups, e.g., groups with mobility issues and disabilities, do not invite other volunteers to join the same planting session, due to the potential vulnerability of the groups.

5. Research

Two University of Cumbria students studied aspen for their dissertation. They were:

1. Oscar Adams

Oscar's dissertation evaluated the survival and growth rates of aspen trees at six in their first growing season across South Cumbria. He collected data on heights, soil types present and performed vegetation surveys. The condition of the trees was compared to suitability ratings provided by the ESC-DSS (Ecological Site Classification – Decision Support System). He found that of the six sites where BOOM had planted aspen, all six sites were either "very suitable" or "suitable" for aspen.

2. Emilia Ramm

Emilia looked at tree heights, soil types, grazing evidence, tree protection types and ground vegetation heights to try and understand why aspen had higher survival and growth rates in certain areas over others. Emilia discovered that there were too many factors across each site, and differences in genetics, to pinpoint exactly the reason why some trees did better than others.

6. Conclusion

The BOOM project worked with a wide variety of organisations and volunteers to successfully propagate and reintroduce aspen trees. A total of 3600 trees have been reintroduced to 47 new locations in south Cumbria. It was evident that the 1.2m deer tubes increased survival and growth rates and similar size protection should be used in the future.

At least 620 people have been educated about aspen, either through online talks, nature discovery events or by being involved with propagation and planting. The BOOM project

engaged various community groups who all enjoyed being out and getting involved in tree planting.

Landowners who have allowed BOOM to plant aspen on their land should take the tree protection off the trees 5 years after planting or when the tree is a sustainable size with branches out of reach of deer grazing.

As aspen in now part of many woodland grants, BOOM is confident that aspen will be planted in many new locations in the future. It is recommended that this aspen is locally sourced and not from the continent. Continued collection and propagation of seeds from the female tree at Cinderbarrow is an ideal method to keep increasing the number of individual genetic clones which can then be planted as part of these new tree planting schemes.

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Appendices

Appendix 1: Aspen Reintroduction Sites

Location	Number Planted	Survival Rate at End of BOOM (%)	Tree Protection Used	Season Planted
Oxen Park	50	43	Deer Tube	2019-20
Bouth	97	75	Deer Tube	2019-20
Cleft Ghyll, Longsleddale	87	67	Deer Tube	2019-20
River Bela	12	Unknown	Deer Tube	2019-20
Hardknott Pass	120	Unknown	Deer Tube	2019-20
Greenholme Farm	45	Unknown	Deer Tube	2019-20
Sadgill	45	44	Deer Tube	2019-20
HMP Haverigg	50	Unknown	Deer Tube	2019-20
Witherslack Estate 1	30	0	50cm cardboard	2020-21
Witherslack Estate 2	20	0	Rabbit Spiral and Cardboard	2020-21
Witherslack Estate 3	29	79	Deer Tube	2020-21
Witherslack Estate 4	30	67	Rabbit Spiral and Cardboard	2020-21
Brown Howe Level 1 and 2	51	90	Deer Tube	2020-21
Brantwood	120	33	Rabbit Spiral and Cardboard	2020-21
HMP Haverigg	50	Unknown	Rabbit Spiral	2020-21
Horrace Farm	20	Unknown	Livestock Fencing	2020-21
Brown Howe 2	14	100	Deer Tube	2020-21
Hardknott Pass	137		Deer Tube, Unfenced, Livestock Fencing and Cardboard	2020-21
Canal Foot, Ulverston	49	Unknown	Cardboard	2020-21
Greenbank Farm	20	Unknown	Deer Tube	2020-21

The Helm, Oxenholme	18	100	Deer Tube	2021-22
Staveley	80	99	Deer Tube	2021-22
Witherslack	50	90	Deer Tube	2021-22
Capplebarrow, Longsleddale	41	Unknown	Deer Tube, Livestock Fencing	2021-22
Eggerslack Wood	30	97	Rabbit Spiral	2021-22
Staveley	70	100	Deer Tube	2021-22
Crosthwaite	104	Unknown	Rabbit Spiral	2021-22
Can Wood, Graythwaite	300	94	60cm Tubex, Cactus Guards	2021-22
Ambleside	60	97	Deer Tube	2021-22
Barrow Island	100	Unknown	Rabbit Spiral, Cardboard	2021-22
Hardknott Forrest	200	Unknown	Unfenced	2022-23
Hoathwaite Farm NT	200	Unknown	Rabbit Spirals and Livestock Fence	2022-23
Rothay Park	34	Unknown	Deer Tube	2022-23
Knoll Cottage	5	Unknown	Unfenced	2022-23
Longsleddale	50	Unknown	Deer Tube	2022-23
Low Bank Farm	50	Unknown	Deer Tube	2022-23
Harrowslack Cottages	3	100	Deer Tube	2022-23
Robinson Place Farm	20	Unknown	Deer Tube	2022-23
Robinson Place Farm	30	Unknown	Deer Tube	2022-23
Boon Wood	34	Unknown	Deer Tube	2022-23
High Nibthwaite	60	Unknown	Deer Tube	2022-23
Parkamoor	200	Unknown	Deer Tube	2022-23
Graythwaite	300	Unknown	Unknown	2022-23
Nature Reserve	60	Unknown	Deer Tube	2022-23
Hollin Bank Farm	123	Unknown	Deer Tube	2022-23
Wood House, Broughton	150	Unknown	Deer Tube, Deer Fenced	2022-23