Back on our Map

Spiked Speedwell

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1. Introduction to BOOM

Back on Our Map (BOOM) aimed to re-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 including Cumbria Wildlife Trust, Natural England and Forestry England.

The project restored habitat and reintroduced species across 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 (Figure 1.1).

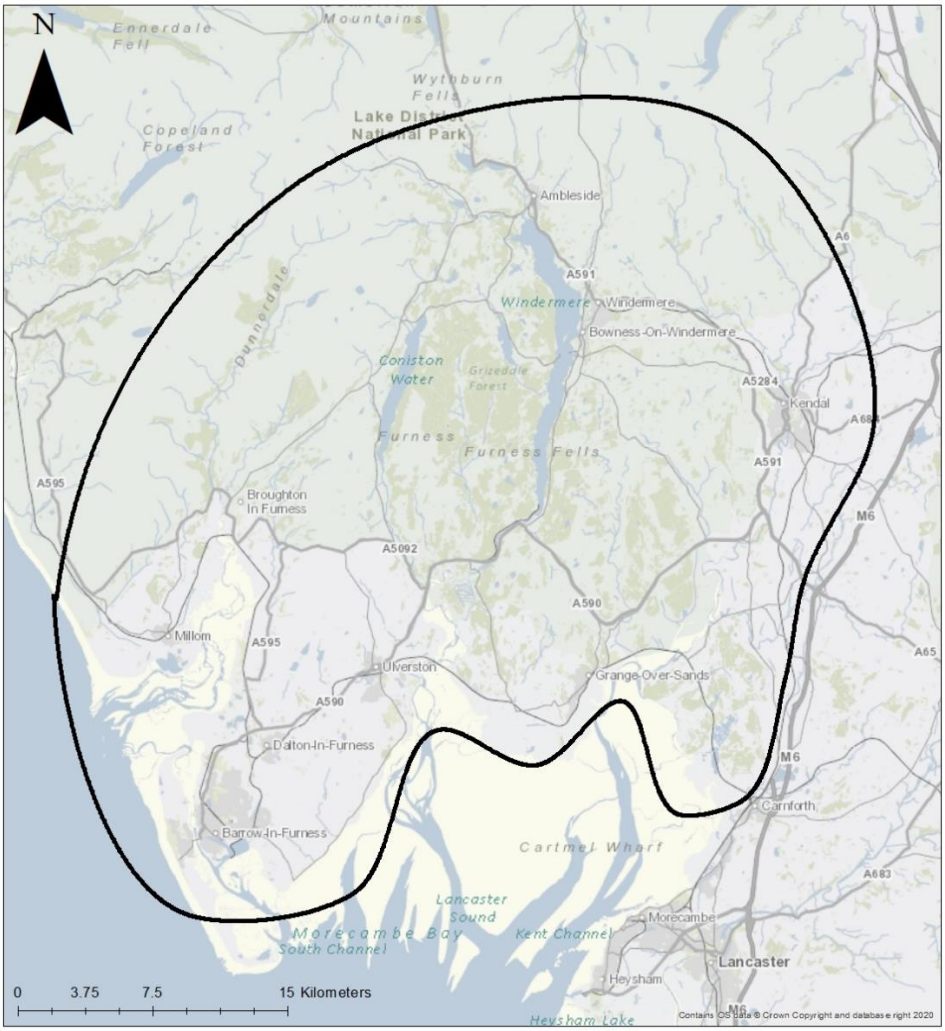


Figure 1.1: Map of the BOOM working area.

BOOM reintroduced and expanded the range of the hazel dormouse, Duke of Burgundy and small blue butterfly, goldilocks aster, great and oblong sundew, green-winged orchid, maidenhair fern, spiked speedwell, and aspen (table 1.1). The pine marten community-based feasibility study identified suitable locations for future reintroduction. 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*	Reintroduction
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. Reintroduction-based social activities and training events helped communities get involved with the BOOM species reintroductions.

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

2. Species background

Spiked speedwell, *Veronica spicata,* is a perennial herb native to Britain and Ireland. Two subspecies of *V. spicata* are separated by the eastern and western regions of the UK. Here in the west of England we host the hybridised subspecies *hybida* with subsp. *spicata* only occurring in very localised regions of eastern England. Although the morphological differences are not as clear cut as first thought, the differences in ecology and population trends is enough to keep them a separated subspecies (Stroh et al., 2023). For purposes of this document, *V.spicata* will be used as the name of the plant and will refer to all subspecies of spiked speedwell, including those considered *V.hybrida,* unless stated otherwise.

Spiked speedwell is a strikingly attractive plant found on carboniferous limestone and other hard basic rocks. It grows mainly on inaccessible cliff ledges, rock crevices, river gorges and sand dunes (Pigott and Walters, 1954). Away from pressures of grazing livestock and rabbits, it also occurs on short sward grasslands, often humic soils on cliff-tops and steep slopes. They are highly intolerant of shade and competition often thrive in harsh environments that have some soil instability (Pigott and Walters, 1954). The scattered nature *V.spicata* populations across the UK and their presence in habitats that would never have supported a closed woodland environment, suggests that they are relics of late-glacial 'steppe-tundra' vegetation most of which was lost to the era of dominant woodland spread (Pigott and Walters, 1954). The plant remains protected on Schedule 8 of the Wildlife and Countryside Act, 1981, deeming the following acts, without a licence, illegal: intentional picking, uprooting or destruction, selling, offering for sale, possessing or transporting for the purpose of sale (live or dead, part or derivative); advertising for buying or selling (Wildlife and Countryside Act, 1981).

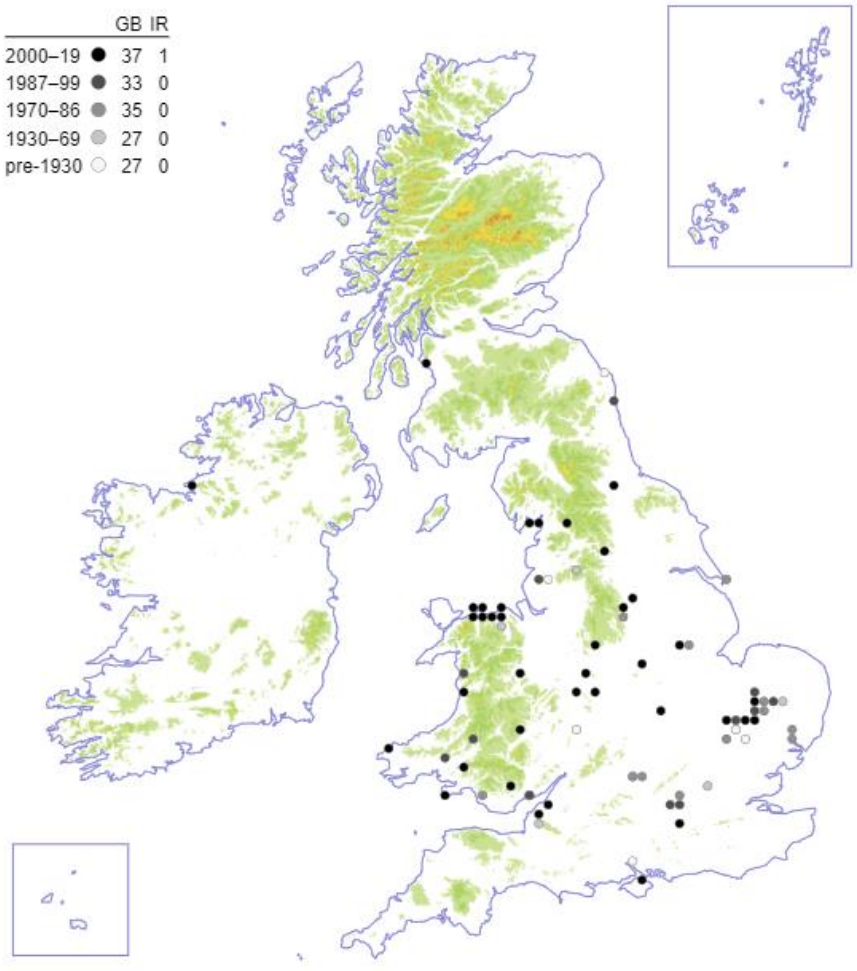
3. Project Rationale

V. spicata in the east of England (Cambridgeshire, Suffolk and Norfolk) has seen a considerable decline of 80% up to the 1990s (Stroh et al., 2023). The subspecies in the western edges of the country have sustained at a similar state since the 1960s but remain isolated. With such limited dispersal ability and disjointed distribution these localised populations are at risk of extinction. Predominantly seen south of the Scottish border, *V. spicata* remains in a few small colonies in south Cumbria, namely Humphrey Head and Heathwaite.

However increased agricultural intensification across the region over the last century has left these populations isolated and vulnerable to extinction, with it previously thought as extinct in north Lancashire (Fischer and Matthies, 1997; WallisDeVries et al., 2002).

Over the past decade, the re-establishment of appropriate limestone grassland management in south Cumbria has paved a way for many species of plant to naturally re-colonise into their historic and natural range. Unfortunately, *V. spicata* has very limited dispersal abilities and with populations being small and over grazed by rabbits, it is unlikely to naturally re-colonise areas of its own accord.

Therefore, reinforcement of current populations and translocation of *V. spicata* into new sites within its historic range in Arnside and Silverdale AONB seems necessary in order to help this plant achieve what it cannot do autonomously. Translocation of *V. spicata* has already been demonstrated as achievable and successful by collection of seed and subsequent planting at Heathwaite, this proposal will follow on from the population reinforcement undertaken in 2017/18 as part of the Headlands to Headspace project.



Veronica spicata L. in *BSBI Online Plant Atlas 2020*, eds P.A. Stroh, T. A. Humphrey, R.J. Burkmar, O.L. Pescott, D.B. Roy, & K.J. Walker. https://plantatlas2020.org/atlas/2cd4p9h.4bv [Accessed 15/09/2023]

4. Reintroduction objectives

As part of the Back on Our Map project, the aim for the *V. spicata* was as follows:

- Reinforce the population of *V. spicata* at the donor sites, Humphrey Head and Heathwaite.
- Translocate *V. spicata* into new areas within its historic or geographic range
- Set up a greenhouse experiment to understand the plants at the donor sites in detail
- Use the results from the experiment to aid important decisions in the project
- Share results with volunteers, partners and the wider public
- Establish a project legacy for continuation into the future.

5. Project location

5.1 Donor site 1 – Humphrey Head

Humphrey Head (SD 388 746) is a striking limestone peninsula, jutting out into Morecambe bay at the southern tip of Cumbria, south of the village of Allithwaite. The western cliffs of the peninsula and the fields a top the cliff are part of a Nature Reserve leased and managed by Cumbria Wildlife Trust. This forms the Humphrey Head Site of Special Scientific Interest (SSSI). The land is owned by Holker Estate and a local famer, Harry Wilson, grazes cattle in the fields. When the tide is low, it is possible to walk the base of the cliff perimeter and follow a path back across the fields on top.

Humphrey Head is home to rare fauna and flora; such as the peregrine falcon (*Falco peregrinus)*, green winged orchid (*Anacamptis morio)* and spotted cat's ear (*Hypochaeris maculate)*. There is also a substantial population of *V. spicata* here that resides on the western cliff face and in areas on the cliff top that have been disturbed by rabbits.

The top of the cliff is separated from grazing cows by a fence, meaning the sward is high. As a poor competitor this limits chances for *V. spicata* to occupy these areas. However, on the cliff face the plant does not need to compete with nutrient loving grasses and is not at risk from rabbits that nibble the flower heads, so the speedwell here grows tall and large in pockets of disturbed soil dotted along in crevices on the cliff face.

5.2 Donor site 2 – Heathwaite ‘Triangle field’

Six and a half kilometres east of Humphrey Head, across the mudflats of Morecambe Bay lies Heathwaite, SD4485 7661. A medium sized field on the western side of Arnside Knott in the Arnside and Silverdale AONB. It is owned by the National Trust and is protected as part of the Arnside Knott SSSI. In summer the field boasts a beautiful selection of wildflowers that are grazed occasionally as part of a conservation cattle grazing regime set up by the National Trust and tenant farmers.

There is a small and isolated population of spiked speedwell here that, in comparison to Humphrey Head, grow small and short despite the cattle grazing and shorter sward. The site has large population of rabbits, and if flower spikes are not caged at the correct time, these can be promptly eaten. It is possible, however, that the predation from rabbits has encouraged the plant to reproduce vegetatively, rather than relying on pollination of its flowers, potentially exacerbating the risk of genetic bottlenecking.

5.3 Donor Site 3 – Far Arnside

Lying 700m to the south of Heathwaite is a privately owned cattle farm in Far Arnside, owned and managed by the Gardeners. On the coastal edge of the field, where a slope begins to run down towards the sea and the grass turns to scrub, there is a small population of spiked speedwell. Similarly to Heathwaite, these grow short and small and there is evidence that they are negatively affected by grazing rabbits.

5.4 Release site 1 – Heathwaite ‘Secret Field’

The initial plan was to reinforce the population at Heathwaite through planting in the same field and also in a similar location slightly further north east up Arnside Knott. After discussions with the National Trust it was decided to only plant speedwell of Heathwaite origin back into Heathwaite until sufficient evidence is provided to ensure that mixing the two donor location genetics will not cause outbreeding depression of the Heathwaite plants. The BOOM project aimed to find this evidence through the results of germination experiments, highlighted in section 8.

5.5 Release site 2 – Jack Scout

Jack Scout, SD459736, has many similarities with Humphrey Head, both occupy west-facing limestone cliffs that overlook the same sand flats. Also, both sites have small areas of calcareous grassland and similar associated plants such as blue moor grass and limestone bedstraw (*Sesleria caerulea* and *Galium sterneri*).

Jack Scout lies 6km from Humphrey Head, across Morecambe Bay, and 3.2km from Heathwaite as the crow flies. The land is owned and managed by the National Trust and a local farmer grazes the land with his cattle at specific times of year.

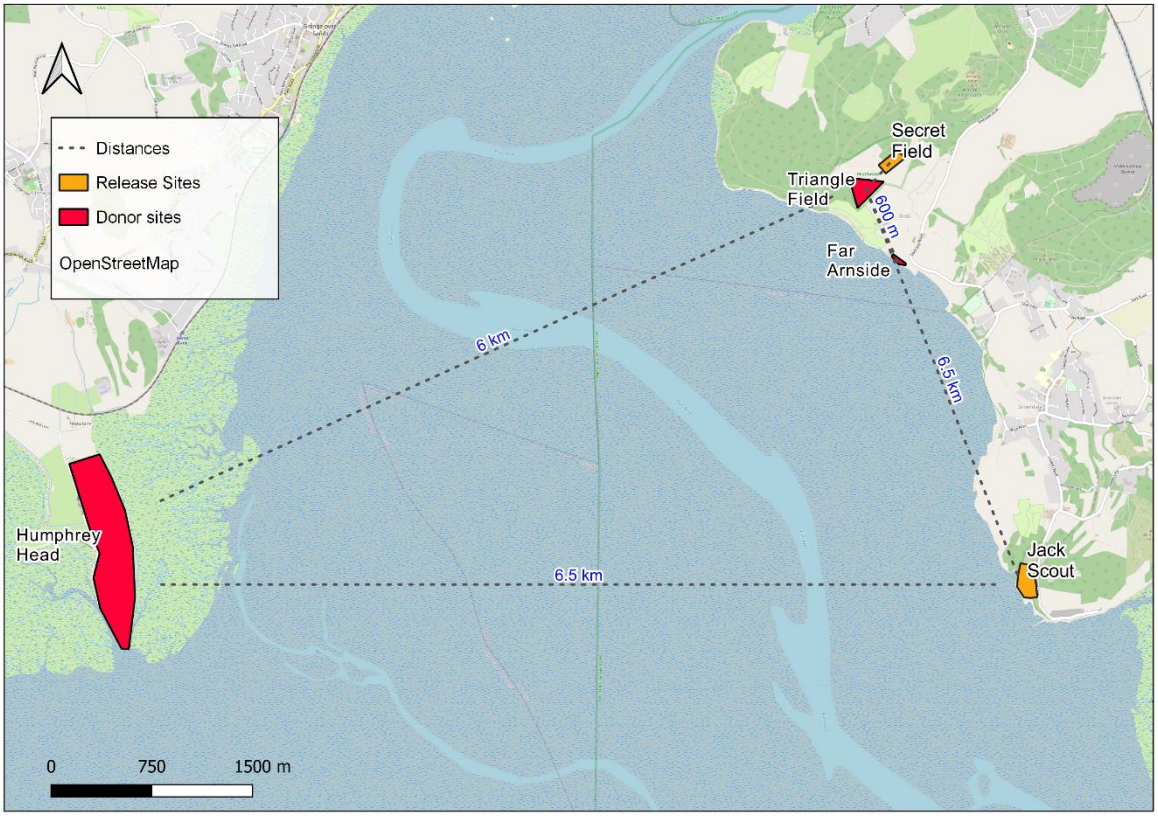


Figure 5.1 *Map of donor sites for V.spicata (red) and release sites (orange)*

6. Project Partners

The success of this project would not have been possible without the collaboration from a wide range of partners and stakeholders, listed below:

Table 6.1. *List of project partners and their role in the V.spicata project*

Partner	People	Role

The University of Cumbria	• Ian Convery, Professor of Environment and Society. • Dr. Dorthe Villadsen, Lecturer in Conservation.	• Lead organisation for BOOM and employer of BOOM officers and staff. • Key member of stakeholder group • Academic support for genetic experimentation work
The National Trust	• Craig McCoy, Arnside and Silverdale Area Ranger • John Hooson, Nature Conservation Advisor	• Land managers for donor and recipient sites, Heathwaite and Jack Scout • Practical, onsite support in reintroduction process • Committed to ongoing monitoring • Facilitated discussions with the Trust's Natural Environment Advisory Group.
Cumbria Wildlife Trust	• Peter Jones, Reserves Officer • Julia Sier, Head Gardener at Plumgarths • Wendy Nelson, Volunteer Reserve Warden	• Land managers for the donor site, Humphrey Head. • Practical, onsite support in reintroduction process • Committed to ongoing monitoring • Growing and propagating plants
Local community	• Anne Kitchen • Lynne Farrell	• Valuable guidance and knowledge on *V.spicata* ecology and growing techniques

6.2 Consents and Agreements

As part of any translocation process, there may need to be licenses, consents or agreements in place before any work takes place. It is advised that a thorough investigation be initiated with landowners and local statutory bodies concerning what processes need to be started before any translocation preparation. This will ensure the project is legally viable. Below is a list of licences, consents or agreements that were obtained by this project prior to translocation:

- A31 Wild Plant licence from Natural England. (*V. spicata* is protected on Schedule 8 of the Wildlife and Countryside Act, 1981 meaning you need a licence to collect seeds or material from the wild).

- SSSI – A consent from Natural England to perform a translocation within a ‘Site of Special Scientific Interest’
- Landowner agreements – Written contracts with the landowners in question about the works to take place onsite presently and into the future.

7. Pre-translocation work

7.1 Donor site population monitoring

As part of the ongoing work to assess the ‘founder population suitability’, it was decided monitor the populations of *V. spicata* at each donor site. The main aim being to get the best estimate of population size. Plant reintroduction peer reviewed literature state that the highest contributing factor to reintroduction success is the number of that particular species that you put back (Godefroid et al., 2011; Maschinski and Albrecht, 2017) i.e. the higher quantity of animals or plants of invertebrates the higher chance of achieving a self-sustaining population in the long run. Furthermore, the IUCN guidelines state that no more than 10% of a donor population should be removed for translocation (IUCN, 2013). Therefore, it was important for us to take seed from a large number of plants but without causing any detriment to the naturally occurring donor population.

7.1.1 Heathwaite population monitoring

Counts were conducted each year at the donor site of the original population and at the locations within the same field that were planted as part of the Headlands to Headspace project. BOOM staff and volunteers counted flowering spikes, non-flowering plants and any rabbit predated plants at a similar time in August each year. Site 1, which is the naturally occurring population of speedwell at the site is the only plot to have increased in size, from 40 in 2019 to 156 in 2022, an increase of 290%. All other plots that were planted as part of Headlands to Headspace project decreased in size, with some plots showing a 0% success rate (see table 7.1).

Figure 7.1 *Map of Heathwaite, triangle field with locations of speedwell planted as part of the Headlands to Headspace project.*

Table 7.1 *the % increase and % survival of the Headlands to Headspace project.*

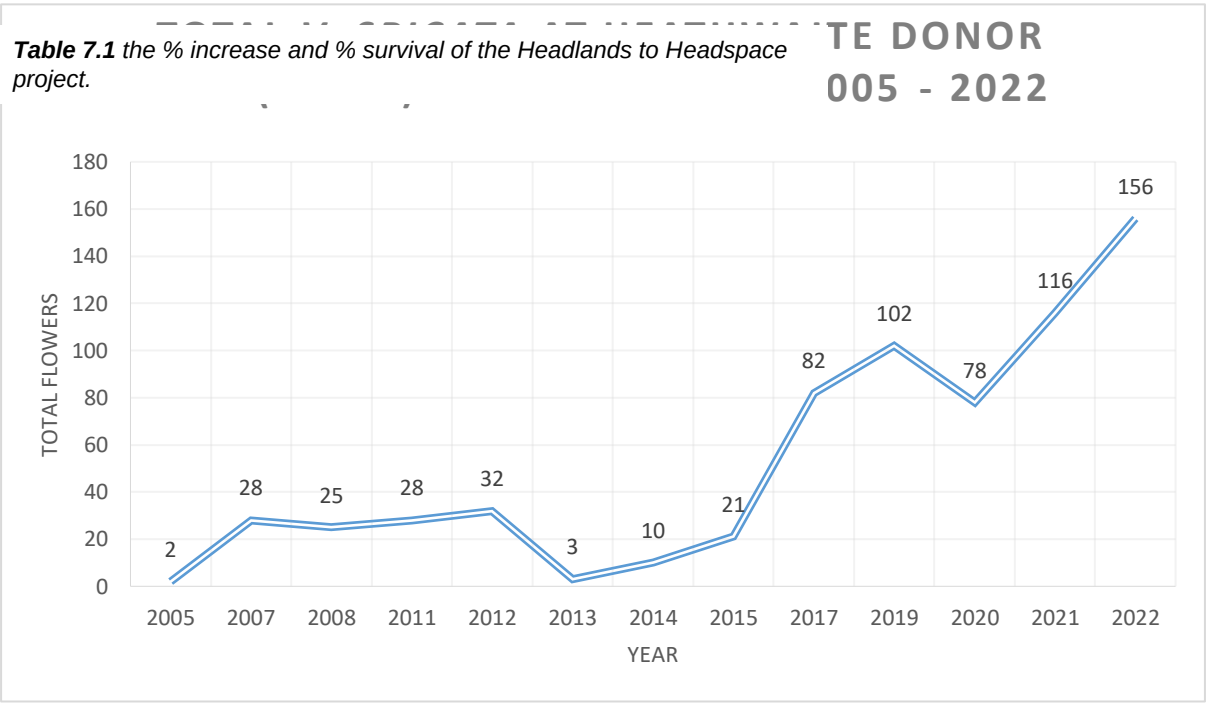


Figure 7.2 *Line graph of the population at the original location of speedwell (Site 1) at Heathwaite from 2005 to 2022*

Plot	Total planted	% increase 2019 - 2022	% survival 2019 - 2022
Plot 1 (original)	**0**	**290.0**	**100**
Plot 2	**49**	**-67.3**	**32.7**
Plot 3	**50**	**-100.0**	**0**
Plot 4	**44**	**-50.0**	**50**
Plot 5	**51**	**-100.0**	**0**
Plot 6	**30**	**-70.0**	**30**
Plot 7	**30**	**-83.3**	**16.7**
Plot 8	**31**	**-80.6**	**19.4**
Plot 9	**26**	**-65.4**	**34.6**
Plot 10	**SEED**	**0**	**0**

7.1.2 Humphrey Head population monitoring

In August 2020 a survey was conducted of Humphrey Head to understand the population size of *V. spicata* on site. *V. spicata* was recorded at nearly every point along the western cliff face (See fig 7.3) with >1000 plants counted. It was actually deemed impossible to count all plants so we can only estimate the population size to be about 2 – 3 thousand plants.

7.2 Seed and material collection

The BOOM team strictly followed IUCN guidelines for translocation and only removed seeds from 10% of the known population at each donor site (IUCN, 2013). Seeds were selected from ripe seed pods and were not collected from plants previously used for collection or previously introduced as part of Headlands to Headspace project. This was thought to reduce the likelihood of genetic bottlenecking.

Each plant can produce a large amount of seeds and hence the total number of seeds removed was a small proportion of the total produced. Seeds were tapped out of pods in to an envelope and the grid reference of the plant, the date and the site name were carefully written on the front using a sharpie pen. Some seeds were sown directly into seed trays (using the technique described below) whilst others were kept in a cool room or refrigerator over winter and sown in spring.

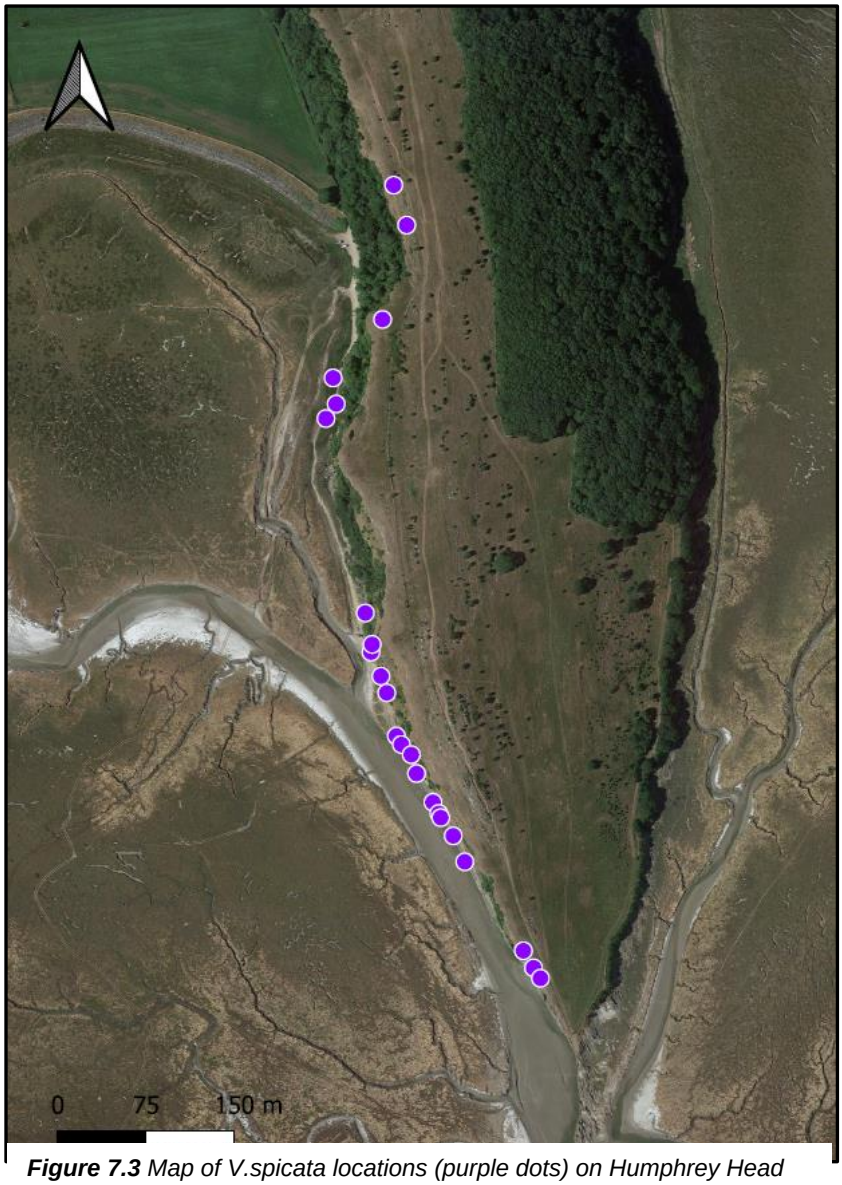


Figure 7.3 *Map of V.spicata locations (purple dots) on Humphrey Head*

7.3 Propagation

BOOM used peat free organic compost when possible. Before sowing seeds, the compost was sterilised. This can be done with boiling water or by putting your compost into the microwave for 1 minute. Sterilising the compost will prevent other species or plant and fungi growing in your trays and impacting your plants.

The compost was left over night in a sealed bag to cool. Once the soil cooled to the same temperature as the surrounding environment it was combined with horticultural grit and placed into standard seed trays with the ratio of 1 part grit, 2 part compost. *V. spicata* has a high

germination rate, so thin seed sowing is recommended. Each tray was labelled with the seed provenance and the date of sowing. A cloche was placed over each seed tray to keep the moisture level constant and reduce the impact of frost, and they were placed outside over winter. Once the seed had germinated and produced at least 2 true leaves they were pricked out and potted into root trainers or individual pots using the same method for compost sterilisation and grit to compost ratio. It is important to monitor seedlings moisture level and water from beneath when necessary.

7.4 Recommendations

- It is best to do the count at peak flowering time, around the middle of August.
- In order to get the most accurate count, split the area into quarters using a quadrat, and count each corner at a time before adding together.
- Use a clicker to count in areas of high abundance.
- If the plants are in an area with a high population of rabbits, it is recommended to cage your speedwells as they flower to allow them to pollinate and set seed before they are predated by rabbits.
- Remember to take binoculars for counts on inaccessible cliff faces
- When keeping seeds over winter before sowing, try to keep them as dry and as cool as possible.

8. Provenance experiment

8.1 Rationale

Introducing genetic diversity is a great tool to reinforce an isolated population of plants and is a proven method to increase the success of reintroduction projects (Breed et al., 2013; Godefroid et al., 2011; Kephart, 2004; Maschinski and Albrecht, 2017), however, if the plants have been isolated for a very long time they may have adapted to their environment enough to physically change the makeup of their DNA (Edmands, 2007). Therefore, cross pollinating distant populations, i.e. Humphrey Head and Heathwaite may risk outbreeding depression, causing a reduction in fitness and potentially extinction of the native stock (Frankham et al. 2011; Storfer 1999; Forrest et al. 2011; Grindeland 2008), the native stock at Heathwaite being the reintroduction success that would be most celebrated by the National Trust.

Although the *V.spicata* at Humphrey Head and Heathwaite are not too distant in space, as the crow flies, the mud flats and tidal waters of Morecambe Bay may be a barrier for foraging pollinators, meaning they may not occupy the same pollination networks. If this is the case, there is a chance that both populations are isolated, having not cross-pollinated for long enough for them to adapt to their current climatic and ecological niches and potentially influencing their chromosomes. In a scenario such as this it would be counterproductive to adopt the 'local is best' approach, as adaptive potential may be limited and compromised (Breed et al., 2013).

It is strongly recommended throughout the literature that, to salvage an isolated population, genetically diverse donors, ideally from more than one population, are required (Breed et al., 2013; Godefroid et al., 2011; Kephart, 2004; Maschinski and Albrecht, 2017) but it is important to discover whether increasing genetic diversity by mixing the two populations together will hinder or benefit the populations. Anecdotally, both populations have clear morphological differences when growing in the wild. However, this could be a reflection of their immediate environment and not necessarily a difference in their genetics. The best way to discover any chromosomal differences in the plant's DNA is to do a greenhouse experiment, germinating and growing the plants from the different donor sites in the exact same conditions. If they reveal physical differences, which are thought to be most apparent in the early stages of growth, it suggests there may be fixed chromosomal differences and therefore the plants may not be suitable to cross-pollinate and reintroduce together in the wild.

Interestingly, plants at the top of Humphrey Head grow differently in the wild to those on the bottom of the cliff, so these seed were kept separate within the experiment as a control.

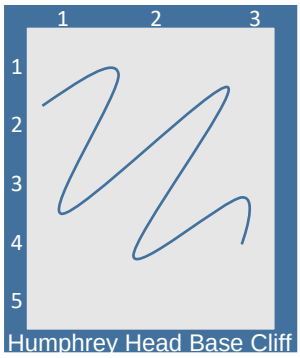
8.2 Methods

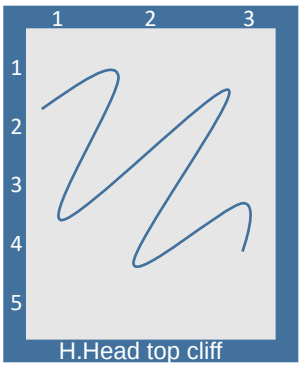
8.2.1 Equipment:

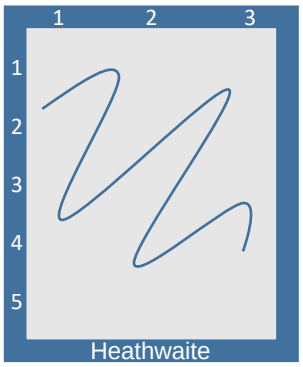
- 15 seeds from Heathwaite, 15 seeds from Humphrey Head bottom of the cliff and 15 seeds from Humphrey head top of the cliff
- 3 seed trays
- Horticultural grit/sand
- Compost (preferably peat free)
- A ruler
- A permanent marker

8.2.2 Set up:

- Using a ruler for guidance, the seed trays were labelled with permanent maker, 1-3 along the top and 1-5 down the side to create a 3x5 grid, shown below:







- Each tray was clearly labelled with the donor site location

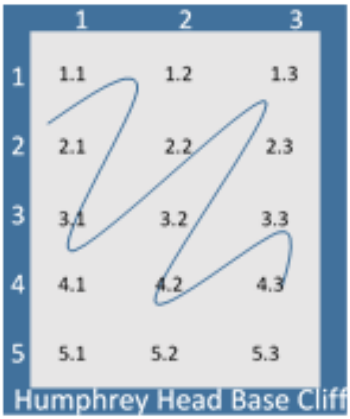
- Compost was sterilised using a microwave and cooled to room temperature

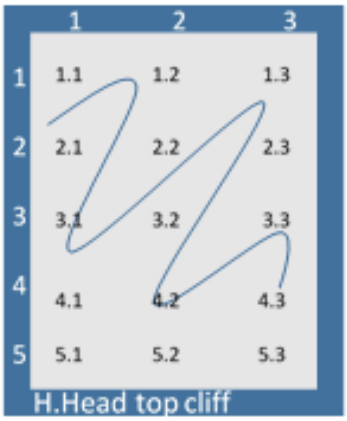
- Compost was mixed with horticultural grit, 1 part grit 2 parts compost

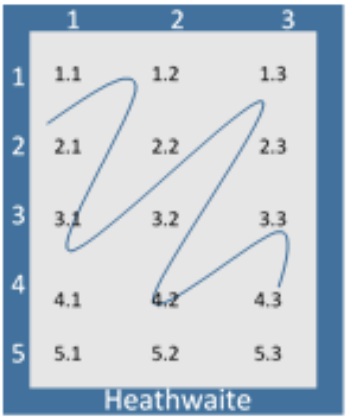
- The trays were filled with the compost grit mixture, keeping the level fairly flat.

- A seed was placed at each grid point 1-5 along row one and repeated for each row until 15 seeds were sown in each tray from each site.

- Each seed was now assigned an individual code that corresponds to its location in the tray, see below:







- Seeds were given to volunteers and the local prison to grow at home either outside, in a green house or polytunnel. Each tray was kept in the same environment. If trays were left outside, the seeds were protected from birds, mice and frost with a mini cloche or netting.

- Seeds were watered with a spray bottle or kept moist from below in a gravel tray. Volunteers were advised that if they were to use a watering can to be very careful so to not move the seeds from their location.

8.2.3 Data collection

Variables collected:

- Date seed was sown
- Date each germinated
- Date they produced true leaves (i.e. leaves produced after the cotyledons)
- Weekly height measurements
- Weekly leaf measurements (one leaf per plant was measured and the largest leaf on the plant was chosen)
- Date of death if applicable

8.3 Experiment results

This experiment was attempted with volunteers, residents of HMP Haverigg and BOOM staff. For one reason or another there was only one set of comparable results available for analysis at the end, of which, the data set is small.

Humphrey Head Top had the highest germination rate of 84%, Humphrey Head bottom a rate of 66% and Heathwaite a rate of 50%. Death rate after germination was 38% for Humphrey Head Top, 36% for Humphrey Head bottom and 56% for Heathwaite.

Time taken to germinate was analysed using an Analysis of Variance (ANOVA) which showed a statistically significant difference between the germination time for the different donor areas ($F(2,94)$ [12.7], $p=1.25e-05$). In a post hoc Tukey's HSD found the mean value of germination

rate was statistically different between Humphrey Head Top and Heathwaite (p = 0.000008), CI= [-35.4, 0.33] and between Humphrey Head Top and Humphrey Head Bottom (p=0.017), CI=[-24.6, -2.7].

Time taken to produce true leaves also showed a statistically significant difference between the donor sites, (F(2,52)[17.4], p=1.61e-06). Tukey's multiple comparison with 95% confidence intervals identified a significant difference between Humphrey Head Top and Heathwaite (p=0.00001, CI=[27.1,75.5) and between Humphrey Head Top and Humphrey Head Bottom (p=0.00005, CI=[19.04,58.9], but not between Humphrey Head Bottom and Heathwaite.

Leaf length was also analysed using ANOVA and Tukey's HSD, this highlighted a significant difference between the mean leaf length of Humphrey Head Bottom and Heathwaite (p=0.05, CI=[-0.05,6.74).

The sample size was too low to make any conclusions from the data, although preliminary analysis would suggest some difference between the sites but there is simply not enough evidence, yet, to base any project decision making on.

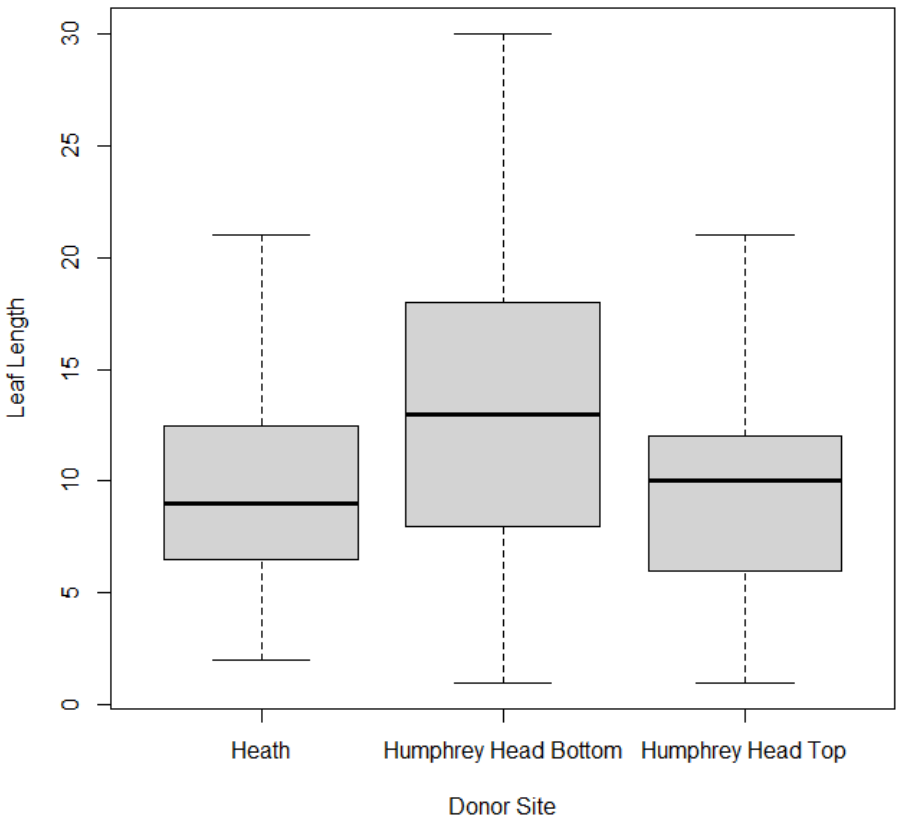


Figure 8.1. Box and whisker plot showing the difference in leaf length between the three donor areas for *V.spicata.*

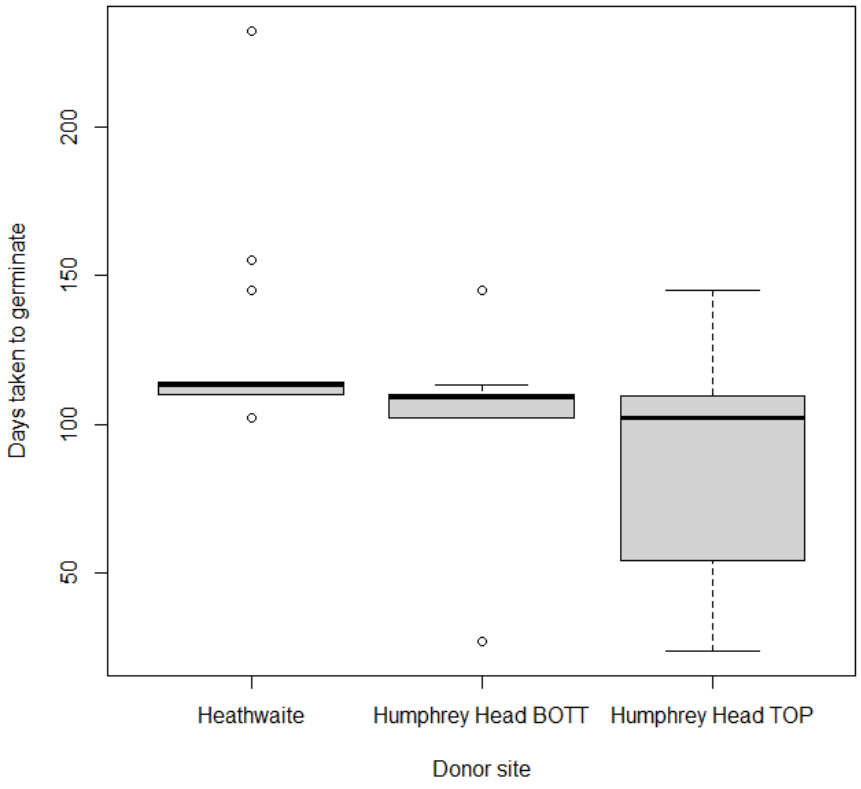


Figure 8.2. Box and whisker plot showing the difference in germination time between the three donor areas for *V.spicata.*

9. Translocation methodology

In October 2021, 62 *V.spicata* plants were planted into a field, 'secret field', which is 250m from the original population in the triangle field (see figure 9.1). Six plots, roughly 30cm x 30cm were created by scraping off the top layer of vegetation, exposing a small square of bare earth, 6 – 14 plants were then planted within each plot, depending on how rocky each plot was. These were then caged with small wire cages and secured to the ground with metal pegs. Each plot was then given a generous amount of water, grid co-ordinates of each plot was recorded and ID number written with Sharpie on each stake to assist with future monitoring. All plants planted into the Secret field were of original Heathwaite provenance.

In October 2022, 62 *V.spicata* plants were planted into Jack Scout (see figure 9.2). The donor population was Humphrey Head, which lies 6.5km across Morecambe Bay. Seven plots were created using the same methodology as before and 6 – 10 plants were planted in each.

Table 9.1. The amount of plants translocated to each site

Date planted	Location	Plot ID	Donor pop	No. planted
Oct-21	Secret field	Plot 1	Heathwaite Triangle field	10
Oct-21	Secret field	Plot 2	Heathwaite Triangle field	8
Oct-21	Secret field	Plot 3	Heathwaite Triangle field	14
Oct-21	Secret field	Plot 4	Heathwaite Triangle field	6
Oct-21	Secret field	Plot 5	Heathwaite Triangle field	13
Oct-21	Secret field	Plot 6	Heathwaite Triangle field	11
Total				**62**
Oct-22	Jack Scout	Plot 1	Humphrey Head	10
Oct-22	Jack Scout	Plot 2	Humphrey Head	10
Oct-22	Jack Scout	Plot 3	Humphrey Head	10
Oct-22	Jack Scout	Plot 4	Humphrey Head	10
Oct-22	Jack Scout	Plot 5	Humphrey Head	8
Oct-22	Jack Scout	Plot 6	Humphrey Head	8
Oct-22	Jack Scout	Plot 7	Humphrey Head	6
Total				**62**

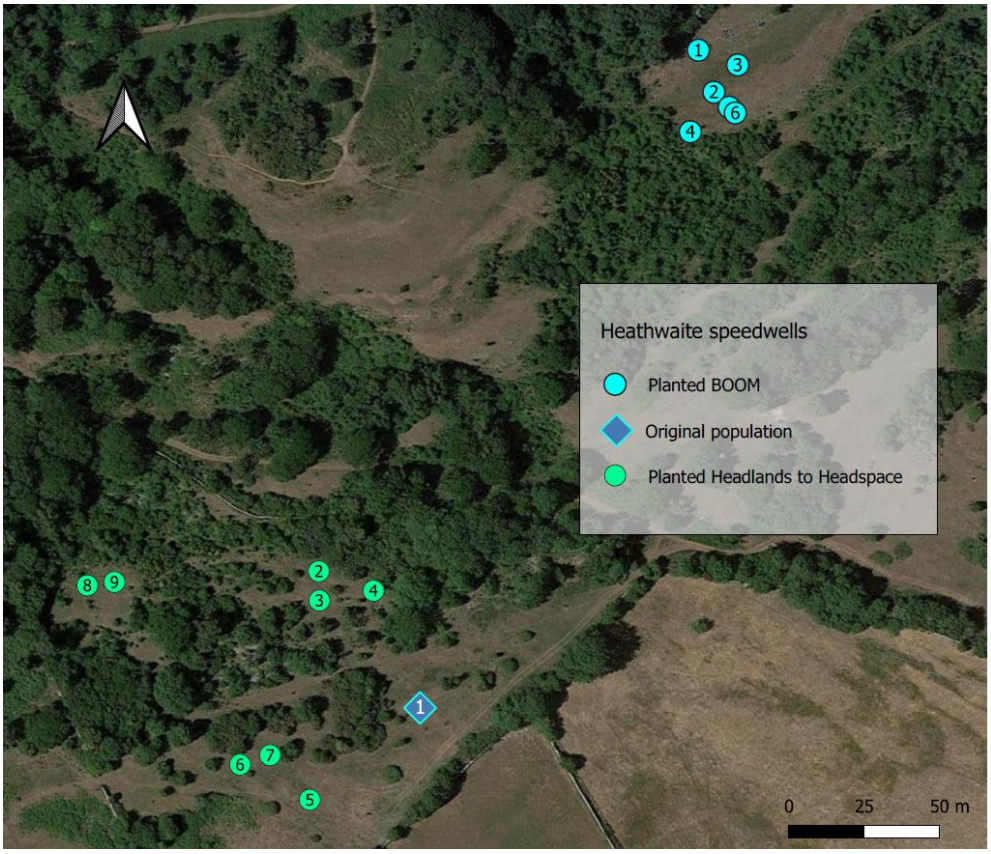


Figure 9.1 *Map of Heathwaite showing V.spicata planted as part of Headlands to Headspace, as part of the BOOM project and the original location of native plants*

Figure 9.2 *Map showing locations of planted V.spicata at Jack Scout as part of the BOOM project*

9.1 Recommendations

- It is best to plant adult plants into the wild that have robust root systems
- If possible remove the top layer of vegetation that will surround the translocated plant to give it the best opportunity to establish without competition
- If you do remove the vegetation be sure to water your plants, especially in dry spells as removing the grass may remove some moisture from the soil.
- Cage your plants to protect from livestock and rabbits.
- Plant in well-draining soil, with very little shade and preferably on a slope/somewhere that soil is often disturbed.
- Plant at the beginning of autumn to avoid dry spring weather, but preferably well before any expected frost.
- Secure your cages well as the disturbed ground will attract badgers and they can easily dig up all that's been planted.
- Take a cautious approach in regards to mixing genetics and always use evidence to back up your decisions. Even so, it is easy to get caught up in 'local is best' attitude; try to remember that boosting genetic diversity can save populations so be prepared to do this when possible and the evidence says it is feasible.

10. Monitoring results

Both planting sites, the Secret field and Jack Scout, have been monitored for population size, reproduction and predation since initial planting. Ideally counts would have taken place monthly, but this wasn't always possible, and results of which are shown below. Despite having the same number planted during translocation (62), plants at Jack Scout increased in number by 237% in 10 months after planting, solely by vegetative spread, as monitoring took place between November and August and seed had not yet been set. During the count in August, Jack Scout had 100 flowers across all plots. Plot 7, which initially had the lowest number of plants (6) saw the highest percentage increase 87% and the most number of flowers on the final check (23). At Heathwaite, the Secret Field, the plants were of original Heathwaite provenance, had 0% increase in 22 months. Two of the plots were lost to rabbits or badgers when the cages blew off in a storm and the others little to no increase vegetativley or through reproduction. Flowers were only found on the most recent count, and just 2 were counted.

Table 10.1 showing the number of plants at each monitoring count and the percentage increase for each site

Count after planting	No. Plants Secret Field	Provenance	% increase	No. plants Jack Scout	Provenance	% increase
Time of planting	62	Heathwaite	0.0	62	Humphrey Head	0
Count 1	52	Heathwaite	-16.1	63	Humphrey Head	1.6
Count 2	62	Heathwaite	0.0	101	Humphrey Head	62.9
Count 3	55	Heathwaite	-11.3	125	Humphrey Head	101.6
Count 4	62	Heathwaite	0.0	209	Humphrey Head	237.1
Count 5	47	Heathwaite	-24.2			
Count 6	55	Heathwaite	-11.3			
Count 7	59	Heathwaite	-4.8			

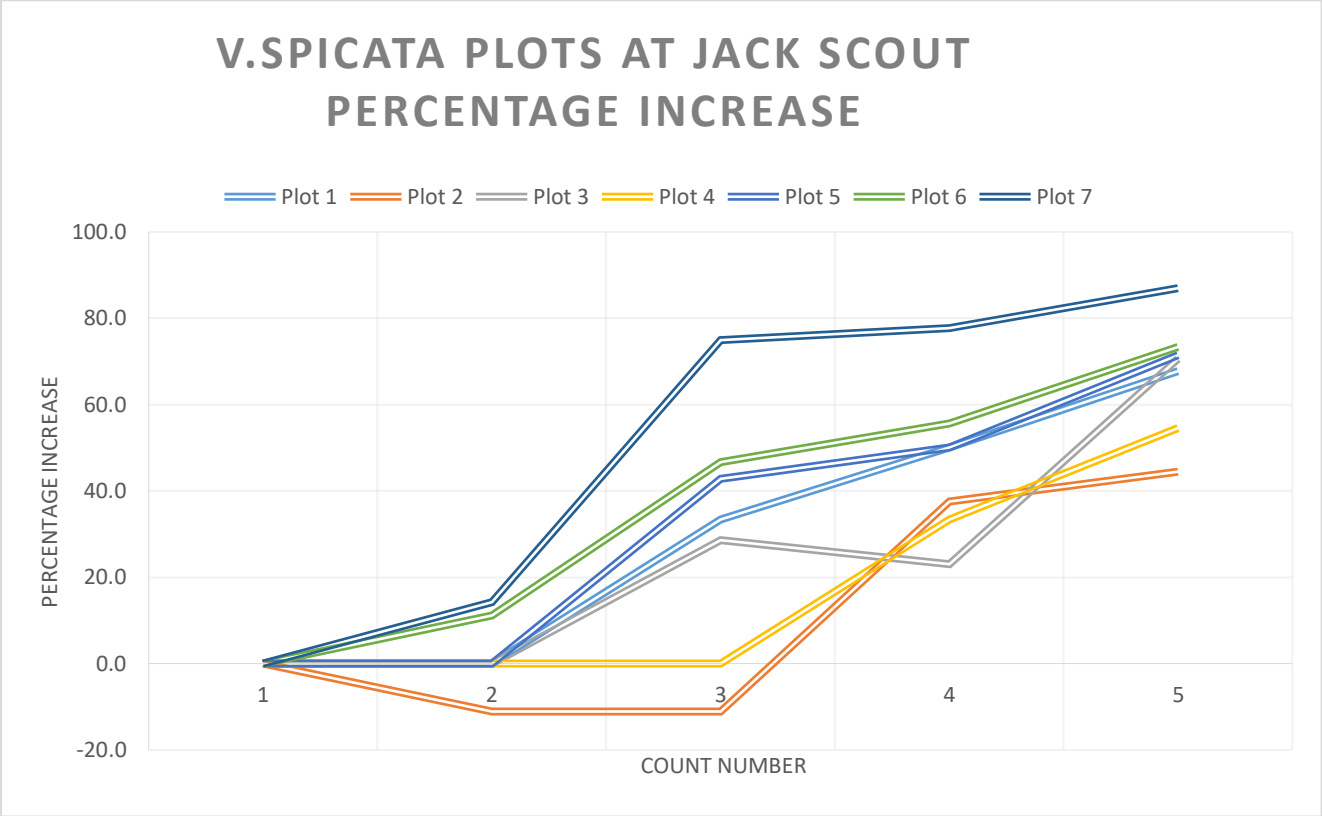


Figure 10.2 Line graph showing increase in *Veronica spicata* numbers at each plot in Jack Scout after translocation.

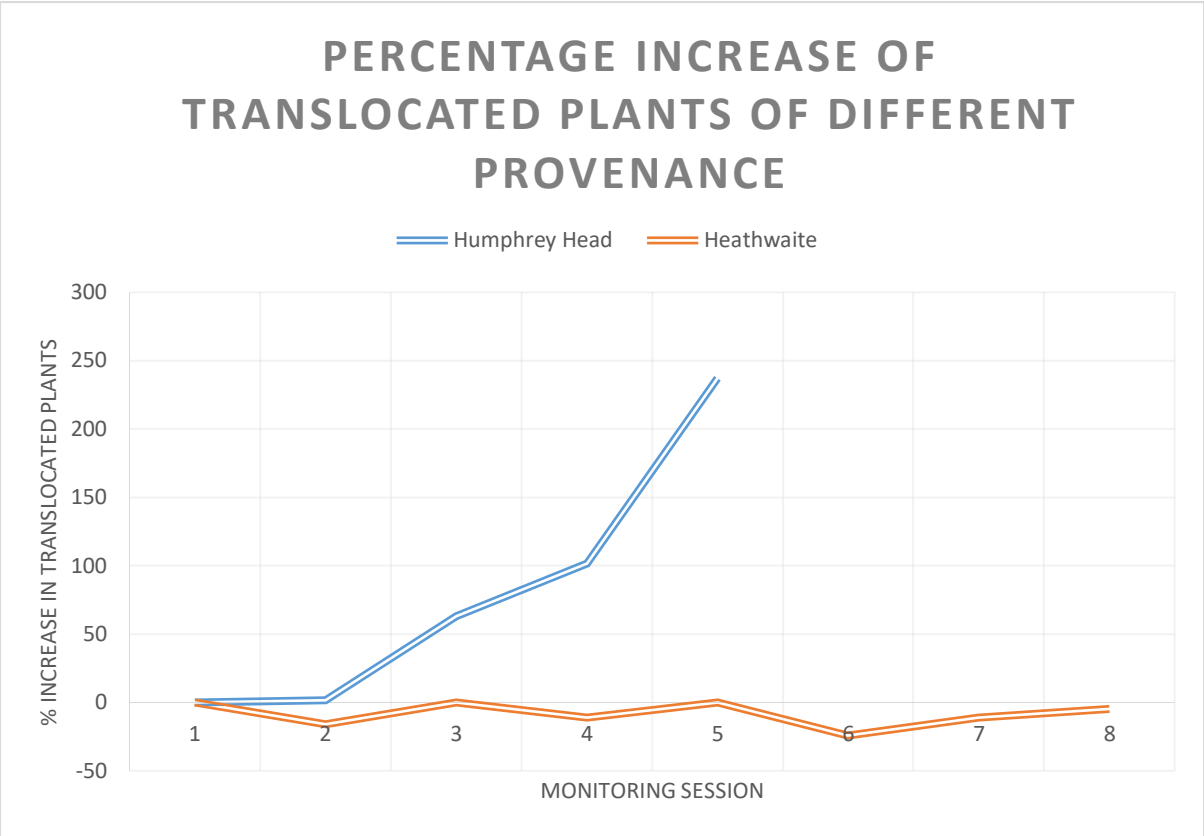


Figure 10.2 Line graph showing the percentage increase of plants after translocation comparing the different donor sites. Monitoring for 10 months at Jack Scout (Humphrey Head provenance) and 22 months at the Secret field (Heathwaite provenance).

10.1 Recommendations

- To obtain accurate monitoring results it is best to recruit a volunteer local to the area to visit the plants on a monthly basis to record data. This will remove pressure and travel time from the staff member who may be located further away.
- Once the plants begin to spread vegetatively, it can be become difficult to identify individual plants which can therefore make monitoring ambiguous. To standardise the counts the BOOM project counted all separated stems as an individual plant. And flower heads were recorded by every flower spike even if these split into two or three at the top of a singular stem.

11. Community Engagement

Community engagement for the *V.spicata* has been small but focused. This project would not have been successful without the dedicated help of one of our key volunteers Julia Sier, Julia took on the responsibility of growing on many rare plants for the BOOM project and spiked speedwell was no exception. Her care, attention to detail and dedication provided us with the number of plants needed for translocation.

BOOM also recruited a small group of volunteers to take part in the greenhouse experiment. Each volunteer was given their own set of seed, compost, trays, cloches and monitoring sheets, and we had a dedicated training session at the University of Ambleside to go through the methodology and rationale in detail. A similar set up and training session occurred at HMP Haverigg with residents who were taking part in the John Muir programme set up by BOOM.

The two planting sessions involved a small group of volunteers.

12. Summary, Legacy and Conclusion

In summary, despite some challenges in regards to provenance and failed germination of seed, the *V.spicata* project has adapted the planting strategy and persevered to find discover the best course of action. Below is a bullet pointed summary of outcomes in the project.

- Planted 124 *V.spicata* into south Cumbria, within its natural range
- Collected initial experiment data on the provenance of plants from the donor sites, although this needs to be continued.
- Initial data suggests there is a difference in morphology of the donor site plants when grown in the same conditions, implying a chromosomal difference, although data is small and needs to be repeated.
- Documented 237% increase in translocated plants at Jack Scout, of Humphrey Head provenance.
- Documented -4% increase in translocated plants at the Secret Field, of Heathwaite provenance, although the population Is currently stable.
- Developed strong relationships with local growers, volunteers and partners.
- Secured a strong legacy through the National Trust, Cumbria Wildlife Trust and the Arnside and Silverdale AONB.

12.1 Legacy

As landowners at Heathwaite, the National Trust will continue work, which was first started in 2005, monitoring the *V.spicata* onsite including those planted as part of Headlands to Headspace Project and the BOOM project. The Arnside and Silverdale AONB have recently developed a nursery space at the offices in Arnside. Discussions have taken place to hand over plants to nursery staff and volunteers who will continue to grow *V.spicata* into the future. A volunteer training day, in which volunteers will be trained in experiment monitoring methods will to take place so that the research into the donor populations can be continued. There has been a change of staff at Cumbria Wildlife Trust, who manage the site at Humphrey Head, however clear guidance will be sent and communicated with the new site manager to continue monitoring of *V.spicata* onsite. Volunteer reserves ranger Wendy Nelson, who has been a valuable part of this project, will continue her good work of monitoring all vegetation onsite.

12.2 Conclusion

Initially planned as purely a translocation project, after detailed conversation with landowners it became apparent that there were genuine concerns about introducing different genetics into areas where *V.spicata* were only just sustaining their population, the project then became an investigation into the plant morphology at the donor sites as well as a translocation. Despite showing increased numbers in recent years, the population at Heathwaite is considered isolated and vulnerable; the increased numbers could be in relation to increased survey effort by the BOOM team.

Plant provenance experiments were therefore designed to help prove that the donor sites were in fact or the same genetic origin, that outbreeding depression was incredibly unlikely (Frankham et al., 2011), and to save the population at Heathwaite, introducing some genetic diversity from Humphrey Head was essential, therefore easing the concerns of the National Trust. However, due to issues with weather, commitment and the technical nature of the experiments, very little data was collected, and the data that was collected did evidence a difference in morphology of the donor populations. It's difficult to take these results seriously given the low sample size but it does emphasise the importance of understanding donor stock genetics before committing to translocation, especially if a localised plant community is highly valued by landowners and local public.

It is still the impression of BOOM that introducing genetics of Humphrey Head *V.spicata* at Heathwaite will increase the population fitness and allow the population to become self-sustaining (Breed et al., 2013; Godefroid et al., 2011; Kephart, 2004; Maschinski and Albrecht,

2017). However, without the evidential support from the experiments and with respect to the landowners the project took a cautious approach to translocation and only planted *V.spicata* of Heathwaite origin back into Heathwaite (i.e. the secret field).

Plants of Humphrey Head origin were planted within the AONB at Jack Scout. This is because, the habitat resembled that of Humphrey Head, both coastal sites with the same aspect and similar plant communities. Jack Scout is far enough from Heathwaite that this was not considered a risk to the local *V.spicata* community there. Comparing the translocated plants at Jack Scout and the Secret Field has shown an incredible difference in results. This is likely to be, as the experiments suggest, that plants of Humphrey Head origin have increased fitness compared to those of Heathwaite and have thrived in their new location. However, other factors relating to the recipient sites have not been taken into consideration, such as humidity and soil PH, and could have an influence on these results.

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Appendix

	Year	ID	No. Flower heads	No. nibbled	No. non flowering	**No. total**
Count of naturally occurring population only	2005	1				**2**
	2007	1				**28**
	2008	1				**25**
	2011	1				**28**
	2012	1				**32**
	2013	1				**3**
	2014	1				**10**
	2015	1		5		**21**
	2017	1	11		71	**82**
Count of original plants and newly planted at different sites within Heathwaite as part of Headlands to Headspace project	2019	1	40	2	60	**102**
	2019	2	5	0	4	**9**
	2019	3	1	0	9	**10**
	2019	4	2	0	1	**3**
	2019	5	4	0	0	**4**
	2019	6	0	0	5	**5**
	2019	7	0	0	5	**5**
	2019	8	0	0	6	**6**
	2019	9	0	0	1	**1**
	2019	10	NA	NA	NA	**0**
	2020	1	19	0	59	**78**
	2020	2	0	0	9	**9**
	2020	3				
	2020	4	1	0	9	**10**
	2020	5				
	2020	6				
	2020	7	0	0	11	**11**
	2020	8	0	0	8	**8**
	2020	9	0	0	8	**8**
	2021	1	3	13	100	**116**
	2021	2	0	0	17	**17**
	2021	3	0	0	5	**5**
	2021	4	0	0	0	**0**
	2021	5	0	0	0	**0**
	2021	6	0	0	11	**11**
	2021	7	0	0	8	**8**
	2021	8	0	0	7	**7**
	2021	9	0	0	10	**10**
	2021	10				
	2022	1	10	0	146	**156**
	2022	2	1	2	13	**16**
	2022	3	0	0	0	**0**
	2022	4	6	4	12	**22**
	2022	5	0	0	0	**0**
	2022	6	0	0	9	**9**
	2022	7	0	0	5	**5**
	2022	8	0	0	6	**6**
	2022	9	0	0	9	**9**
	2022	10				