
Peter Howarth

# Back On Our Map

## The Small Blue Butterfly

Kent, Ellie

# Contents

# 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, Cumbria Wildlife Trust, Natural England and Forestry England.

The project focussed on 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, aspen and reinforced the Duke of Burgundy at a key site (table 1.1). 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 the small blue butterfly, including pre-translocation survey methods, translocation methodology, results and community engagement.

## 2. Species Background

The small blue butterfly, (*Cupido minimus),* is the UK's smallest resident butterfly, about the size of a 5 pence piece (Dawson, 2000). It is dusky in colouring and often mistaken for small species of moth. Although hard to spot, the small blue butterfly is attractive and delicate, the males boasting iridescent blue scales on their upper wing with small claspers at the end of their abdomen. The females are browner in appearance with a more pronounced swelling of the abdomen when full with eggs (Ellers and Boggs, 2003).

In late May and through June, the female will disperse to lay eggs onto single florets of the developing larval food plant, kidney vetch, (*Anthyllis vulneraria).* The larvae are cannibalistic, so the females have evolutionarily adapted to not lay on a flower that already has an egg present (Asher et al., 2001). Once hatched, the larvae will bury itself deep into the flower head where it is protected from predators (Dawson, 2000). In later instar stages, the larvae will move to the outer edges of the flower head to feed. When the larvae have grown, about mid-July, they will make their way to the ground where they will either pupate and become part of a second, smaller, brood of adults in August or pass the winter as a dormant caterpillar under soil, moss or lichen and emerge the following spring (Asher et al., 2001).

Small blue populations are monophagous and dependent on the presence of their sole larval food plant, kidney vetch (Krauss et al., 2004). Kidney vetch thrives on nutrient poor, shallow soil. It is often found on calcareous grasslands, coastal dunes and cliff tops (Rose and O'Reilly, 2006; Stroh et al., 2023). As a poor competitor, kidney vetch has evolved to occupy spaces that other plants cannot, meaning populations can flourish in early successional conditions and areas that have naturally occurring bare ground. This also includes human-made habitats like road embankments, old quarries, slag heaps and post-industrial landscapes. Male small blue butterflies are territorial and will occupy sheltered patches of long grass or scrub and both sexes will roost and take shelter in this vegetation over night or in poor weather. It is therefore necessary to have areas for roosting in close proximity to areas of kidney vetch in which females can disperse to lay their eggs. Other flowering plants such as bird's foot trefoil (*Lotus corniculatus*) and wild strawberry (*Fragaria vesca*) provide a rich nectar source for feeding adults (Asher et al., 2001; Dawson, 2000).

If the habitat remains appropriate and the population size continues to be stable, the small blue butterfly remain sedentary, flying not much more than 40m (Morton, 1985). However, there is evidence of small blue adults colonising new areas of suitable habitat several kilometres away from their initial site. This usually only occurs if the population is large enough

and there is suitable connectivity to appropriate habitat the small blue will colonise new areas, forming a metapopulation (Hanski and Gilpin, 1997).

## 3. Project Rationale

The small blue butterfly is a habitat specialist, meaning specific habitat requirements are needed for a population to survive and thrive ("The State of the UK's Butterflies 2022 Report," n.d.). For the small blue butterfly, this includes areas of kidney vetch among other habitat features such as long grass and sheltered areas with specific microclimate. Unfortunately, in our rigidly managed and partitioned landscape, the natural occurrence of early successional habitat is no longer common and when it does occur, it is isolated, limiting butterfly colonisation to new areas when valuable, early successional vegetation succumbs to more mid-successional, shade tolerant small trees and scrub (Warren et al., 2021). This is why, especially in northern reaches of the UK, we see the small blue populations occupying post-industrial, human made pockets of land only to be removed or destroyed by development of buildings and infrastructure. This means that current populations are often left isolated and vulnerable to extinction(R. Frankham, 1995(a); R. Frankham, 1995(b)).

Habitat fragmentation has caused a monumental contraction in the distribution of the small blue butterfly, reducing nearly 50% since the 1980s, reinforcing the fact that habitat fragmentation is one of the biggest causes of species decline ("The State of the UK's Butterflies 2022 Report," n.d.; Warren et al., 2021) . Small blue butterfly populations are now restricted to the southern counties of the UK but can be seen in fragmented pockets of coastal habitat in Scotland and Wales.

Once flourishing in stretches of the Eden Valley and Westmorland, the small blue in Cumbria is now only seen on the West Coast, in grassland areas between Maryport and Workington. After a translocation from Workington in 2015, where small blue habitat was at threat from development of a car park, there is now a stable population of the small blue butterfly at Barrow Slag Banks in south-west Cumbria.

The Barrow Slag Banks are exceptionally good habitat for the small blue butterfly and the population has flourished. Although the banks belong to Westmorland and Furness Council, due to its unusual topography the site is likely to remain undeveloped, reducing risk to the current population. However, the encroaching patches of sea buckthorn, areas of dense sward that may shade out kidney vetch seedlings, the isolated nature of the site in midst of sprawling urbanisation and the small blue's lack of dispersal ability leaves the population vulnerable to genetic bottlenecking and damage from stochastic events (Jiménez et al., 1994). The future of the small blue butterfly populations in Cumbria is uncertain without the intervention of

conservation projects and a commitment from developers to be sympathetic to species loss and leave patches of land for rare butterflies to occupy.

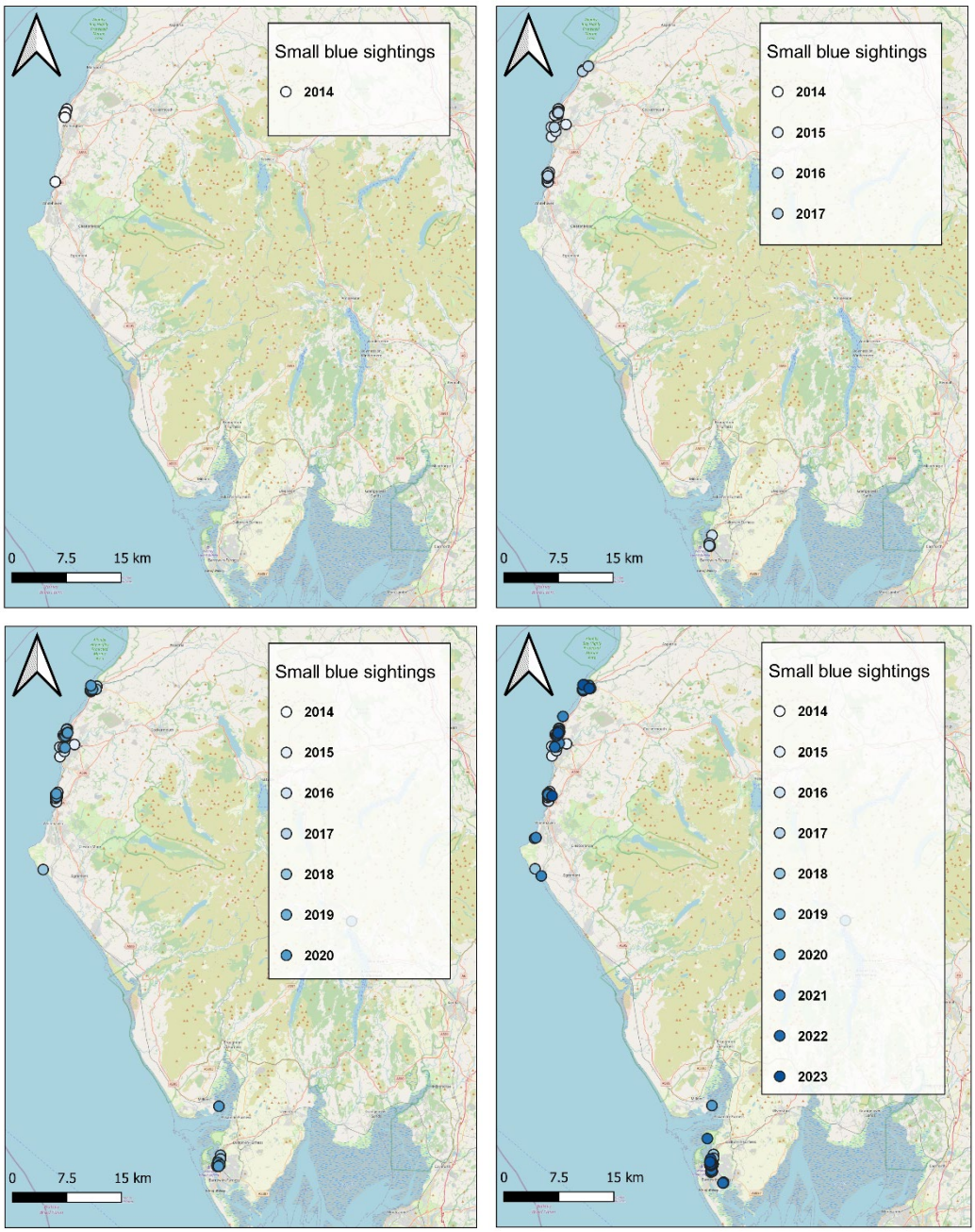


**Figure 3.1.** Small blue sightings in Cumbria from 2014 – 2023

# 4. Reintroduction objectives

**BOOM small blue project aim:** To reinforce the population of small blue butterfly at the donor site and translocate adult butterflies into new sites, forming a metapopulation in the final year of the project.

**BOOM small blue project objectives:**

- To improve the habitat at the donor site, Barrow Slag Banks.
- Obtain a detailed understanding of the population at the donor site through mark and recapture survey techniques.
- Create and improve habitat at the recipient site, Hodbarrow Nature Reserve
- Investigate additional sites for translocation.
- Translocate small blue butterflies from the donor site to the recipient site in the final year of the project.
- Recruit volunteers to assist in surveying and monitoring.
- Ensure landowners at the recipient site are trained and skilled in monitoring the reintroduced population and commit to doing so in the future.
- Raise awareness of the small blue project through community engagement events.

# 5. Project Location

## 5.1 Donor Site – Barrow Slag Banks

The Barrow Slag Banks (SD188711) is a site located on the South West coast of Cumbria towards the western tip of Morecambe Bay. Nestled adjacent to the urban town of Barrow-in-Furness to the south-east and the Island of Walney to the west, on a clear day the slag banks host spectacular views of Black Combe and the Lake District Fells looming to the North.

Although a special site for flora and fauna there is a constant reminder of the proximity to a large industrial town as the drone of the A590, which borders the banks' eastern edge, can be heard from most spots onsite.

The Barrow Slag Banks was formed from over a century of waste from Cumbria's iron and steel production that began in the 1850's and finally ceased in the 1980s (Henderson and Royall, 2015). Apart from some areas that were partially remediated with soil and clay in the 1990s and early 2010s much of the site remains as it was, with vast areas of bare ground and steep rocky cliffs (see figure 5.1). The soil is nutrient-poor and well-draining providing the perfect conditions for kidney vetch to grow, which it does across most of the site. The unusual topography, steep slopes and banks, provides protection from vicious winds off the sea, and when the sun reflects off the stark white slag, large pockets of warm air become trapped, providing the perfect microclimate for sun-loving butterflies.

The flora consists of a species-rich range of plant communities. The most common plants are those in the daisy (*Asteraceae*) and bedstraw (*Galium*) family, and in late spring, there are orchids dotted along the banks.

**Figure 5.1.** Images from the Barrow Slag Banks

## 5.2 Cavendish Docks

A site just north of Cavendish Docks and south of Salthouse Road in Barrow in Furness was brought to the attention of the BOOM team in 2020 by members of Butterfly Conservation who had recorded small blue butterfly on site. The site is an abandoned area of land that covers 160ha. There is a small but sustaining patch of kidney vetch on site as well as rare flora and fauna including reptiles. The site is 3km from Barrow Slag Banks and it is thought that the small blue naturally colonised Cavendish Docks from Barrow Slag Banks since population establishment in 2015. The site is managed by Cumberland Council and is destined to be part of a £200 million development of a 650 home Marina Village (Murphy, 2010) representing an acute and direct threat to the recently colonised small blue butterfly.

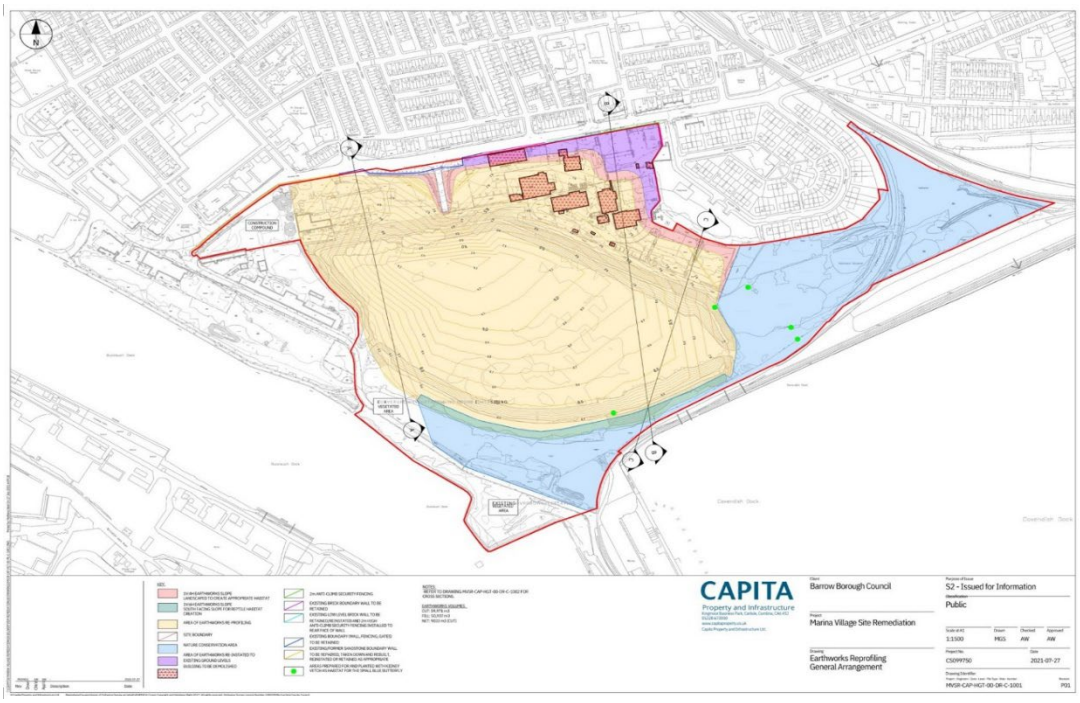


**Figure 5.2** Map of Cavendish Docks as part of the LD169 Barrow Port Area Action Plan July2010 (Murphy, 2010)

## 5.3 Recipient site – Hodbarrow Nature Reserve

The site selected to be the recipient site is Hodbarrow Nature Reserve (SD173780), run by the RSPB. It lies in the shadow of Black Coombe fell and between the villages of Millom and Haverigg. Once an iron ore mine that ceased production in the 1960s the site was then flooded

to form a freshwater coastal lagoon protected by a seawall that spans 2km around the reserve. It was purchased by the RSPB in 1986 who continue to protect it today primarily for its colonies of breeding terns that arrive in spring and nest on islands of slag in the lagoon.

Since its time as a site of intensive industry, Hodbarrow is now a Site of Special Scientific Interest (SSSI) and forms part of the Special Protection Area (SPA) in the Morecambe Bay and Duddon Estuary.

On the south-eastern side of the lagoon are large areas of calcareous grassland that hold many rare plants, butterflies and amphibians. There are also areas of bare ground and sand dunes, which is the perfect substrate for sowing kidney vetch seed. Hodbarrow is a post-industrial site with similar plant communities and areas of shelter to Barrow Slag Banks making it an ideal recipient site for a small blue butterfly translocation.

**Figure 5.3.** Hodbarrow Nature Reserve

## 5.4 Millom Iron Works Nature Reserve

Millom Iron Works Nature Reserve lies 2.2km northeast of Hodbarrow Nature Reserve and is another biodiverse site with rich cultural heritage from the iron industry that now boasts a haven of wildlife and biodiversity. Owned and managed by the newly united Cumberland Council, the BOOM project obtained permission to plant and sow kidney vetch into

appropriate areas onsite securing potential new colonisation areas for the small blue in future years.

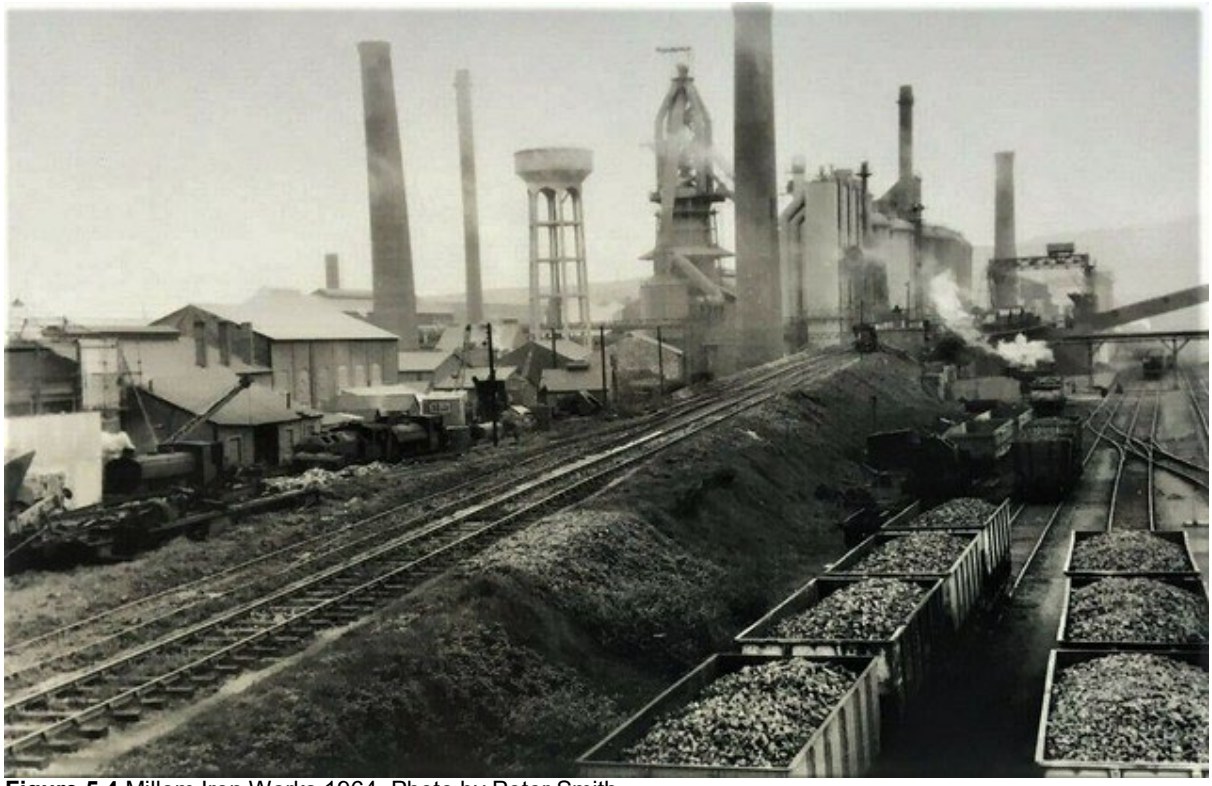

**Figure 5.4** Millom Iron Works 1964, Photo by Peter Smith
https://www.flickr.com/photos/147645911@N08/50581664142/

## 5.6 Other potential sites

Hodbarrow and the Barrow Slag Banks are 7km apart as the crow flies across the Duddon Estuary and between the two sites lies Sandscale Hawes Nature Reserve, managed by the National Trust, which itself provides potential small blue habitat and can be seen as a stepping-stone between the two main sites. The Natural England-managed reserve of North Walney Island is also highly suitable small blue habitat, it is thought that there is little need for management work here and the small blue are likely to colonise this site of their own accord.

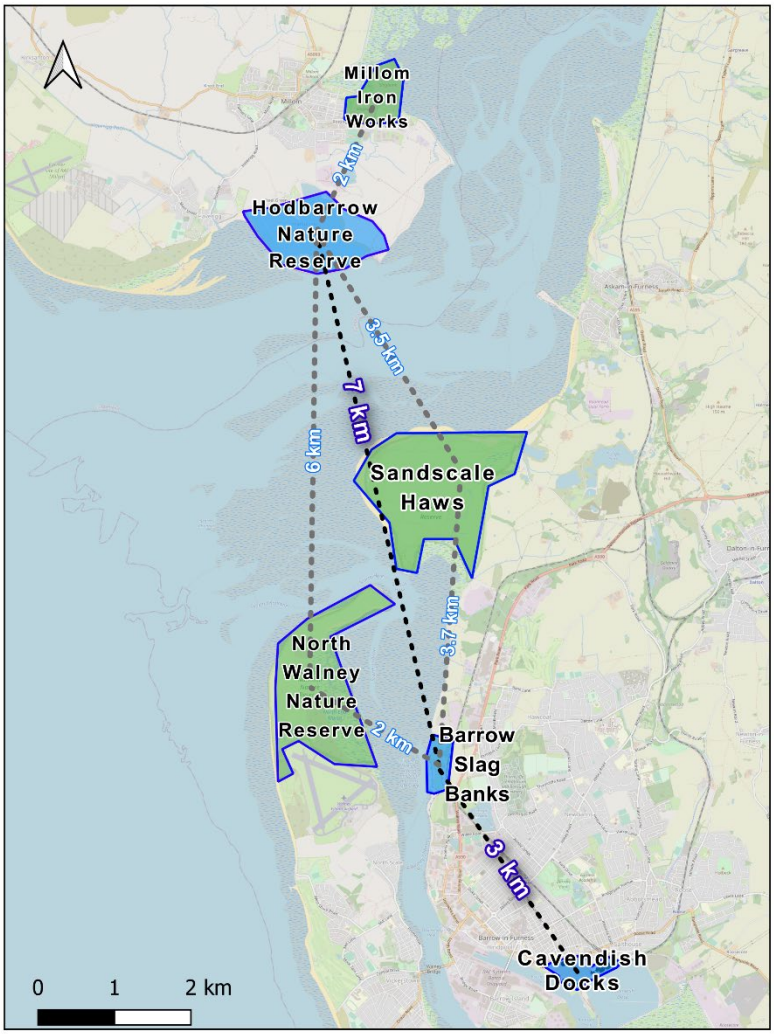


**Figure 5.5.** Map of small blue project area, including all sites and the distances between them. Sites that the Small blue butterfly are now present or have been known to be are blue polygons and sites that provide good stepping-stones and future sites are green polygons.

## 6. Project Partners

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

**Table 6.1**. All partners connected with the BOOM small blue project and how they were involved

| Partner | People | Role |
|---|---|---|
| The University of Cumbria | • Ian Convery, Professor of Environment and Society. | • Lead organisation for BOOM and employer of BOOM officers and staff.<br>• Key member of stakeholder group |

| | | |
|---|---|---|
| | • Dr. Dorthe Villadsen, Lecturer in Conservation.<br>• Michael Mitchel, Principle Lecturer in the Institute of Arts | • Academic support for students conducting research alongside the small blue project<br>• Creation of a BOOM related augmented reality art installation at Hodbarrow Nature Reserve, aiming to connect local people with the cultural and ecological history of the site. |
| Butterfly Conservation (BC) | • Dave Wainwright, Head of Conservation, England.<br>• Chris Winnick, Chair of BC Cumbria Division. | • Provided valuable support and guidance throughout all stages of the project<br>• Lead training sessions for mark and recapture survey techniques.<br>• Provided community and social support in presentations and workshops |
| The Royal Society for the Protection of Birds | • Dave Blackledge, Nature Reserve Site Manager<br>• Mhairi Maclauchlan, Cumbria Coast Warden.<br>• Rachelle Reagan, Hodbarrow Tern Warden<br>• Chris Goding, Hodbarrow Tern Warden | • Manages the main recipient site, Hodbarrow Nature Reserve.<br>• Practical, onsite support during habitat works<br>• Social engagement support during guided walks<br>• Committed to ongoing monitoring, volunteer engagement and small blue-focused habitat management. |
| Westmorland and Furness Council | • David Haughian, Senior Programme Manager<br>• Andrew Thompson, Contractor | • Gave permission to access, survey and conduct habitat work onsite at Barrow Slag Banks and Cavendish Docks<br>• Allowed access to non-public access site, Cavendish Docks.<br>• Allowed BOOM to guide and lead small blue mitigation onsite at Cavendish Docks<br>• Provided contractor work in the form of scrape and bund creation on site. |
| HMP Haverigg Prison | • Residents | • Assisted in growing and planting of kidney vetch at Hodbarrow Nature Reserve. |

| | | |
|---|---|---|
| Cumberland Council | • David Rawle, Senior Estates Surveyor<br>• Emanuel Flecken, Parks, Open Spaces and Bereavement Manager | • Allow access and work at Millom Iron Works Nature Reserve. |

## 6.1 Consents and Agreements

As part of any translocation process, there may need to be licences, 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:

- 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.

## 6.2 IUCN requirements

Prior to any reintroduction or translocation, it is important that particular biological and social aspects be met in order to optimise chances of success and mitigate any risks. As part of the BOOM project, we complied with reintroduction guidelines outlined by the International Union of the Conservation of Nature (IUCN, 2013).

Below is a list of considerations set out by the IUCN guidelines that were assessed in detail during the development phase of the project

- Habitat suitability
- Climate suitability
- Founder population suitability
- Genetic considerations
- Disease and parasite considerations
- Animal Welfare considerations

- Social considerations

# 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 to monitor the population of small blue butterfly at the donor site. The main aim being to get the best estimate of population size. Published studies suggest that the highest contributing factor to reintroduction success is the number of that particular species that you put back (Armstrong and Seddon, 2008; Bellis et al., 2019; Godefroid et al., 2011) 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 a large number of butterflies but without causing any detriment to the population. The most accurate survey methodology to obtain population estimates is mark and recapture surveys. This would also provide us with data on the life expectancy and dispersal of the small blue on site.

The slag banks is a popular donor location for small blue translocation projects. It was therefore important that as practitioners, we understood any fluctuation in population size because of the removal of adults. By continuing the mark and recapture study in future years we will be able to document any fluctuation and hopefully provide evidence of the most sustainable method of translocation, i.e. the maximum number of butterflies that can be removed without causing any detriment to the population. With this being the first mark and recapture study of the small blue that we are aware of, we hope that all evidence we gather will support and contribute to many small blue butterfly conservation projects in the future.

In May 2021 a group of BOOM staff, students and volunteers were trained in mark and recapture survey techniques by David Wainwright from Butterfly Conservation.

### 7.1.1 Pre-release monitoring methodology

Surveys took place once or twice a week during the small blue flight season, the end of May and throughout June, of 2021 and 2022. In 2022, these surveys were led and conducted by Samantha Haddock (University of Cumbria) as part of her undergraduate dissertation work.

#### *7.1.1.1 Time:*

Surveys took place between 10:30 and 15:00 and in good weather conditions, i.e. when the temperature did not drop below 10 degrees Celsius and with low wind speeds.

#### *7.1.1.2 Equipment:*

- Butterfly, insect net.
- Sharpie Pen
- Garmin GPS unit
- Recording sheet with clipboard (see appendix 1 for recording sheet).

#### *7.1.1.3 Area:*

- A fixed transect was highlighted which covered all locations small blue are known to occupy in addition to recognised areas of appropriate habitat.

#### *7.1.1.4 Marking:*

Upon capture, each butterfly was given a unique combination of dots that corresponded with their identification number. Any combination of dots within the pattern shown below can make any number up to 109. For example, to identify a butterfly as number 33 one would mark a dot on the right hand side of the butterfly wing on the positions representing ‘10’ and ‘20’ and on the left hand wing at positions representing ‘1’ and ‘2’. Each dot was placed very carefully using a Sharpie pen and done so through the holes in the net to limit handling of the butterfly and reduce any likelihood of damage. Different coloured Sharpie pens were used for different survey days.

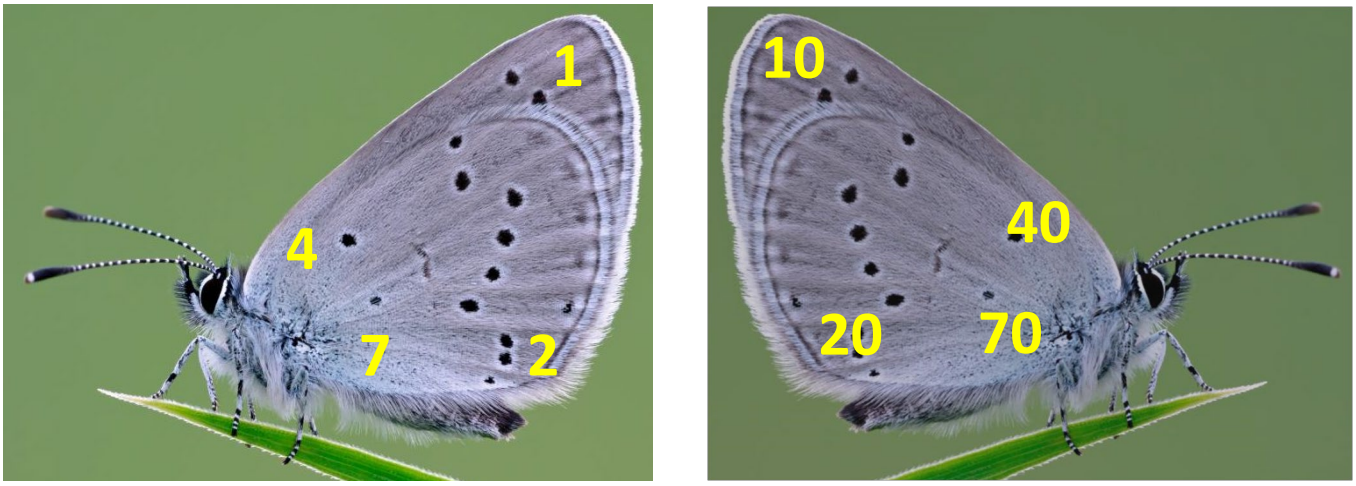


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**Figure 7.1** A diagram to show the location of each dot for mark and recapture. Any combination of dots within the pattern shown below can make any number up to 109.

Once marked, a 10-figure grid reference was recorded using a GPS, the sex of each butterfly was identified as male and female and the time that it was captured. The butterfly was released and transect continued. Recaptured butterflies were either identified in situ (if they settled on a leaf) or if in flight were promptly captured and released to be certain of identification. Any butterflies recaptured within 3 minutes of initial capture and release were not counted.

**Figure 7.2** Project Officer Ellie Kent with volunteers Helen Wallace and Sammy Haddock

### 7.1.2 Statistics

A Truncated geometric model (Eberhardt, 1969) was used to create population estimates with the mark and recapture data, using the following equation:

$$\text{Population estimate: } \hat{N} = \frac{r(s-1)}{s-r}$$

***r*** = total number of individuals captured

***s*** = total number of captures.

The standard error was calculated using the formula below.

$$\text{Standard error} = \sqrt{\frac{\hat{N}\hat{p}}{\hat{q}^2}}$$

Where $\hat{q} = \frac{s-r}{s-1}$, and $\hat{p} = 1-\hat{q}$.

### 7.1.3 Pre-release monitoring results

In total, 514 (263 in 2021 and 251 in 2022) unique individuals were marked and just 90 (33 in 2021 and 57 in 2022) were recaptured, showing a recapture rate of 17.5% (12.5% in 2021 and 22.7% in 2022).

Our highest estimate of population size for the small blue was 1350 (± 670 SE) in the 2nd week of June 2021. This was based on 72 different individuals captured in total and 76 actual captures, i.e. just 4 recaptures, which gave us a very high standard error.

$$\text{Population estimate} = \frac{72\,(76-1)}{76-72} = 1350\ (\pm\ 670\ \text{SE})$$

Our lowest population estimate was in the last week of June in 2022, 29 (± 11 SE) small blue adults. This was based on 11 different individuals captured in total and 17 actual captures, i.e. 6 recaptures.

$$\text{Population estimate} = \frac{11\,(17-1)}{} = 29\ (\pm\ 11\ \text{SE})$$

17 - 11

The average population estimate across both seasons was 624 (± 307 SE) butterflies. The highest amount of recaptures within one day was four; this individual travelled 194m over 3.5hours.

The furthest an adult travelled in a day was 414m in 45mins. The average distance the small blues travelled over both seasons was 41m. The longest amount of days between recapture of a marked individual was 24 days.

For a more detailed analysis on sex-based dispersal, please ask for the dissertation by Samantha Haddock titled *Sex Biased Dispersal in the Small Blue Butterfly (Cupido minimus).*

## 7.2 Habitat management works

To achieve our project objectives a large amount of habitat management work was planned and implemented at both the donor site and recipient site.

### 7.2.1 Habitat preservation – the donor site (Barrow Slag Banks)

To preserve the small blue habitat at the Barrow Slag Banks a management plan was created and agreed with Westmorland and In-Furness Council. This included the creation of scrapes and bunds. Bunds can be described as small butterfly banks, generally created with a small digger; they are usually south facing crescent shaped banks that range from 5-20m long. A scrape is the removal of the top layer of soil. Scrapes are essential for the establishment of kidney vetch. As an early-colonising plant that is quickly out-competed by other vigorous vegetation, the scrapes provide kidney vetch with a ‘head start’ in the disturbed bare soil that the seeds need for germination (Dawson, 2000).

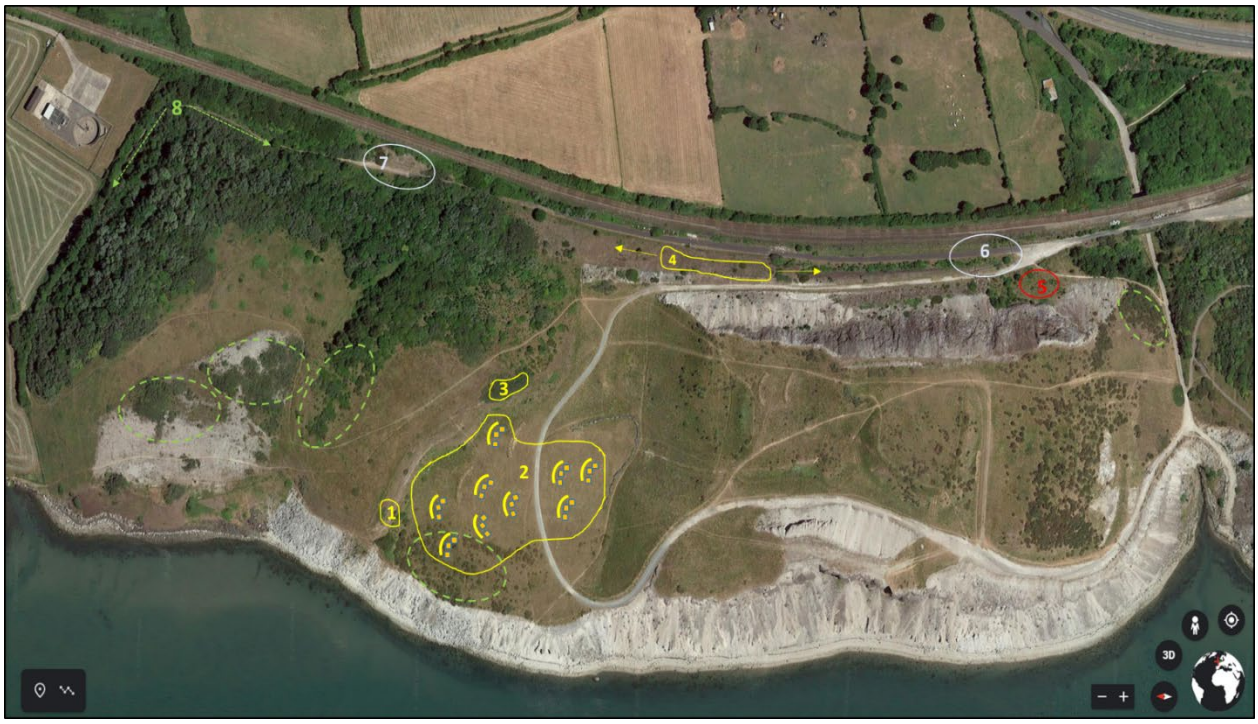


**Figure 7.2.** Map of management work to take place on North Bank, Barrow in Furness. Areas bordered in yellow are high priority areas. Areas in light blue are medium priority and areas in dashed green are low priority scrub clearance. Areas in red are regarded good habitat. 1 = Removal of sea buckthorn; 2 = Scrape and bund creation, yellow semi-circles represent bunds and the adjacent three orange squares represent scrapes into which kidney vet seed will be sown; 3 = Removal of sea buckthorn; 4 = Clearance of cotoneaster, sea buckthorn, whitebeam saplings and kidney vetch planting; 5 = Good habitat area to sow kidney vetch seed; 6 = Remove whitebeam saplings and remaining scrub; 7 = Clear sea buckthorn on grassland and remove gorse, potential bund and scrape; 8 = widen path.

Unfortunately, due to Covid restrictions, time restraints and the sensitivity of the site being used as a refugium for translocated reptiles the scrapes and bunds were not created. However, the site has naturally occurring, unusual topography, meaning this was not a huge set back to the project and the small blue butterfly population continued to flourish.

During the winter seasons of 2020 – 2022 a large amount of sea buckthorn scrub removal took place. The areas of sea buckthorn that posed most threat to emerging kidney vetch and the butterfly population was on a very steep slope. Despite attempts to complete this work with a contractor, it was decided the use of a digger was unsafe and all removal was completed by hand with the very welcome help of residents from HMP Haverigg.

### 7.2.2 Habitat creation – the recipient site (Hodbarrow Nature Reserve)

After consultation with Natural England and Chris Winnick and Dave Wainwright from Butterfly Conservation, Hodbarrow Nature Reserve was selected as an appropriate site for a small blue translocation. Although the site displayed good potential, the translocation was conditional upon the creation of small blue specific habitat. There was a large, naturally occurring patch of kidney vetch next to the bird hide on the southern edge of the site. This area is unfortunately exposed to the elements and often windswept from gusts off the sea. The plan therefore, was to utilise this kidney vetch as a donor source of seed and create appropriate habitat in more sheltered areas of the reserve. After our detailed work at the Barrow Slag Banks, we have direct evidence of small blue butterflies using kidney vetch in wind swept, exposed, locations for egg laying although flying adults are rarely spotted in these locations.

Three days of large-scale habitat management took place at Hodbarrow Nature Reserve in early spring 2021 with contractors, Evans Agricultural. Details of this work are shown in Figures 7.4 and 7.5.

In total, 13 scallop-shaped bunds were created varying from 4 – 8 m long, large corridors of gorse scrub were removed and kidney vetch seed was sown and 200 plugs were planted into bare earth on top of the bunds, with the hope that seed will set and colonise lower areas of the slopes. Any scrub on the seaward side of the bunds was left to provide protection from the wind if possible.

**Figure 7.3** Project officers Anya Kuliszewski, Ellie Kent, Mic Mayhew and Project manager, Jo Sayers ready for a day of removing sea buckthorn

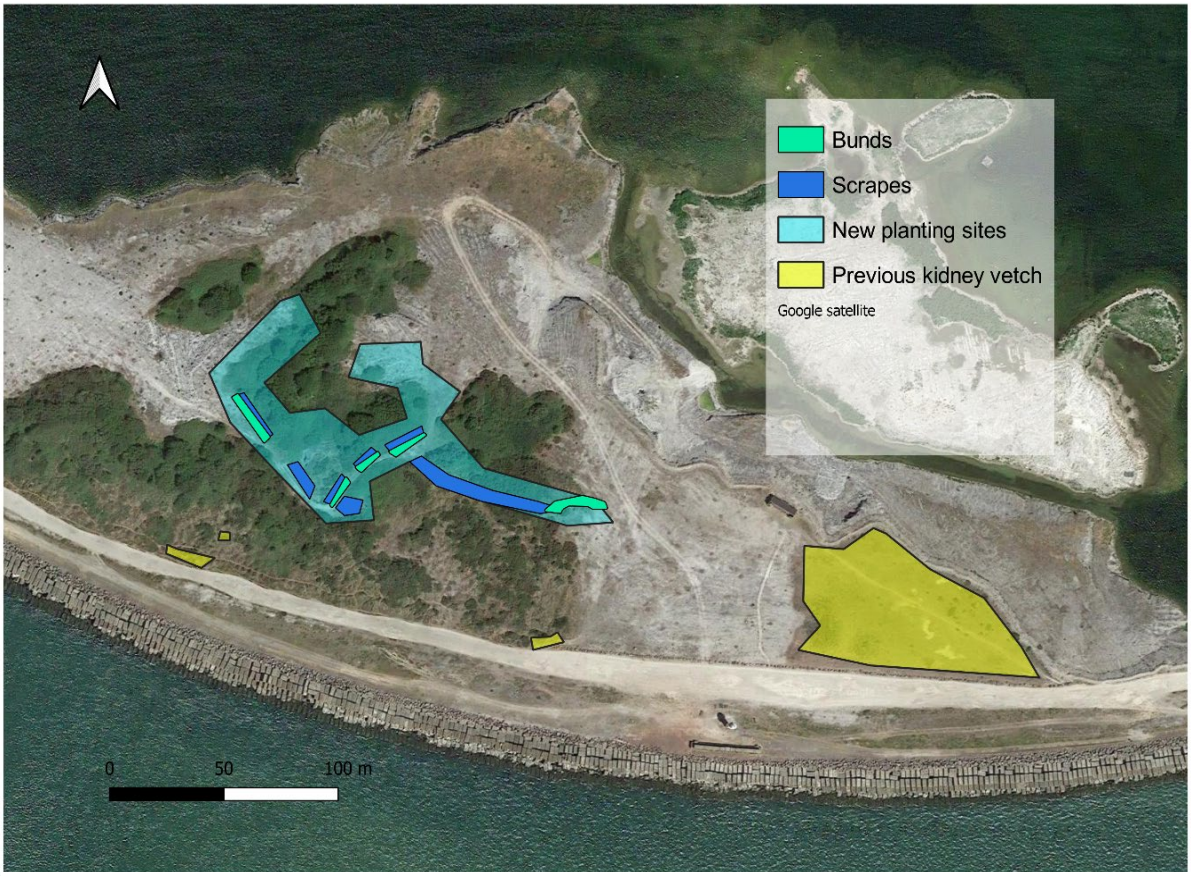


**Figure 7.4**. Map of habitat management work that took place at Hodbarrow Nature Reserve. In area close to bird hide (Site 2) SD173780

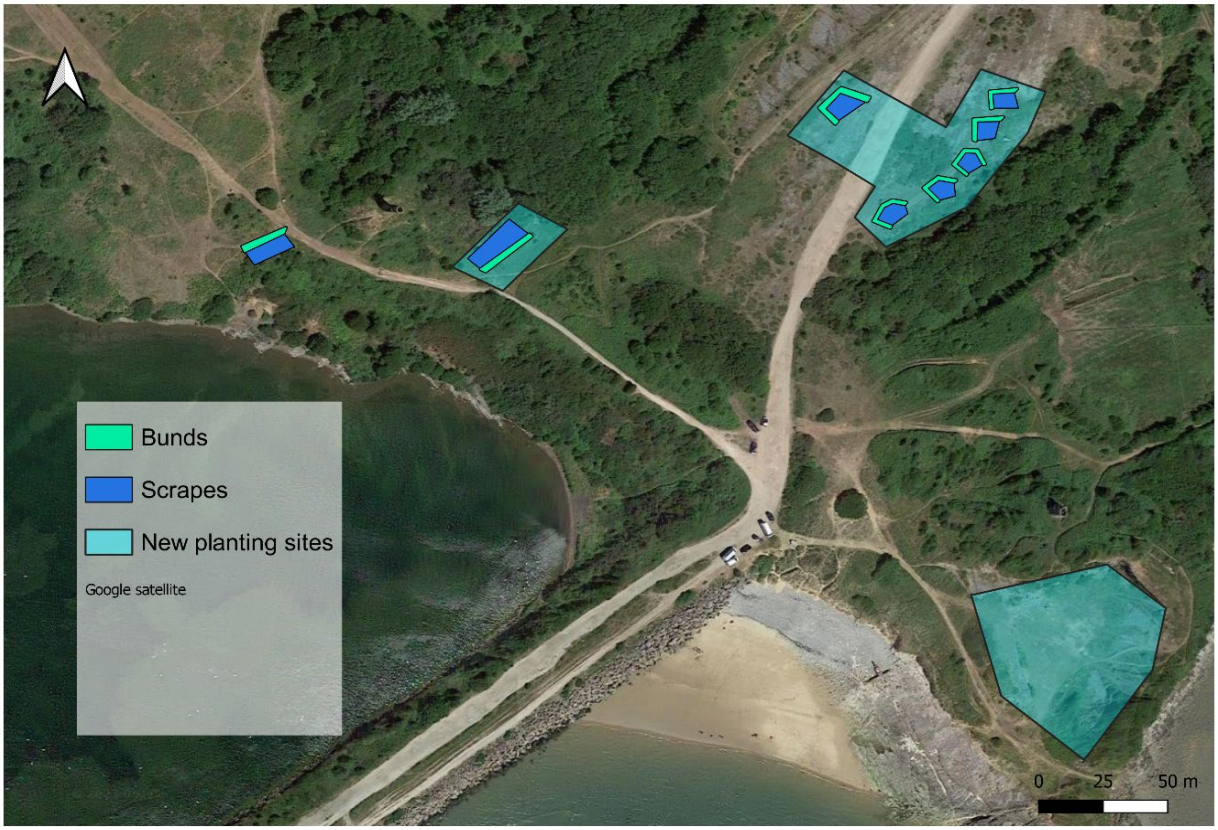


**Figure 7.5.** Map of habitat management work that took place at Hodbarrow Nature Reserve. Area close to old lighthouse (Site 1) SD182782


**Figure 7.6**. Map showing location of site 1 and 2 at Hodbarrow Nature Reserve

## 7.3 Mitigation works – Cavendish docks.

In 2021, we were made aware through butterfly conservation of the existence of a small blue colony on an area that was proposed for the immediate development of 650 houses. At the time, this development was being led by David Haughian from Cumbria County Council. We had meetings and site visits with the council and their ecology team to discuss mitigation of the risk to the small blue butterfly. Fortunately, the Council had planned for 'nature area' on site; this consisted of an area of land left free from development. Unfortunately, this was not where the small blue had colonised. The BOOM project therefore proposed that scrapes and bunds were created in the 'nature area', filled with limestone gravel (to dampen the impact of nutrient rich soil) and that kidney vetch was planted and sown into these areas with immediate effect. It was also advised by BOOM that they translocate the kidney vetch onsite to the nature area. This was completed by the council and the BOOM team and local volunteers then surveyed the site for small blue and for signs of eggs/larvae and translocated these to the

nature area. This work was completed by Andrew Thompson, the contractor for the previously called Cumbria County Council. All details of the work are shown in Figure 7.6.


**Figure 7.7** Map of habitat management and mitigation work at Cavendish Docks

## 7.4 Recommendations:

- Before completing any translocation, especially for habitat specialists, it is important to ensure the habitat is appropriate in terms of food availability and connectivity. It is also important to understand the donor population. The BOOM team recommends mark and recapture surveys to get the best estimate of population size. This will ensure you take enough specimens to improve chances of a successful translocation but not too many, which could result in damaging the donor population. The survey data will allow decisions to be made using the evidence that has been found.
- If conducting mark and recapture on the small blue butterfly, we would strongly recommend that butterfly nets with large holes are bought. This will allow the butterfly

to be marked through the net so that handling them is not necessary and reducing risk of damage.

- To comply with the assumptions of a mark and recapture survey, it is advised to work within a closed site (i.e. no butterflies are moving in and out) and also in a fairly small location to allow time to cover the whole site, maximising opportunities for recapture. Our site was too large and there were too many butterflies, meaning our recapture rate was small. This unfortunately gave us estimates with very high error.
- When planning any translocation, developing a good rapport with the local council and nearby development firms is advised. This allows access to particular sites and the chance to offer advice relating to conservation of their land. This is especially relevant for species like the small blue butterfly as they can often inhabit abandoned land which is often council owned.
- Always complete habitat management in winter to avoid breeding bird season.
- Kidney vetch plugs need a large amount of watering after being planted onsite. Although kidney vetch thrive in poor nutrient, bare ground, when planting plugs it is advised to plant in areas with an adequate amount of soil and not just bare slag/rock as this means the roots are more likely to take.

## 8. Translocation methodology

In May 2023, a group of BOOM, RSPB staff and volunteers met at the Barrow Slag Banks to collect adult small blue butterflies. The team focused on areas previously known to have a high density of small blue. Using a telescopic butterfly net the team captured 64 adult butterflies, attempting an equal ratio of both male and female. Upon capture, each butterfly was marked with a unique number using a sharpie pen (numbering system described in section 7.1). Each number was recorded with the time and date of capture along with the sex of each butterfly. These butterflies were then promptly placed into individual pots within a pre-iced cool box ready for transportation. They were then transported immediately to Hodbarrow Nature Reserve and released at the point indicated in the map below. This point is thought to be optimal small blue habitat with a high abundance of kidney vetch, flowering plants for nectaring and long grass for roosting.

The translocation was staggered across 2 days to allow for discrepancies in the weather. Extra care was taken to find adult females as males are thought to be more active and visible, therefore having a higher likelihood of being captured.

**Figure 8.1** Harvesting small blue butterflies on site at Barrow Slag Banks.

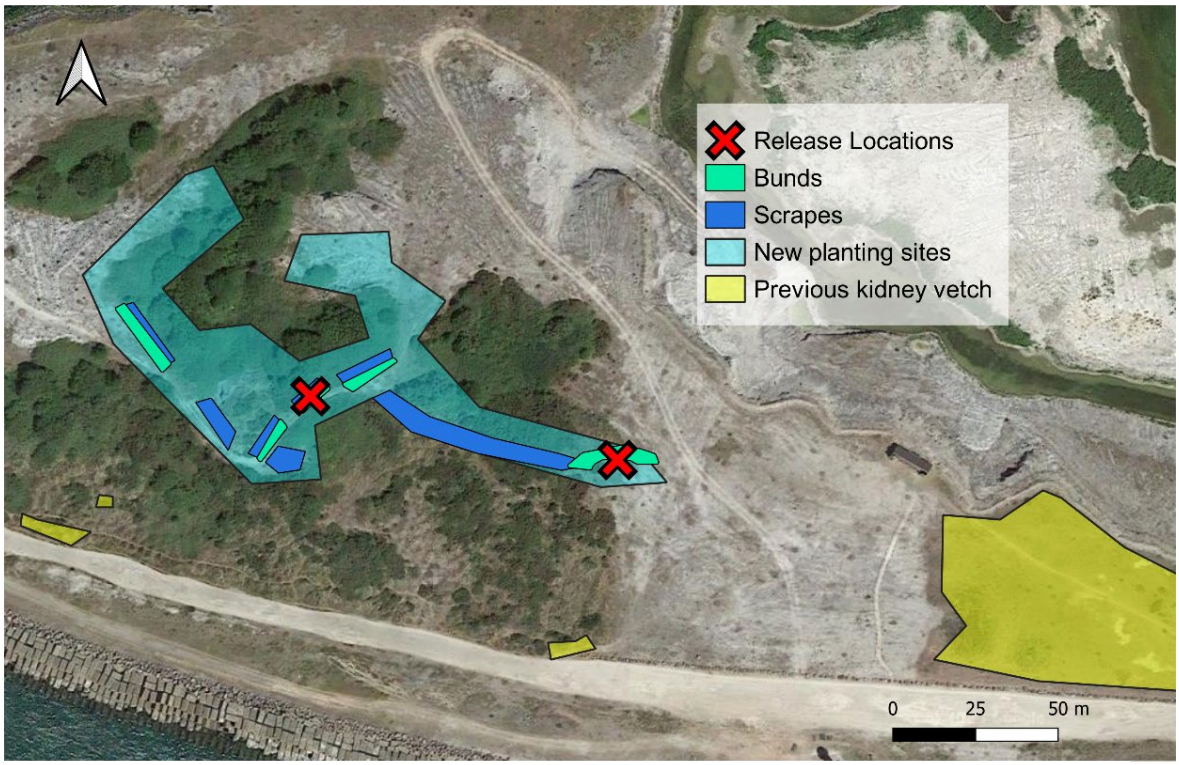


**Figure 8.2.** Map of release locations at Site 2 in Hodbarrow Nature Reserve

## 8.1 Recommendations

- Be sure to keep to time when catching butterflies, if like our sites, there is a good journey in between, don't leave your butterflies in the cool box any longer than necessary.
- It is also beneficial to plan release locations in advance to save time.
- It is not essential to mark butterflies on release; but it provides useful data on survival, dispersal and translocation success. Wwe found unmarked butterflies mating in August, making us aware there had been a successful second generation. We would not have been able to prove this if we had not marked the released individuals.

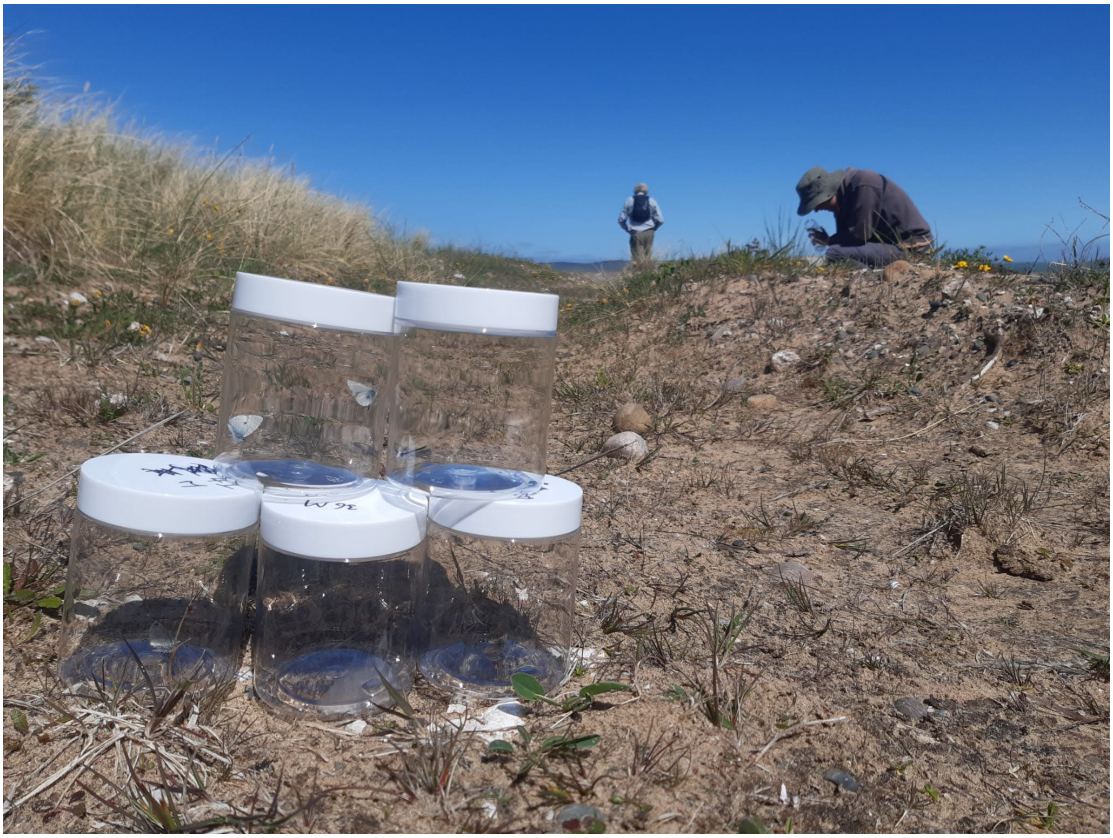

**Figure 8.3** small blue butterflies caught, marked, and ready to be put into the cool box

# 9. Monitoring methodology

## 9.1 Short term post reintroduction monitoring

Monitoring is an extremely important and integral part of any translocation programme. We therefore set in place a robust sequence of monitoring to help us understand key features of the newly reintroduced population such as survival, mortality, reproduction and dispersal.

Upon release of the small blue butterfly in May 2023, the release area was walked daily for 2 hours between 11.00 and 13.00 until the end of the flight period (about 2 weeks). Surveying was not limited to the release area but was conducted broadly across the site and into any neighbouring habitat areas to document occupancy and potential dispersal/colonisation.

If a small blue butterfly was found, the individual identification number should be recorded, along with a 10-figure grid reference of where the butterfly was found, date and time (See appendix 2). If an identification number was not visible, team members may use a net to recapture the individual and get an accurate ID. If small blue butterflies were seen elsewhere on site outside of the dedicated times and area then effort should be made to make a recording of this.

Key variables to record:
Time, weather, date, 10 fig GR, ID no., specific behaviour (including ant-larval interactions, use of specific floral resources, and any predation/mortality), reproduction evidence (i.e., mating, oviposition, presence of immature stages).
All participants were given a recording sheet, clipboard, pen, GPS and butterfly net.

## 9.2 Long term post reintroduction monitoring

Ideally, long term monitoring should take place annually after the initial release period for up to at *least* 5 years post release (preferably 10) (Dalrymple et al., 2012; Maschinski and Albrecht, 2017) .

Timed counts are used as a technique to estimate population abundance and should adhere to the following protocol. This will begin in May 2024 by the RSPB at Hodbarrow.

When:

- Make sure timed counts are in the peak flight period, this will be May and June for the small blue butterfly.

Time of Day:

- The survey should ideally take place between 10:45 and 15:45.
- Between 10:00 and 16:30 is allowable. Activity drops rapidly during late afternoons on warm days.

Weather:

- Warm, bright/sunny weather (13 - 17°C, at least 60% sunshine)
- Sunshine should be estimated to the nearest 10% of the time it was sunny while counting.
- Bright cloud casting a shadow is classed as sunny
- Temperature should be recorded in the shade using a portable thermometer.
- If there is no sunshine, the temperature must be about 17°C.
- No rain or strong winds (no more than five on the Beaufort scale, unless area is significantly sheltered).
- If the temperature is less than 17°C, be sure there is sufficient sun for butterfly activity.

Equipment:

- Recording sheet with clipboard and pen
- Portable thermometer
- Map of area
- Butterfly guide
- Anemometer (if no access to an anemometer, please use table opposite).
- GPS

**Table 9.1.** Table to aid estimating wind speed

| THE BEAUFORT SCALE: Code | MPH | Description | Specifications on land |
|---|---|---|---|
| 0 | 0-1 | Calm | Smoke rises vertically |
| 1 | 1-3 | Light air | Slight smoke drift |
| 2 | 4-7 | Light Breeze | Wind felt on face & leaves rustle |
| 3 | 8-12 | Gentle Breeze | Leaves & twigs in constant motion |
| 4 | 13-18 | Moderate Breeze | Raises dust and small branches move |
| 5 | 19-24 | Fresh Breeze | Small trees in leaf begin to sway |
| 6 | 25-31 | Strong Breeze | Large branches move & trees |

Personal equipment:

- Watch
- Camera if desired

Doing the survey:

1. Briefly walk the site to identify the extent of the flight area.
    - If adults are spread over a large area, it is better to identify sub-populations and survey them separately.
2. Count adults by walking the site, either in a series of parallel lines or in a zigzag path, covering the flight area as thoroughly and evenly as possible
    - It is important that the walk passes through areas of high and low adult density: if only the best patches are visited the analysis may over-estimate abundance
3. Recording should be made at a slow, steady pace. Count the number of butterflies seen in a fixed time (in minutes) sampling the whole flight area.
    - This usually takes between 5 and 120 minutes depending on the size of the colony area.
4. It is advised to limit the count area to a standard 5m either side and ahead of the surveying individual as they walk, to avoid possible over counting of the same individual, especially highly visible and active species on small sites.
    - It is inevitable that some butterflies may be counted more than once, this will be accounted for in analysis.

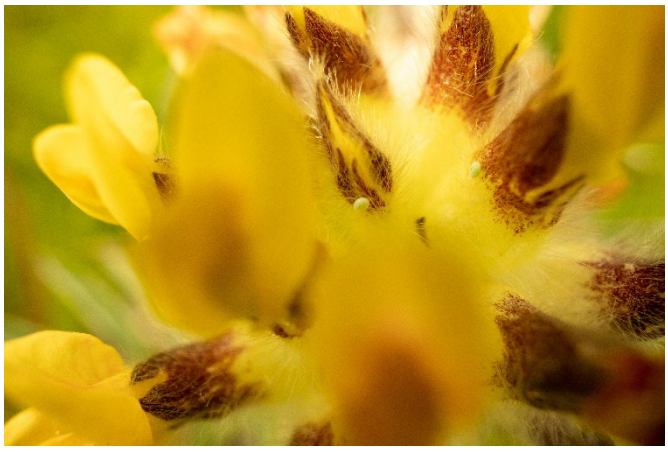

**Figure 9.1 & 9.2.** Small blue eggs nestled in kidney vetch flowers

# 10. Results

## 10.1 Mark and Recapture of released butterflies

Over the course of 2 days, the 22nd and 25th of May, we released 32 male and 32 female small blue butterflies into Hodbarrow Nature Reserve within 3 hours of capture at Barrow Slag Banks. Short term adult monitoring took place for 2 weeks after the first release. During monitoring a total of 72 recaptures were recorded, of which 27 (42.2%) were unique individuals. Thirty-seven butterflies (57.8%) were not recaptured during monitoring. A male butterfly with ID 14 had the highest recapture rate of 9 individual recaptures since release and 5 individuals were captured up to 11 days after their initial release. A higher number of males (72.9%) were recaptured in comparison to females (32.8%). Most recaptures were of individuals from release 1 (66.6%, 48 recaptures) compared with 23.6% (17 recaptures) from release 2. Even when compensating for the extra 2 days of surveying for butterflies in release 1, they had a higher daily capture rate compared with release 2 (release 1 = 5.3 butterflies a day, release 2 = 2.5 butterflies a day).

**Table 10.1**. Summary of results from the small blue translocation in May 2023.

| | Total | Percentage (%) |
|---|---|---|
| Total released | 64 | |
| Total unique individuals recaptured | 27 | 42.2% |
| Total recaptures | 72 | 112.5% |
| Total not recaptured | 37 | 57.8% |
| Total male | 46 | 71.9% |
| Total female | 21 | 32.8% |
| Max time elapsed since release | 11 days | |
| Highest recapture rate | 9 captures | |
| Release 1 daily capture rate | 5.3 butterflies | |
| Release 2 daily capture rate | 2.5 butterflies | |

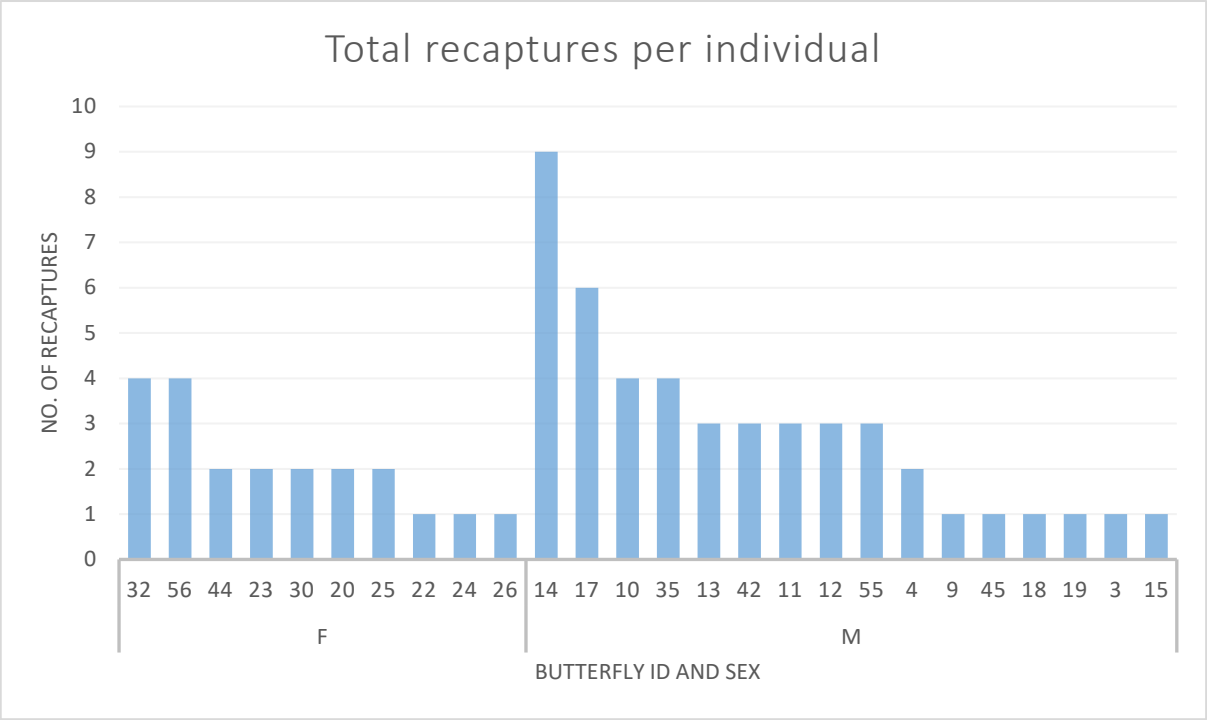


**Figure 10.1**. Bar chart showing total recaptures per individual butterfly and the comparison between male and female

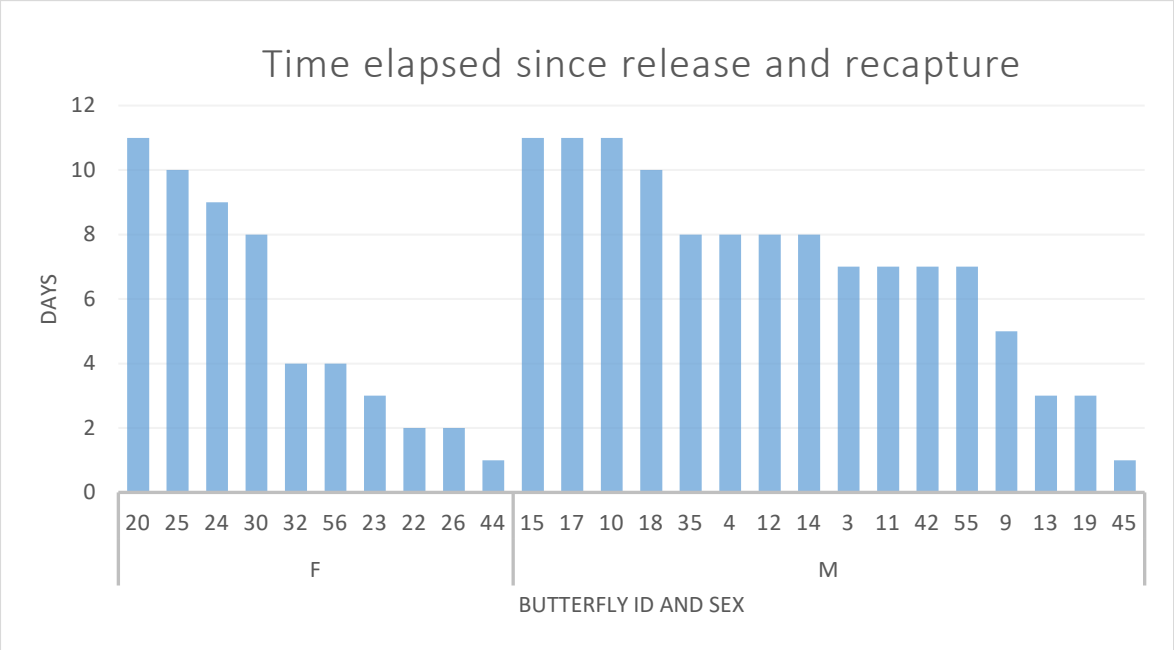


**Figure 10.2.** Bar chart showing the amount of time between release and recapture with comparison between male and female

## 10.2 Dispersal

On average male butterflies were found further from the initial release site than female butterflies (male =45.08m, female=34.43m). Butterflies from release day 1 dispersed smaller distances than those from release 2, on average release day 1 butterflies were found 38.9m away from release site and release 2 were found 49.7m. The butterfly which was found to have moved the furthest was a female butterfly, ID-30, who was found 216m from the initial release site.

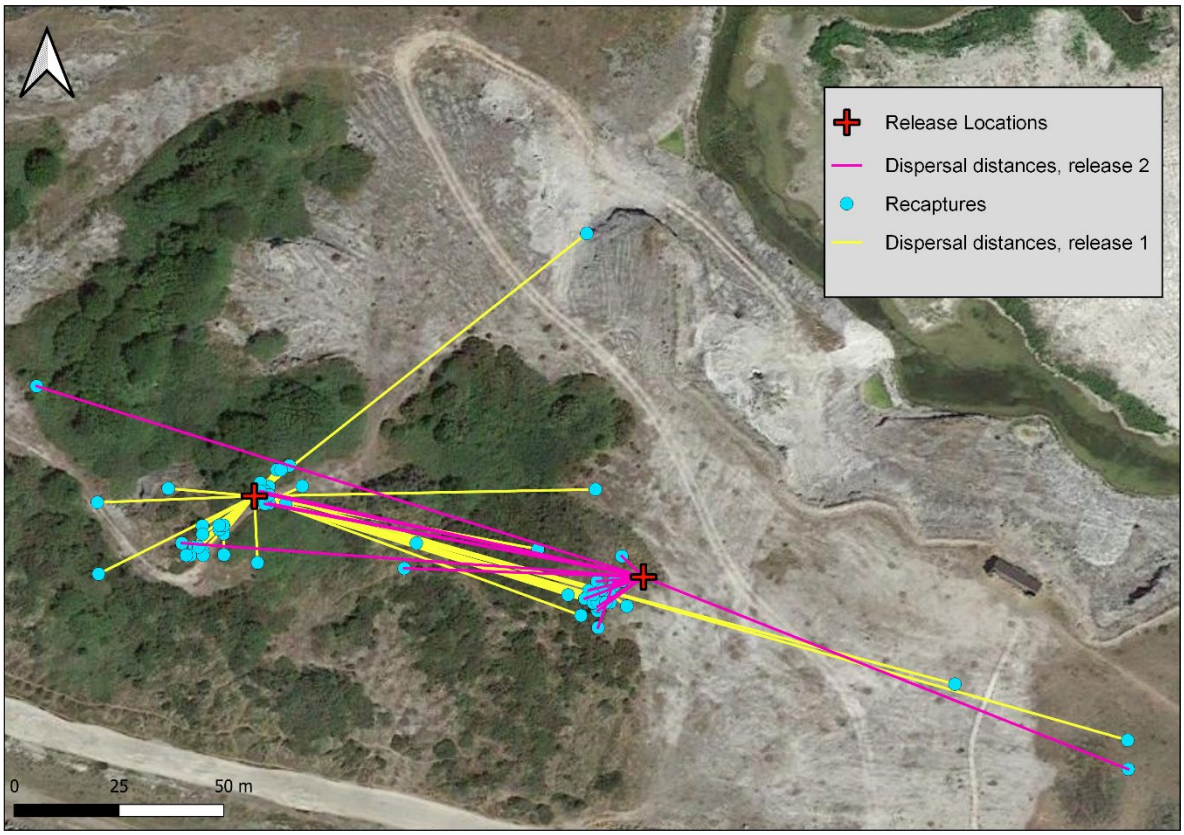


**Figure 10.3** Map showing the different dispersal patterns between release 1 and release 2 of release and recaptured small blue butterflies

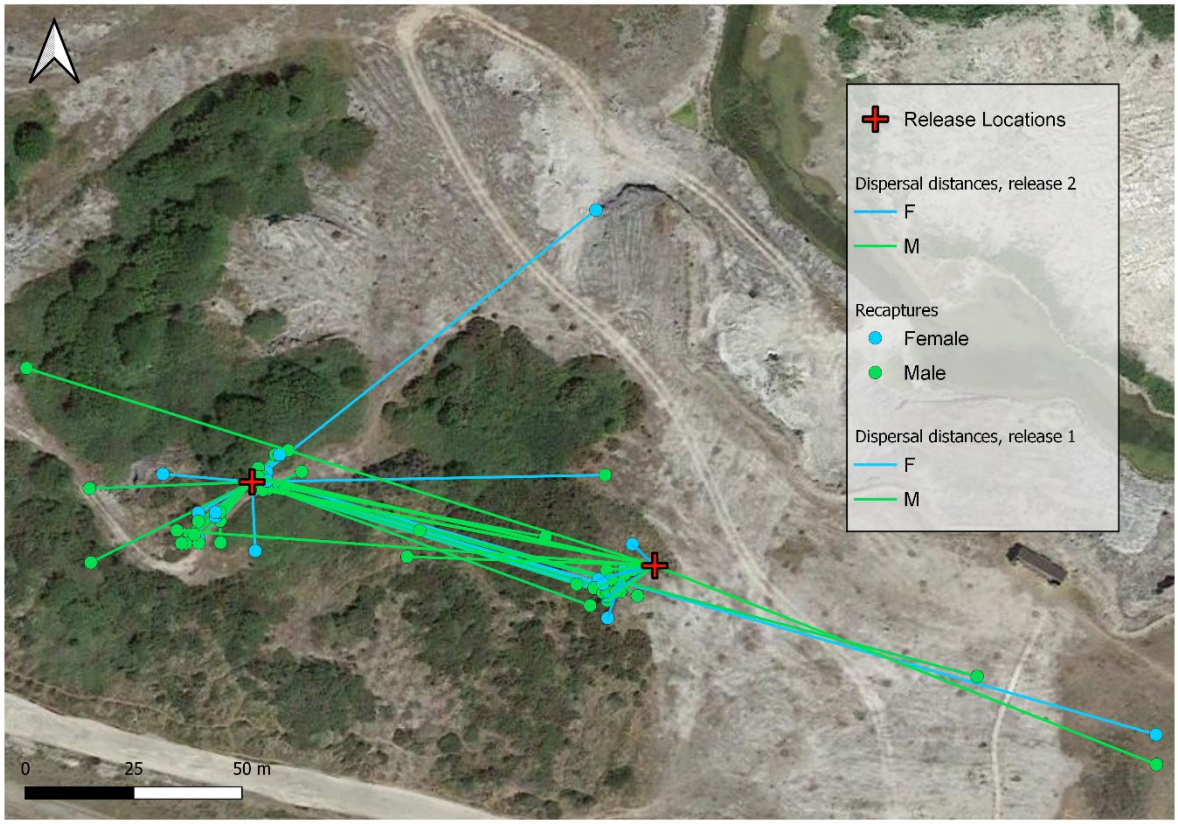


**Figure 10.4** Map showing the different dispersal patterns between male and female butterflies at release 1 and release 2.

## 10.3 Eggs and larvae monitoring

On the 14th of June 2023, approximately 3 weeks after the release, an egg and caterpillar count was conducted at Hodbarrow Nature Reserve with staff and volunteers. A total of 148 eggs were found in 73 different locations (i.e. 1m2 space of kidney vetch) (See Figure 10.5). No more than 2 eggs were found on a singular seed head and this only occurred 3 times. A high of 9 eggs was found within 1m square. This co-ordinate was written incorrectly and therefore we are unable to see where this was in reference to the release sites. The furthest known egg was found 222m away from the release sites. As it is impossible to know which egg related to which release site, distances were measured from a single location between the two. Twenty-eight larvae were found at 12 different locations within the release area. The furthest larvae was found 194.8m away from the release area.

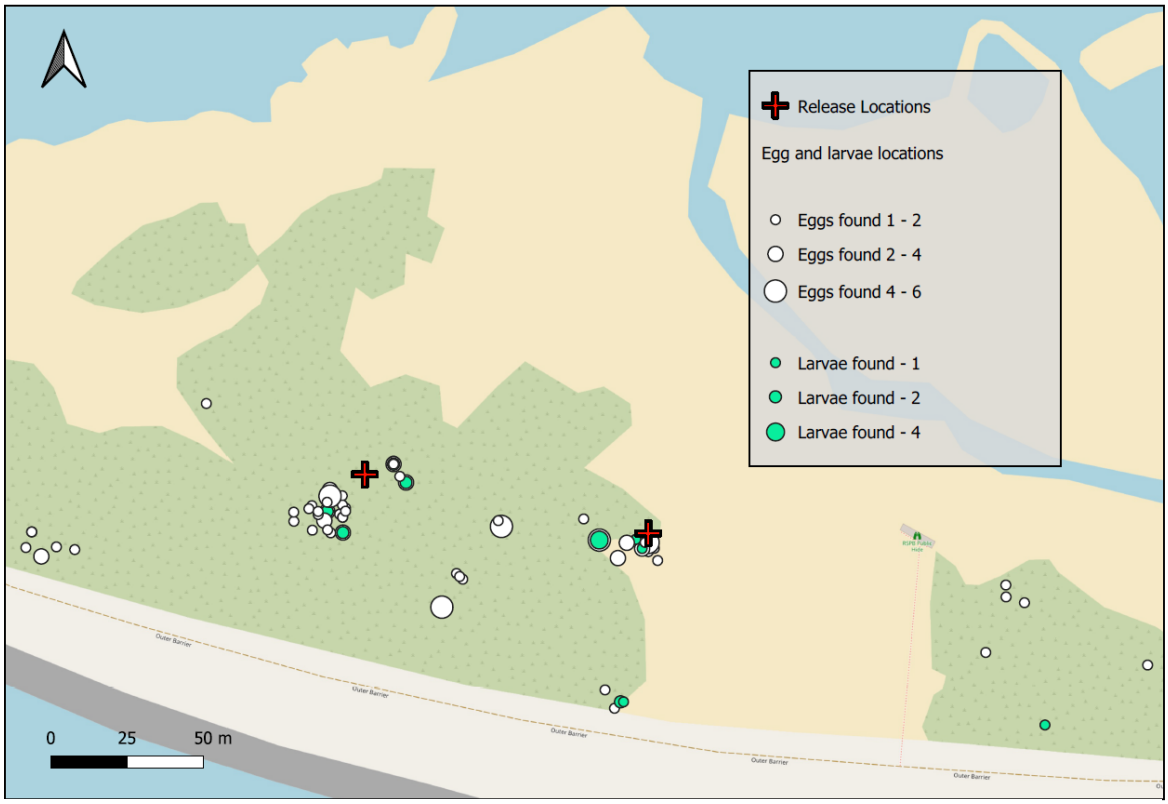


**Figure 10.5.** Map of egg and larvae survey results

# 11. Community Engagement

## 11.1 Community engagement and volunteering in Barrow and Millom

The conservation of the small blue butterfly at Barrow Slag Banks, and the eventual translocation of butterflies to RSPB Hodbarrow has been an interesting community engagement journey, marked by dedicated volunteers and a heart-warming connection to a local school. Despite facing challenges such as limited access to transportation and time constraints due to work commitments, and the isolated nature of the sites, the volunteering initiative linked to this species still managed to thrive due to dedication of a small group of individuals.

Our group of small blue butterfly volunteers, the RSPB Hodbarrow volunteers and residents of HMP Haverigg have completed a total of 80 volunteer days for the small blue since the project commenced in 2019. This is despite the initial stages of BOOM coinciding with the beginning of the Covid Pandemic. Within these 80 days the volunteers have assisted in: the planting of 3000 kidney vetch plugs, the removal of vast swathes of encroaching sea buckthorn, the mitigation of the small blue from a site proposed for development, 14 days of

mark and recapture surveys, 2 days of adult butterfly translocation and 6 days of post-release monitoring. On a few of these sessions we were also joined by Mind-in-Furness, a local mental health charity, giving them the opportunity to learn about the small blue and participate in a mark and recapture survey.

### 11.1.1 Recruitment challenges in Barrow

Recruiting volunteers from the immediate local area in Barrow did pose difficulty for the BOOM team. We ran an initial recruitment drive which included social media posts, writing articles and adverts in local volunteering magazines as well as attending the local volunteer recruitment fair. This initial recruitment gave us a list of 16 people who would be interested in volunteering on this project, but due to issues around transportation, work commitments, and accessibility to the site. Only three volunteers decided that they could commit to the small blue butterfly volunteering role (which included being trained on the mark and recapture process). The town's geographical location nestled on the Cumbrian coast means both public transport and driving to the site is costly and difficult (as well as having an environmental impact), so we only wanted to recruit volunteers from the local area. Additionally, there is not a large retired population in the area meaning volunteers are often confined to being able to work with us on very limited days.

## 11.3 Student placement and dissertation contribution

One of the notable volunteer contributions was the BOOM student placement, Sammy Haddock, who chose to centre her dissertation on the small blue butterfly. This academic endeavour not only contributed valuable research to the project, but also assisted with training other volunteers on the mark and recapture survey. Sammy's dissertation is titled 'Sex Biased Dispersal in the Small Blue Butterfly' for which she achieved a distinction.

## 11.4 Engaging Haverigg Primary School

One of the most heart-warming moments in the small blue butterfly translocation journey occurred when Haverigg Primary school joined the initiative. The partnership with the school not only brought an element of education but also instilled a sense of responsibility and care for the environment in young minds. During the translocation event at RSPB Hodbarrow nature reserve, each child had the opportunity to release a small blue butterfly into its suitable habitat.

The children were very enthusiastic about being involved, and the day tied into a wider arts project the school had worked with on BOOM.

## 11.5 General community engagement

In a creative effort to get the community engaged in the project in the depths of the pandemic, BOOM officers planned and implemented an online Butterfly Webinar, which centred on the two BOOM butterfly species. Alongside ourselves, we were lucky enough to have three expert speakers from Butterfly Conservation contribute to the event and we reached an audience of 79.

The small blue project has also been presented to natural history groups and societies on three different occasions and project officers have been invited to contribute to 2 prestigious conferences: The Butterfly Conservation Northern Symposium and the Wildlife on Brownfields conference in Glasgow which was part of Glasgow's Science Festival 2022.

The BOOM project has also lead 8 guided walks at the Barrow Slag Banks and Hodbarrow in relation to the small blue butterfly but also other rare flora and fauna that occupy the sites.

**Figure 11.1** Guided walk at Barrow Slag Banks

**Figure 11.2** Mark and recapture training session

**Figure 11.3** Guided walk at Barrow Slag Banks

# 12. Summary

In summary, despite some challenges to overcome, the small blue project has excelled in the past four years of BOOM, achieving beyond initial expectations. Notable achievements include:

- The translocation of 64 adult small blue butterflies to a new site within their current range
- Successful monitoring of the translocated population, showing initial success in the first year.

- Evidence of reproduction in the translocated population from egg counts and the emergence of a second generation of adults.
- Successful small blue habitat creation at a new site through scrapes and bunds
- Planting of 3000 kidney vetch plugs
- Successful monitoring of the donor site through mark and recapture surveys.
- Providing the opportunity for academic research and dissertations
- Working with the local council, volunteers and ecologists to mitigate damage to a newly found small blue population on a development site.
- Training local volunteers and students in mark and recapture techniques.
- The removal of large amounts of sea buckthorn that is threatening kidney vetch populations with the help from residents of HMP Haverigg.
- Engaging the community through guided walks, talks and conference presentations.
- Providing a rare opportunity for children from local primary schools to take part in a butterfly translocation.
- Establishing a legacy for the project by training individuals in butterfly monitoring methods to build future capacity.
- Establishing good lasting relationships with the project partners, the dedicated volunteers and the local community.

# 13. Conclusion

This document acts as evidence of the achievements of the project but also aims to provide guidance to those undertaking similar butterfly recovery and translocation initiatives and from this standpoint, there are a few things to discuss.

It is interesting to note that butterflies from release 1 had a higher recapture rate and yet dispersed a smaller distance from those in release 2. This could be related to the position of release site 2; it is slightly more exposed, depending on the weather conditions in the days post release the butterflies may have been dispersed by the wind before having the chance to find shelter within the sand dunes. It could also be a result of the male butterflies from release 1 already occupying the best nearby territories, challenging those from release 2 to venture further afield beyond the monitoring area. We also witnessed a higher recapture rate in males than females, which is a factor we were expecting (Auckland et al., 2004), as males occupy territories and will defend them valiantly (Asher et al., 2001).

Those intending to complete a similar project in the future may benefit from recording weather data in the day's post release, to increase the size of their monitoring area and to take extra care to catch female butterflies for translocation, as they are harder to find. It may also be beneficial to research male territory spaces and preferences, which is something we did not do, and use this to help indicate release site locations and size of monitoring area.

The small blue butterfly population at the Barrow Slag Banks is strong and thriving, this means that the site is considered a popular donor site for small blue translocations. In an attempt to understand any detrimental impacts this may have on the current population, the BOOM project conducted two seasons of mark and recapture surveys with the expectation that the results would give an accurate understanding of population size, therefore generating an appropriate number (10% of population (IUCN, 2013)) that could sustainably be removed for translocation, as well as understanding any fluctuations in population due to increased frequency of removals. Unfortunately, in both seasons, our results were considered inaccurate due to the high standard error. In order to minimise the standard error there needs to be a higher number of recaptures. In other words, there were too many small blue butterflies across a too large area for our team to recapture enough to balance the data. Although this was disappointing, actually, the large number of butterflies was enough evidence for us to proceed with the translocation and evidence from the donor site suggests the impact of removal was negligible, although this is likely to be clearer next season. The mark and recapture surveys at the Barrow Slag Banks, if slightly amended in terms of methodology to obtain more recaptures, would be a fantastic longitudinal ecological study, to understand the impact of removal for translocations on butterfly communities. This will be suggested to academics at the University of Cumbria to pursue with interested students.

It is difficult to be certain that this small blue translocation was a success before completing 10 years of post-translocation monitoring (at least), as this would be the desired minimum monitoring timescale if project funding were not a constraint (IUCN, 2013). However, from an end of project perspective, seeing the reproduction evidence, the second generation, the dispersal, the continued commitment from the RSPB and the satisfaction from the volunteers it would be difficult to *not* deem this project a success. The BOOM team are proud of what has been achieved and value the RSPB's dedication to progress the project into the future. Staff at RSPB Hodbarrow have been advised and trained in monitoring methodologies and the same will be offered to Sandscale Haws and North Walney Nature Reserve, this will really optimise understanding of a small blue metapopulation in south west Cumbria. Given the precarious nature of funding for projects such as BOOM, and the consistently short timescales (i.e. 4 years to research, deliver and monitor a reintroduction) it is invaluable and necessary

to obtain legacy of project partners to continue monitoring into the future. This will help us and similar future projects know and understand the successes and failures with the hope to improve the standards of future reintroductions.

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## Appendix 1

Survey sheet for mark and recapture surveys

| Date: | | | | Name: | | Start Time: | | End time: | |
|---|---|---|---|---|---|---|---|---|---|
| Pen colour: | | | | Weather: | | | | | |
| ID | M/F | Grid Ref | Plant and Height | Time | Recaptures time + grid ref + plant height | | | | Notes |
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## Appendix 2

Survey sheet for short term monitoring post release

| **I.D** | **Grid reference** | **Time** | **Date** | **Weather** | **Specific behaviour** (specific floral resources, and any predation/mortality, interaction with other species) | **Evidence of reproduction?** (mating, oviposition, presence of immature stages) |
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