Looking after

Spring Speedwell

Veronica verna

Ecology and Conservation Portfolio

BACK FROM THE BRINK

HERITAGE FUND

Plantlife

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At a glance

Common name: Spring Speedwell

Scientific name: *Veronica verna*

Habitat types: found in two types of habitat: cultivated fields with low nutrient status, and skeletal grass-heath

Soil type: calcareous or slightly acidic sandy soils

GB status: Endangered

Contents

Note that many of the sites mentioned in this report are privately owned and not publicly accessible without landowner permission.

Species description

Spring Speedwell is a small annual wild flower which, in the UK, is entirely confined to the Brecks of East Anglia. It generally grows to less than 5 cm in height and can often be much smaller, with some flowering plants less than 8 mm tall (Figure 1). A single stem can branch and generate a leafy tuft, but only when conditons are suitable for prolonged periods of growth. The leaves are oval to lanceolate and deeply lobed with sinuses (cuts between the lobes) reaching well over half way to the midrib on the upper leaves. There are 3 to 7 pointed lobes, with a broader and blunt central lobe which is markedly longer than the lateral lobes. The lateral lobes are narrower and usually more pointed. The upper part of the stem is covered in yellow-tipped glandular hairs which are visible with a x20 hand lens.

The tiny flowers (c. 3 mm across) are sunk deeply between the leaf-like bracts and have four petals which are fused to form a corolla ring which is very weakly attached; the slightest disturbance will cause the entire structure to drop off. The petals are bright sapphire blue with a white base. The rounded upper petal is the largest, with two slightly smaller lateral petals and a smaller, spoon-shaped lower petal. The flowers tend to open only in bright sunlight.

Spring Speedwell may be confused with other annual speedwells (Figure 2). Fingered Speedwell *Veronica triphyllos* is as rare as Spring Speedwell and also confined to the Brecks. It also has a bright blue flower and can grow alongside Spring Speedwell, but its leaf lobes are spoon-shaped and have individual midribs. Fingered Speedwell is also covered with glandular hairs but the glands are red. Breckland Speedwell *Veronica praecox* can also be found in the same places but has unlobed leaves with toothed edges. However, Spring Speedwell flowers several weeks later than both Breckland and Fingered Speedwells with little overlap. Wall Speedwell *Veronica arvensis* is much more common and widespread and has bluntly-toothed lobes on the upper leaves, with sinuses that reach less than halfway to the midrib. Its flowers are generally paler than Spring Speedwell, and may be pink or even white.

Lifecycle and ecology

Spring Speedwell is a short-lived annual, meaning it completes its life cycle within a year; usually within a few months. It generally germinates in late winter but can also germinate in the autumn after wet summers.

Figure 1: Spring Speedwell is a very small plant with bright blue flowers

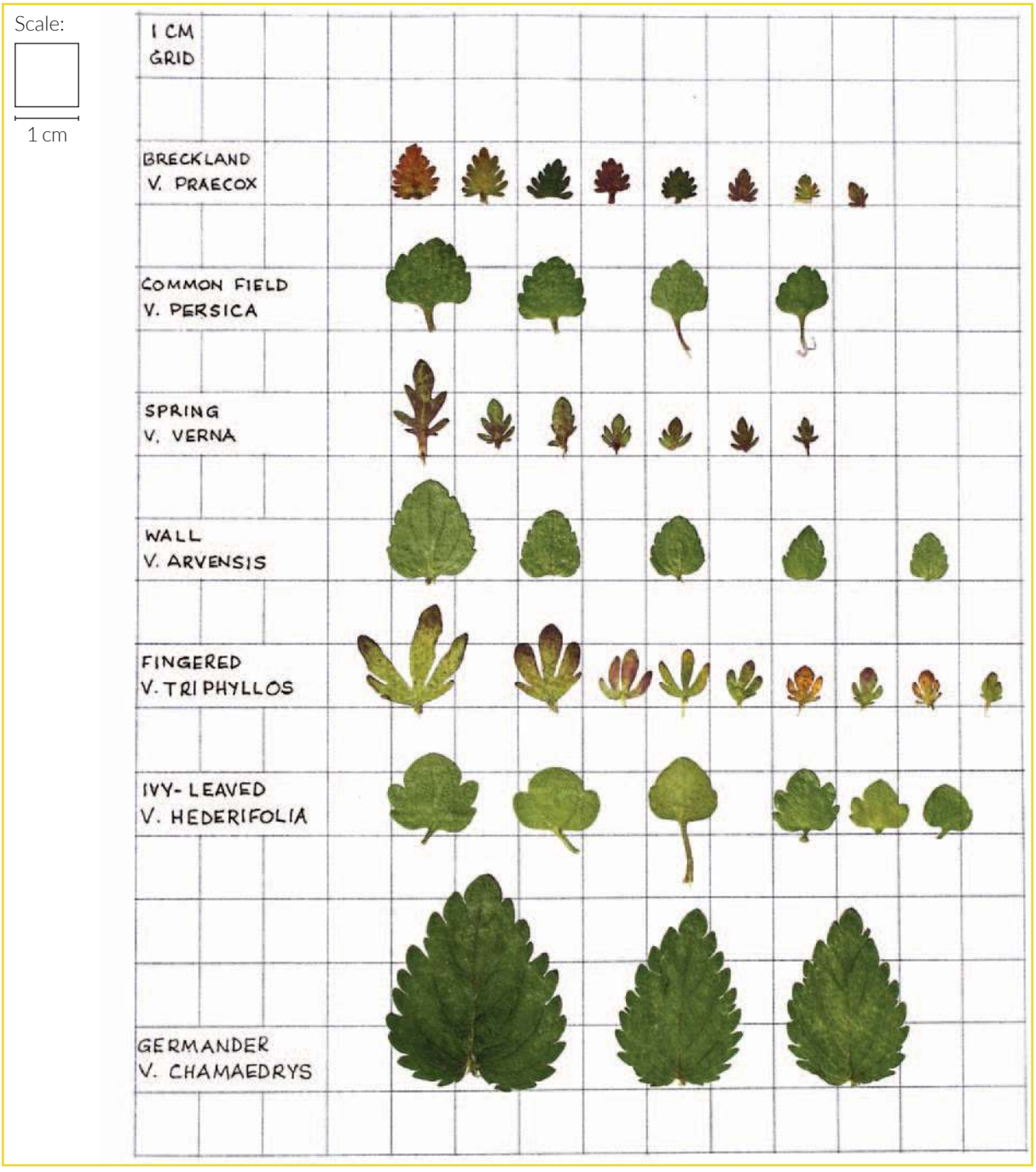

Figure 2: A photographic comparison of Spring Speedwell leaves alongside the leaves of various other species of speedwell which often occur in the same habitats © Norman Sills

Spring Speedwell has been noted as being "dead by May"[1], but its early flowering is not reliable for identification purposes. While there is seasonality in its life cycle, it is greatly affected by the weather and flowering plants found after April could still be Spring Speedwell; the plant can continue flowering in cool damp springs well into May and even June, although this is very unusual. Similarly, in warm damp winters, Spring Speedwell may be in flower as early as February.

The flowers are probably visited by small solitary bees, in common with other speedwells[2], but they may also self-pollinate like other annual speedwell species[3,4].

Spring Speedwell produces a kidney-shaped fruiting capsule that is broader than long and covered with glandular hairs, as is much of the upper part of the plant. The lifecycle can be over within a few weeks but in this time, particularly in early spring, they may be vulnerable to drought[5].

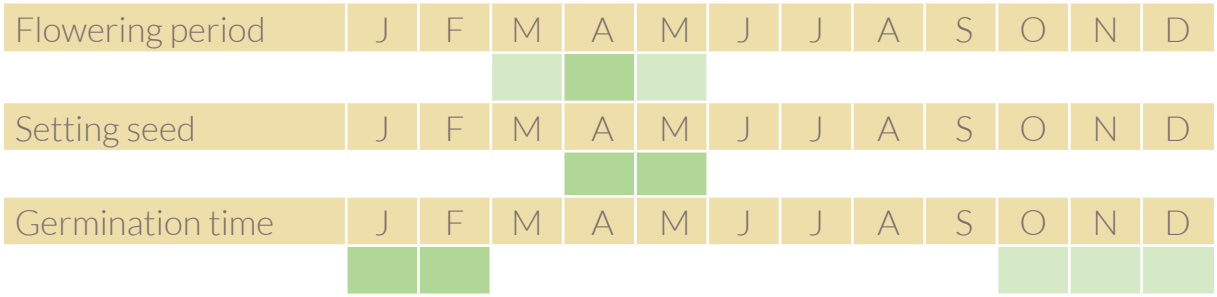

Figure 3: Flowering, seed-setting and germination periods for Spring Speedwell

The longevity of Spring Speedwell seed in the soil seed bank has not been established experimentally, although the seed is believed to be long-lived[6]. Under optimal ex situ storage conditions Spring Speedwell seeds are long-lived, and the two UK collections held at the Royal Botanic Gardens (RBG) Kew's Millennium Seed Bank have retained 100% viability after 36 years stored at 15% eRH (equilibrium relative humidity) and -20°C[7]. Spring Speedwell shows little, if any, dormancy. Germination tests show that it will readily germinate across a range of constant and alternating temperatures typical of spring and autumn in the UK. Germination begins quickly, with total germination after two weeks of incubation. No dormancy-breaking pre-treatments were applied during these tests, and neither warm nor cold stratification increased germination percentage or germination rate[7].

Habitat

Spring Speedwell is a specialist of the unusual drift geology of the Brecks – an area which is centred on a low point on a chalk escarpment that is continuous with the Chilterns on one side and, on the other side of the Wash, the Lincolnshire Wolds. It is found in two types of habitat: cultivated fields with low nutrient status, and skeletal grass-heath.

Although it is rare to find cultivated fields with low nutrient status, such conditions are common in the Brecks because of the extraordinary nutrient poverty of the soils themselves, allowing Spring Speedwell to persist in field corners and on the margins that escape treatment with fertilisers or herbicides. The advent of agri-environment schemes promoting the cultivation of field margins without subsequent dressing or cropping, has encouraged the creation of maintenance of such habitats and enabled some populations to flourish. Spring Speedwell populations have also increased where the farmer has actively improved the habitat and undertaken beneficial management, without the stimulus of an agri-environment scheme.

The more natural habitat for this plant is skeletal grass-heaths, so named for their lack of Heather *Calluna vulgaris* (Figure 4). The arid, sandy soils are very low in nutrients, creating a harsh environment for most plants and reducing competition. The open nature of this habitat is maintained through summer droughting and the activity of wild and domestic animals, especially European Rabbits *Oryctolagus cuniculus* that crop the vegetation and provide the necessary germination opportunities through the creation of bare areas of substrate.

Spring speedwell has an Ellenberg Reaction value ('R') of 5+ which assigns it a preference for soils which are moderately acid, so that it would be 'only occasionally found on very acid or on neutral to basic soils'[8]. This may be misleading because Spring Speedwell is associated with sandy habitats, many of which are considered to be acidic, but which, in the Brecks, are also variously calcareous. Therefore, an Ellenberg analysis of the Breck heaths assigns a low average 'R' to most of the vegetation which may misrepresent the local substrate pH. However, Spring Speedwell does tend to occur where there has been leaching (e.g. brows of hills, furrow edges, undisturbed skeletal soils) which will have available calcium reduced to some extent.

Figure 4: Spring Speedwell is a specialist of short, rabbit-grazed turf in the Brecks © Jo Jones

The unique geology of the Brecks

Glacial till was deposited in this area during the Anglian glaciation (which ended ~420,000 years ago).

This glacial till is composed largely of sand and pulverised chalk bulldozed up from the bed of the North Sea. The resulting till deposits are highly variable with a mixture varying from almost pure sand to almost pure chalk, and all shades in between. This material is very free-draining and has many of the micro-climatic characteristics of pure sand but tends to have a high pH. It shows extreme diurnal temperature fluctuation and tends to be very arid; when dry, it is highly mobile on the wind and can form dunes (and has done historically). A more unusual feature is that mixes with a high proportion of chalk can coagulate and form a material known locally as 'chalk putty' which is malleable and less freely draining. A return to aridity does however break it up and turn it to dust. In places where the substrate is stable, for instance over river valley gravels, the lime has been leached out, leaving almost pure sand and gravel with a scattering of flint fragments.

Box 1: A description of the geology of the Brecks, demonstrating why it supports Spring Speedwell populations

The plant is an indicator of ecologically important sites, either because they are intact grass-heaths; or because they are cultivated fields with very low nutrient status; or because the more acidic soils restrict the uptake of nutrients except by plants adapted to these conditions. In such circumstances, it can occur with a wide variety of other species of interest, including species of concern such as Fingered Speedwell *Veronica triphyllos* and other Breckland species. Many of these species have undergone significant declines and so the presence of Spring Speedwell may indicate the presence of a significant assemblage of species of interest.

Soil profile

It has only been possible to take a soil sample from one population of Spring Speedwell at a reintroduction site. There are so few extant and reintroduced populations for this species, that collecting samples of environmental variables is now severely limited. This may make it more difficult to identify the full range of potential reintroduction sites with soil characteristics that are suitable for Spring Speedwell.

The Spring Speedwell population at the reintroduction site is only present at one end of an arable margin. However, the entire strip is managed in a sympathetic manner and it is not understood why Spring Speedwell is so restricted across this area. Three soil samples have been analysed from the strip:

i. soil taken at the location with Spring Speedwell,
ii. soil taken halfway along the margin where Annual Knawel *Scleranthus annuus* and Corn Spurrey *Spergula arvensis* are present, and
iii. soil taken at the far end of the margin from the Spring Speedwell population where Fingered Speedwell *Veronica triphyllos* and Annual Knawel are present.

Soil pH

The soil pH at the Spring Speedwell population is neutral-acid with a pH of 6.2. The margin becomes more acidic along its length moving to pH 5.0 in the middle and 5.3 at the opposite end. As only soil at this one population has been sampled, it is not known if pH is a restrictive factor to the establishment of Spring Speedwell. It is also not known why Fingered Speedwell is not present at the same locations as Spring Speedwell, as the former species grows on acid, neutral and alkaline soils. It is possible that this could be because of variations in soil texture or organic content, or perhaps a difference in the ability of the two species to take up soil nutrients.

Soil texture

The soil texture at the Spring Speedwell population is sand (Figure 5). The two other soil samples taken from the margin were also sand, with very little difference in particle size. Sand has a high warming rate, becoming warmer earlier in the spring than other soil textures, which perhaps favours the early flowering Spring Speedwell. It also has low to very low available water and very rapid drainage which may restrict the development of other competing vegetation.

Proportion of bare ground

There is no information about the amount of bare ground present at the Spring Speedwell population.

However, the margin is autumn cultivated and it is expected that there would be a high proportion of unvegetated soil in April-May when Spring Speedwell is in flower. It is a widely held view in the botanical community that Spring Speedwell is intolerant of competition and is strongly associated with good availability of bare ground.

Soil nutrients

Spring Speedwell has been thought to grow on soils with low nutrients. However, the soil sample from the reintroduced site suggests otherwise.

Phosphorus was 39 ppm (Index 3.6). This is relatively high and the soil phosphorus falls along the margin to 34 ppm (Index 3.4) in the middle and 32 ppm (Index 3.2) at the end where Fingered Speedwell is present.

The potassium level at the Spring Speedwell population was lower than the rest of the margin, at 43 ppm (Index 0.7). Away from the area occupied by Spring Speedwell, the potassium levels were higher, with 67 ppm (Index 1.1) in the middle of the margin and 63 ppm (Index 1.0) at the far end.

Magnesium levels did not vary along the margin, with 26 ppm (Index 1) at both ends and 25 ppm (Index 0.9) in the middle.

Calcium was very low throughout the margin with 433 ppm at the Spring Speedwell population rising to 541 ppm in the middle and 445 ppm at the opposite end.

Texture triangle: Soil Survey of England Wales (UK)

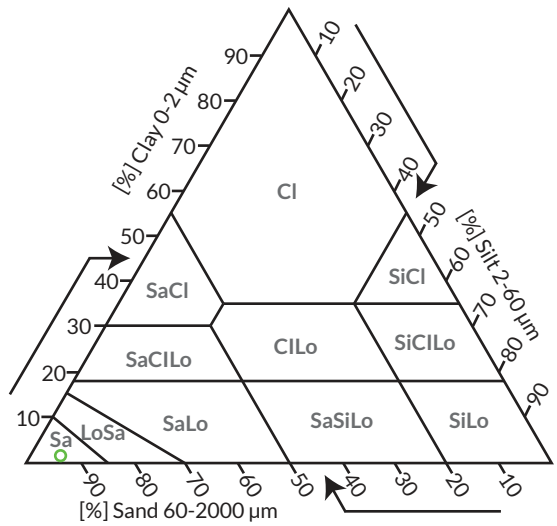

Figure 5: Soil triangle displaying the proportions of clay, silt and sand present at the Spring Speedwell population

As the soils are all acid-neutral this low level of calcium is unsurprising.

The acidic nature of the soil may restrict these macronutrients making it more difficult for plants to absorb them from the soil. In addition, the free drainage may mean that soil nutrients are leached which could also restrict vegetation growth. It is possible that Spring Speedwell is better adapted to acidic conditions and can survive in areas unsuitable for other plants. However, with just a single sample, it is not possible to draw any firm conclusions about the soil properties that Spring Speedwell favours and it may well be present on calcareous sandy soils. Further soil tests at the other populations of Spring Speedwell, including extant natural populations and successful reintroductions, would be very useful to describe the soil characteristics better.

It is important to remember however that these are very few samples and there are uncertainties about the collection methods. These results might also be anomalous because of nutrient deposition (as described below). Other factors, such as availability of nitrogen or the humus content of the soil, were not tested, and could be important.

Vegetation communities

Spring Speedwell is an early flowering species and requires some form of soil disturbance for germination and to reduce competition. Generally, there are very few other plants present in close proximity to Spring Speedwell. Small Cudweed *Logfia minima*, Rue-leaved Saxifrage *Saxifraga tridactylites*, Fingered Speedwell *Veronica triphyllos* and Mossy Stonecrop *Crassula tillaea* are all known to occur at the same location as the reintroduced population of Spring Speedwell at Weeting Arable Weed Reserve.

Within the grass-heath communities, Spring Speedwell can occur in both CG7b Sheep's Fescue *Festuca ovina* – Mouse-ear Hawkweed *Pilosella officinarum* – Wild Thyme *Thymus drucei*: moss *Cladonia* spp. subcommunity and U1c Sheep's Fescue Festuca ovina – Common Bent *Agrostis capillaris* – Sheep's Sorrel *Rumex acetosella*: Common Stork's-bill *Erodium circutarium* – Shepherd's Cress *Teesdalia nudicaulis* subcommunity. The arable sites vary between these communities, either with acid soils that have a calcareous influence, or vice versa. Although at opposite ends of the pH spectrum, the sub-communities are very similar to each other and, when highly skeletal, are barely discernible, the only distinction being the abundance of lime in the upper soil horizons, the calcareous soil and lime having been

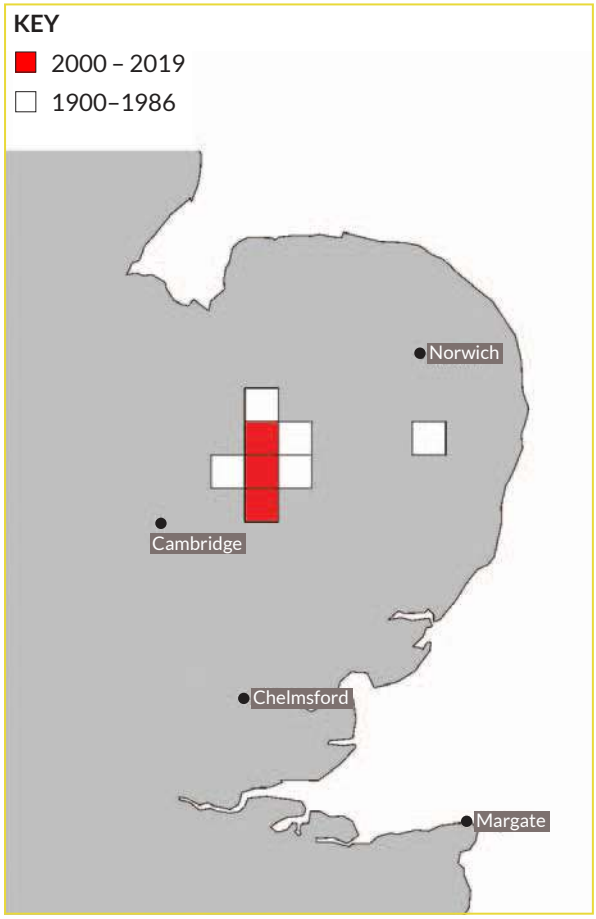

Figure 6: Spring Speedwell distribution in Britain and Ireland. The data used to create this map has been provided under licence from the Botanical Society of Britain and Ireland (BSBI) and accessed from the Society's online database.

leached out in the acid soil. Both types of soil must be very sandy and mobile to support Spring Speedwell.

Distribution

Spring Speedwell is entirely confined to the Brecks of Norfolk and Suffolk (Figure 6). There is one 1914 native record from the Waveney Valley in East Norfolk, and a few further flung places where the plant is believed to have been introduced, but otherwise all records are from vice-counties 28 West Norfolk and 26 West Suffolk. Even here, the plant is rare, and now only known from a handful of sites. Other populations in East Anglia and introduced populations in Devon appear to have been lost.

In recent decades, populations have dwindled (Figure 7). The number of known sites has fluctuated with an average of about 15 sites (+/- 5) known in any one decade as new sites have been discovered while, at the same time, previously known sites have been lost. In some decades, the number of new sites has exceeded those lost, and vice versa. However, no new sites have been discovered in the last 20 years and the plant has been lost from 13 sites during this time.

There remains considerable mystery as to why some populations have declined so strongly despite apparently optimal conditions; however, nitrogen deposition could be a factor (see *Areas of further research*). Spring Speedwell has only ever been known from 52 sites in the UK, only one of those being outside the Brecks and from which it was recorded once in 1914. The species has disappeared from all but three (94%) of its native sites, two of those losses being within the period 2010-2020. This is an alarming decline, with an average loss of 3.5 sites per decade.

The species is widely scattered across continental Europe, western Asia and Morocco[6].

Reasons for decline

The decline in most Spring Speedwell populations can be attributed to several different causes that have changed over time and which act together.

The early losses can be largely attributed to the advent of forestry in the early 20th century. The extensive afforestation of large parts of the Brecks rendered much of the landscape unsuitable, but even so, the historic landscape still retained many large, open grass-heaths and warrens suitable for the plant.

Farming in the Brecks was traditionally a subsistence activity because of the severe poverty and poor water

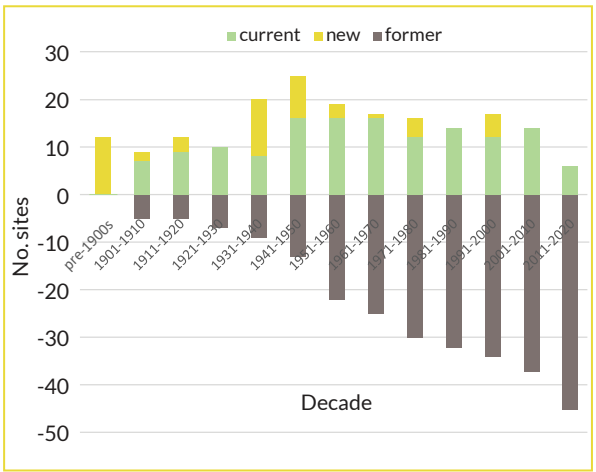

Figure 7: The number of extant and former sites for Spring Speedwell, over the last 120 years, by decade. The number of occupied sites has fluctuated but has shown a decline over the last 70 years, with current sites far outnumbered by sites where the plant is known to have been lost.

retentiveness of the soils. The widespread application of fertilisers and herbicides, coupled with irrigation, has significantly raised the yield potential of Breckland farms and, in so doing, has resulted in sites being lost as the habitat becomes unsuitable; Spring Speedwell is outcompeted in the presence of taller and coarser vegetation comprised of species that can survive in these agriculturally improved conditions.

The Brecks is one of the worst affected areas in the UK for atmospheric nutrient deposition. This phenomenon raises the productivity of even the most impoverished soils and stimulates succession in the vegetation. On the grass-heaths, it leads to the development of a denser sward and the build-up of an organic topsoil, which itself reduces the windblown soil which sustains areas of open sandy habitat favoured by Spring Speedwell. The development of topsoil accelerates ecological succession with rapid loss of open ground conditions to a closed grass sward and eventually scrub woodland.

Figure 8: A 'large' and vigorous Spring Speedwell growing in the midst of a rabbit warren with a rabbit dropping for size comparison © Tim Pankhurst/Plantlife

The decline of the European Rabbit *Oryctolagus cuniculus* is also a factor that may have had a bearing on Spring Speedwell (Figure 8). Although initially introduced to the UK, European Rabbits formed an integral part of the Breck ecosystem following the establishment of managed warrens. On the extensive grass-heaths and warrens of the Brecks, European Rabbits are now a major ecological driver. Their very close grazing and widespread disturbance of the soil surface are important processes that control and reverse vegetational succession and generate habitats suitable for the germination of low-growing annuals, amongst other taxa. A healthy rabbit population is considered essential for the retention of ephemeral Breck annuals dependent on periodically disturbed soils[9].

> Spring Speedwell is outcompeted in the presence of taller and coarser vegetation

European Rabbits have suffered substantial decline in the last 65 years, the main cause being a succession of diseases. Myxomatosis remains at large in the population but in more recent times Rabbit Haemorrhagic Disease (RHD) has become a major cause of death, first with RHD-1 and now with a new strain RHD-2 spreading through the population. Rabbits have been lost from many important sites in the Brecks which formerly supported very large populations. There has been a corresponding decline in the flora of these sites, with the vegetation ceasing to be skeletal and now forming a dense mat of grasses and litter, with little room for small annuals. The site management reaction to this is to apply sheep-grazing but, although this suppresses the growth of the grasses, it generates a tight sward unsuitable for small annuals that require open, disturbed ground.

While the proliferation of Spring Speedwell at some arable sites shows that the plant is not completely reliant upon them, an investigation of the relationship between Spring Speedwell and the presence and prevalence of European Rabbits may be useful particularly for the grass-heaths. However, at some sites, where the decline and loss of Spring Speedwell follows the decline in rabbit numbers, there is still plenty of disturbed, open ground and the vegetation structure appears suitable for the species. It is not understood why Spring Speedwell has disappeared from these sites, but the data suggest that rabbits are key to understanding the issue. Spring Speedwell seeds are capable of surviving ingestion by a range of mammals, with germination recorded from the dung of sheep, fallow deer and red deer[4]. Given that the species can be abundant on rabbit warrens, it is likely that they are eaten by rabbits and the seeds may be deposited in their dry droppings aiding the spread of populations. Germination might be stimulated by the digestive process, or deposition in droppings might confer some competitive advantage, as the sites are so nutrient poor. There has been speculation that the survival of Spring Speedwell may relate to the plants' unpalatability to grazing animals, a suggestion which is supported by their relatively large populations on active warrens[10].

GB status and rarity

Spring Speedwell is classified as Endangered' on the Vascular Plant Red Data Lists for both Great Britain[11] and England[12]. It is very rare and currently known from only four sites across two 10 km squares (hectads) in the UK.

Protection under the law

Spring Speedwell is a Section 41 species of conservation concern under the 2006 Natural Environment and Rural Communities (NERC) act. It has no statutory conservation protection, except where its habitat is a notified feature within a Site of Special Scientific Interest (SSSI).

Cultural connections

Carl Linnaeus chose the genus name *Veronica* based on the pre-existing common use of the name in many other European languages for plants in this group; the name of this genus has been around in English as early as 1572. The name probably reflects a connection with Saint Veronica, whose Latin name is derived from Greek, Berenice, which means 'bearer of victory'.

Some of the species in the genus *Veronica* are edible and nutritious and have been reported to have a similar flavour to watercress.

In Ireland, some species of the genus were sown into clothes as a charm to protect against accidents. In the UK, folklore surrounding speedwells included superstitions that if children picked the flowers, some misfortune would befall their parents. Specifically, in Yorkshire, if you pick a Veronica your mother's eyes will drop out!

Survey method

Monitoring is an important means of tracking long-term changes in rare plant populations in response to management. In theory, this can be done by counting the number of plant spikes each year but for two factors:

- Spring Speedwell can be very tiny and difficult to see, particularly on low-nutrient heath sites; and
- when numbers are very high, an estimation technique is necessary.

Plants should be recorded as individuals. A count is undertaken if numbers are low enough and for larger populations, the number of individuals is estimated within the occupied area. See the *Appendix* for more information about how to estimate the area of occupancy and a recording form.

Habitat management

There are several factors to consider when managing habitat for Spring Speedwell. Providing opportunities for Spring Speedwell to grow, flower and set seed means creating and maintaining bare chalky sands. Plants are very vulnerable to competition from other vegetation and need to be able to exploit open germination conditions when and where they occur. Seeds need to be in contact with the soil to germinate. Disturbance by agricultural machinery (e.g. ploughing, cultivation), passing vehicles, animals' hooves and rabbits are all known to generate conditions that spring speedwell may exploit.

The soil needs to be maintained at a low nutrient status. While Spring Speedwell may persist in a moderately high-nutrient system where competition from other plants is strongly suppressed, it is essentially a plant of ultra-low nutrient conditions.

> Spring Speedwell is a very rare species and is currently known from only four sites across the UK

Consideration should be given to promoting persistence and spread to new areas. Seeds generally fall close to the parent plant but could be dispersed by wind like a grain of sand. It is not known whether this actually happens, but the seeds are of a size and weight that makes this possible. Vegetational succession stabilises the soil surface and interferes with such dispersal. Dispersal may also take place in the guts of herbivores, including rabbits.

Arable farmland is a narrow habitat type, particularly with the additional specific conditions for Spring Speedwell that the soil must also be sandy – and perhaps somewhat calcareous – and have a low-nutrient status. Such places are more or less confined to the Brecks of Norfolk and Suffolk. The requirement for low nutrient status in particular makes such fields unlikely to occur anywhere in an intensively farmed landscape and management of suitable sites is generally, but not always, supported by an agri-environment scheme which compensates the farmer for the loss of yield. Ideal management on arable land involves annual cultivation in autumn, (between October and early December) with no more than a light top-dressing of manure. Spring Speedwell will grow within a crop, such as an autumn

Recording Spring Speedwell

The Breckland Flora Group has a specific method for recording the plant populations that are monitored. This is because many of the plants are hard to find and need care to monitor their populations accurately and consistently.

Monitoring small numbers

The timing of growth of this species varies according to the warmth or otherwise of the winter and spring, so it is often necessary to visit a site several times to check whether it is the best time to count plants: ideally this is when most are flowering and some seeding.

Spring Speedwell is a small plant so 'getting your eye in' is important in order to spot individuals. Searching should, initially, be limited to the most likely areas of suitable habitat in known locations. When a possible plant is located, a careful examination of the leaf structure is needed to confirm the identification because Spring Speedwell can easily be confused with several other species of speedwell with which it often grows.

Each plant should be marked with a small survey flag which can be homemade using barbecue skewers, with some brightly coloured insulating tape on top, though specialist survey flags can also be bought.

Once the first plant has been marked with a flag, the surveyor should search outwards in a spiral from this plant to locate more individuals and these should also be marked with a flag. All suitable areas should be checked and grid references for sub-populations recorded. Each flag can then be counted to make an exact population count.

Monitoring large numbers

When monitoring a large population with thousands of plants, it is best to use a randomly selected quadrat count across the area to estimate the number of plants. Once plants have been found, carefully place a 1 m square quadrat frame onto part of the population and then count all the plants inside the quadrat while on hands and knees (Figure 9). Spring Speedwell is often present in flinty soils, so having a pad to kneel on is helpful! Where there are lots of plants within the frame, use a marker (such as a barbecue skewer) for each plant to avoid double counting. If there is dense vegetation, it is easy for the plants to be hidden and it can help to look at the quadrat area from different directions.

Record the count and then mark the middle of the quadrat area with a survey flag to mark the area as 'done'. This is useful when counting over a large area because the spread of these flags gives a clearer indication of coverage. Use a running average so as to know when enough quadrats have been counted to achieve a reliable estimate of numbers of Spring Speedwell present.

Figure 9: Spring Speedwell is very small, making accurate population surveys a challenging task but using red flags to mark out the plants is a useful technique © Jo Jones

sown cereal or within an un-cropped cultivated area or plot. When such conditions are maintained for several years, very large populations of Spring Speedwell may be attained.

On heathland sites, for a sustainable long-term future, it is essential to maintain rabbit populations. Where this proves impossible, grazing with sheep (and with cattle if appropriate) may be applied to suppress competitive grasses, but soil disturbance is also advised, for example by ploughing, cultivating or rotovation on a short-term rotational basis. It is important to do this before any depth of topsoil has accumulated as otherwise there is a sudden release of nutrients which favours competitive weeds; they then out-compete any Spring Speedwell that may germinate. Extensive studies have shown that the great majority of the Brecks' specialist plants and animals benefit from such works, so there are knock-on

Population changes in response to management at Ickingham

Cessation in cultivation is known to result in an immediate decline in numbers.

The population of Spring Speedwell at Avenue Farm, Icklingham, was recorded at c. 50,000 plants the year after restorative ploughing but without any subsequent cultivation, numbers dropped by 50% the following year and a further 40% one year later. Physical abrasion during the cultivation process may stimulate germination in the seeds.

benefits to disturbing the land[9,10]. There is also some circumstantial evidence that winter and early spring sheep grazing may suppress Spring Speedwell and this should therefore be avoided where possible.

Spring Speedwell is believed to be long-lived in the soil seed bank and may return with the reinstatement of management management that provides enough germination and establishment niches. However, such an event has never actually been observed, so if the species has not been recorded recently and has failed to return despite favourable management, reintroduction is likely to be needed.

Reintroduction

If seeds are kept in suitable conditions (see Storing Wild Flower Seed guidance in *Further reading*), sowing should be undertaken in the summer from July onwards to mimic natural seed dispersal. However, it may be difficult to prepare sites early in the year and maintain an open area, in which case site preparation and sowing could take place in the autumn to enable seed to germinate almost immediately.

The generally recommended rate for species with seed like Spring Speedwell is 100 seeds per m^2 [13]. Higher seed rates could be used for Spring Speedwell as the small seed and seedlings are susceptible to disturbance and herbivory. Seed should be sown onto bare, recently disturbed ground. The seed is intolerant of shade at this point in the plant's lifecycle[7]. There is very little information about the site preparation, sowing rate and method used to broadcast the seed at the two trial reintroductions undertaken at Weeting Heath and Cherry Hill & the Gallops. Both reintroductions were initially successful, but only one has persisted for any length of time. Thus, the reintroduction method suggested below is simply a current recommendation; there may be other unknown factors affecting the success or failure of a reintroduction.

As the complex soil requirements for Spring Speedwell are not fully understood and because the species can reproduce quickly under suitable conditions,

Activity	Timing (month)
Summer-autumn cultivation and sowing	
Prepare the seed bed to create a fine tilth e.g. light cultivation or disking.	June onwards and before October.
Mark out the corners of the plot(s).	June onwards and before October.
Hand sow seed combining the seed with lime-free silver sand (see Broadcast sowing method in *Further reading*).	June onwards and before October.
Roll the sown area to push the seeds onto the soil surface to increase germination.	June onwards and before October.
Avoid using fertilisers.	Throughout.
Survey and ongoing management	
Adult/flowering plant survey.	April.
Continued cultivation and/or soil disturbance of the reintroduction plot(s) in the autumn.	September-October and ongoing if the reintroduction is successful.
Annual adult/flowering plant survey.	April and ongoing to monitor the population.

Table 1: Reintroduction plan based on summer-autumn sowing

broadcasting a low density of seed widely over a greater variety of sites may be preferable to concentrating seed in smaller areas at fewer, traditionally 'optimal' locations. It is possible that some sites which may initially appear suboptimal may return positive germination results and could act to create a more resilient regional population.

1 g of Spring Speedwell seed contains approximately 8,333 individual seeds[7].

Areas for further research

Seed longevity

Given the high conservation value of Spring Speedwell and the importance of the soil seed bank in the recovery and persistence of annual plant populations, it would be useful to conduct some longevity or seed aging experiments on this species.

Soil nutrient composition

There is still uncertainty about the soil requirements of Spring Speedwell, with some populations thriving while others have declined and disappeared despite apparently identical conditions. It seems possible that the cause of these differing fortunes lies within the soil nutrient composition. Further soil testing is needed at current and former sites to gain a clearer understanding of the soil nutrient preferences of Spring Speedwell, as only one site could be tested during the development of this document. Elucidating the soil concentrations of nitrogen and organic matter (not tested here) may be particularly informative which could help to guide future conservation efforts for the species.

Association with rabbits

While Spring Speedwell occurs on arable sites with no significant rabbit activity, its fate on skeletal heaths suggests that there may be an association with rabbit ecology. Population decline and disappearances of the plant are in keeping with the Brecks-wide collapse of rabbit populations and the one good heathland population is on a site which still has a good rabbit population. However, the role of rabbits would appear to be more than mere successional arrest and the creation of bare ground. The relationship with rabbits needs to be illuminated further.

Reintroduction of Spring Speedwell at Weeting Heath

Spring Speedwell was introduced at the Arable Weed Reserve in Weeting, Norfolk in 1972.

Numbers slowly increased to a few thousand in the early noughties but have subsequently expanded exponentially, with 204,000 estimated in 2019 (Figure 10). The population is cultivated annually and sown with an old rye variety which has tall stems and requires a sparser than usual sowing rate. Spraying and manuring are kept to a minimum. This site is now the largest in the country by some margin.

Cherry Hill and the Gallops, Tuddenham is part of a larger SSSI which includes the cultivated headlands of arable fields. Spring Speedwell was known from this location until 1947. The first attempt to reintroduce it was made in 1967 and this was done with seed, but no record was kept of the sowing rate or quantity sown. A peak of 37 plants were seen following the reintroduction, but the population then declined sufficiently to warrant a reinforcement in 1973. Again, there is no record of the sowing method, sowing rate or quantity of seed used for this reinforcement. In 1976, the peak population was recorded of c. 2,777 plants, which was followed by a steady decline in population levels with the last record being in 1999. It is unclear why this reintroduction was not successful in the long term, but it might be due to breaks in the annual cultivation cycle.

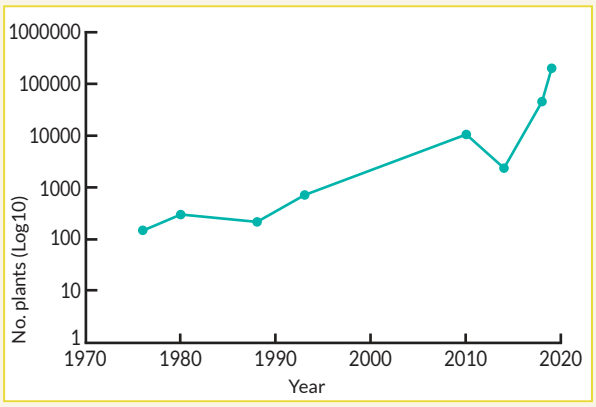

Figure 10: Changes in the Spring Speedwell population at Weeting Arable Weed Reserve. This has been gradually increasing since the 1970s, with a rapid increase in recent years.

Appendix A

How to undertake a survey by identifying the area of occupancy

At the site

Locate the central point, record this grid reference and mark with a cane. Then, systematically look all around the central point for the outer limits of the plant's population, which could be marked with further canes. This gives you an idea of the extent of the area with plants before starting to record. Consult records/maps from previous years when provided and search carefully in areas of suitable habitat for additional populations.

Area of Occupancy

The method asks you to estimate the Area of Occupancy (AOO), which is the area of ground within which a population lies.

To estimate the Area of Occupancy

Decide the boundaries within which the species lies; a rectangle is easiest. Make the smallest rectangle that includes all of the plants. Placing a marker in each corner of the rectangle may help, particularly across a large area or if there are a number of separate areas to measure. To obtain the area, pace (or measure if you prefer) the sides of the rectangle. If there are separate populations of a species on your site: calculate the Area of Occupancy for each population, then add these numbers together to obtain a total Area for the site (Figure 10). If the population is scattered across the whole of the site, the whole of your site may be the area of occupancy.

Using randomly selected sample quadrats

Note: the size of the sample quadrat affects the efficacy of sampling different species. The methods below are devised with a 50 x 50 cm quadrat (divided into 25 10x10 cm cells).

How many quadrat samples should be counted

Select quadrat samples randomly. The number of quadrat samples will depend on the size of the Area of Occupancy, the variability of the plant numbers within the Area of Occupancy and the time available for survey. Ten samples is generally a good number to collect, but more can be done if there is enough time and accuracy increases by using a running average.

Having determined the AOO:

- Count the number of plants if numbers are low enough to do this; or
- Estimate the numbers of plants if the population is too large to count. To do this, within the AOO, collect a number of sample counts of individual plants within randomly selected quadrats of a known size (i.e. 50x50 cm; 1x1 m). Scale up the summed counts to estimate the number of plants in the total area. For example, in an area that is 100 m^2, 10 sample quadrat counts, each 0.5x0.5 m could be undertaken. The total area sampled is then 2.5 m^2. Add up the number of plants counted in each quadrat (say a total of 30 plants). Estimate of total number of plants = 30 x (100/2.5) = 30 x 40 = 1200 plants.

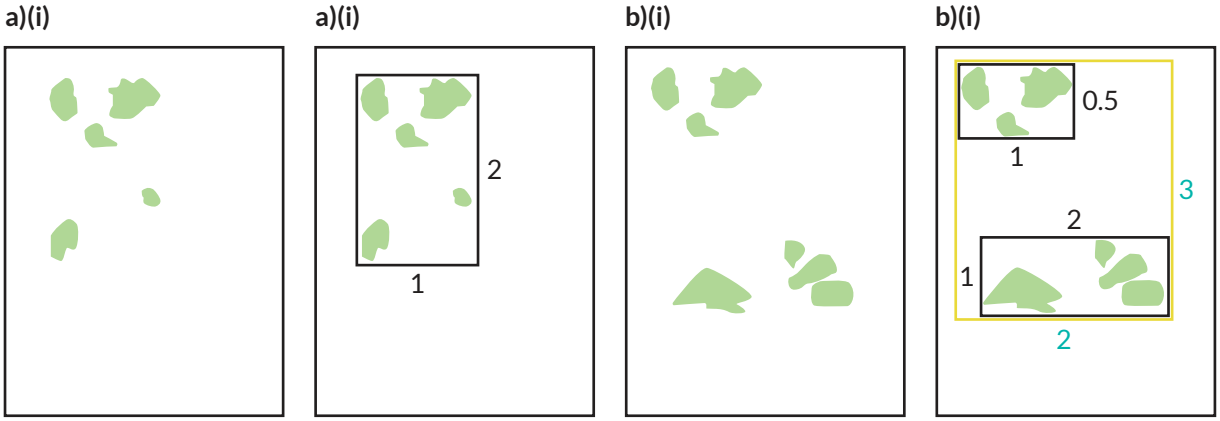

Figure 10: Measuring Area of Occupancy: a)(i) layout of population, (ii) Area of Occupancy = 1 x 2 = 2 m^2; b)(i) layout of a more scattered population (ii) two possible ways of measuring the Area of Occupancy: measuring two areas and totalling them, (1 x 0.5) + (2 x 1) = 2.5 m^2; measuring one larger area 3 x 2 = 6 m^2.

Mangement Unit	Number of clumps (count)	Size of area (m^2)	% of area occupied by species	Area of coverage (m^2)
A	22	150	10	15
B	56	30	90	27
C	3	1	50	0.5
TOTAL	**81**	**181**	**150**	**42.5**

Table 2: Example table summarising the population size, area of occupancy and area of coverage for a site with multiple sub-sites.

Using a running average

This is a way of knowing how many quadrat samples to take to get a 'best estimate'. To calculate a running average, total the number of plants from the first set of quadrats (i.e. the first 5 quadrats out of a sample size of 10) and divide by the number of quadrats. For example, if the first five quadrat counts are 10, 2, 5, 1, and 12 giving a total of 30 plants, the running average count is 30/5 = 6. If quadrat six is 24 plants the average is recalculated as (30 + 24)/6 = 9. Quadrat seven has a count of 2 and the running average is (54 +2)/7 = 8. Quadrat eight has 16 plants and the running average is (56+16)/8 = 9. Quadrat nine has a count is 5 and the running average is (72+5)/9 = 8.5. Continue until each successive average differs from the last by no more than 10% either way. If so, this latest average will then be your count estimate to use. So here it would be: 10% of 9 = 0.9. Then, 9 ± 0.9 = 8.1-9.9, so the running average has been achieved here, as the last average was 8.5.

Recording multiple discrete populations of a species at a site

To summarise information about different populations at a site, information could be gathered together in the format of a table (Table 2). For each population, count/estimate the population, the area of occupancy and percentage area of coverage within the area of occupancy. Marking these populations on a sketch map, with the data alongside and their grid refs might be useful in the future.

The total row is the final figures for the survey. The detailed information on the chart/sketch map informs site level understanding and management.

Null records are just as important as positive records.

Photos

Use photos to show the context in which species is growing (or not), e.g. amount of bare ground, issues from other species/any other disturbance. Photos are excellent for providing an accurate picture of what is happening.

Recording Form

Breckland Flora Group
Recording for conservation

BRECKS FLORA GROUP – RECORDING FORM										
N.B. Please consult the Notes in the 'ID and Recording Guide' for help with this form. Items marked * have explanatory notes.										
Site Code:	Species (Latin/English)*:									
Site name*:		Grid ref*:		Survey date*:						
Site designation*:	SSSI Unit/CWS or RNR number*:	Map locator number (BF only)*:		Recorder(s):						
Consult spp specific guidance on what you should record		Owner/manager unchanged? ('Y' or 'N')								
		Total	Special additional data, when requested*							
			1st year rosettes	Flowering	Non-flowering	Seedlings	Part-open	In bud		
Count or Estimate? ('C' or 'E')*										
How many? (number)*										
Area of occupancy (m^2)						Growth type*:. Individual (I), clump (C), patch (P) or mat (M)? (Put one)				
Of area above, % covered (if required)?										
Area covered (m^2)*										
If required	Abundant ?* (tick)		Frequent? *(tick)			Occasional?* Tick				
	If Medicago sativa, % M s. falcata?									

Site description: *e.g. wheel ruts/verge or centre of ride, bank, sand/chalk pit, arable margin, etc.*	
Reproduction potential: *Are the plants in flower or seed? Are there any young plants?*	
Is the site suitable for germination of seeds? *Give % cover of bare ground.*	
Describe the vegetation around and among the plants.	
Any evidence of grazing by rabbit/deer/ sheep/ponies/cattle? *e.g. shoot tips nibbled, droppings.*	
Are there aggressive species suppressing the plants? *e.g. bracken, bramble, coarse grasses.*	
Are the plants being shaded out by trees or shrubs? *e.g. conifers, bramble. Please describe.*	
Any disturbance/activities which are affecting the plants in a good or bad way? *e.g. horse riding, motorbikes, vehicles, tree felling.*	
Other nationally rare species in same location *(give a 10 fig GR and an estimate of quantity).*	

Sketch map:

Please draw at sufficient scale and detail to allow the exact location and extent of the species to be refound, sketching in any clear, preferably permanent features on the ground. Label the sketch to show target species populations, locations of other rare species at the site, and photo reference points.

PHOTOGRAPHS

If you take any photos, please note the 10 figure grid ref from where photo was taken. Record on the sketch map where the photo was taken from and in what direction the camera was pointing.

Plantlife

NATURAL ENGLAND

Glossary

Archaeophyte – A plant species which was introduced to an area by humans and became naturalised before 1500 AD. Most archaeophytes in Britain first appeared during the Iron Age.

Axil – The angle between the upper side of the stem and a leaf.

Corolla ring – A circular arrangement of petals.

Midrib – The central longitudinal vein of a leaf.

Case studies

- *Recording Spring Speedwell* by Jo Jones (Plantlife)
- *Population changes in response to management at Ickingham* by Tim Pankhurst (Plantlife)
- *Reintroduction of Spring Speedwell at Weeting Heath* by Tim Pankhurst (Plantlife)

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Further reading

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@Love_plants @plantlife.loveplants @LovePlantlife

Plantlife
T: 01722 342730
E: enquiries@plantlife.org.uk
Brewery House, 36 Milford Street, Salisbury, Wiltshire SP1 2AP

Creating the conditions threatened species need to thrive: our unique programme at a glance.

Back from the Brink is the first time ever that so many conservation organisations have come together with one focus – to bring back from the brink of extinction some of England's most threatened animals, plants and fungi. Natural England is working in partnership with Rethink Nature, and the entire project is made possible thanks to funding from the National Lottery.

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