Looking after

Fingered Speedwell

Veronica triphyllos

Ecology and Conservation Portfolio

BACK FROM THE BRINK

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At a glance

Common name: Fingered Speedwell

Scientific name: *Veronica triphyllos*

Habitat types: arable field margins, but occasionally recorded in other disturbed habitats including tracks, waste land and gravel pits

Soil type: calcareous or slightly acidic sandy soils

GB status: Endangered

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

Species description

Fingered Speedwell is a small annual wildflower confined to the Brecks of East Anglia (Figure 1). It has a single stem that branches to form a sprawling tuft, but only when conditons are suitable for prolonged growth. The leaves are oval to lanceolate, but deeply lobed, with sinuses (cuts between the lobes) reaching almost to the midrib. There are three to seven blunt-ended lobes, giving the superficial appearance of a hand.

The flowers are tiny (c. 3-4 mm across), emerging from the axils of leaf-like bracts. The four petals are unequal and fused to form a corolla ring which is very weakly attached: the slightest disturbance will cause the entire structure to drop off. They are bright, sapphire blue, with a white base, the rounded upper petal being the largest, with two slightly smaller laterals and a small, spoon-shaped lower petal. The upper parts of the plant are covered with red-tipped glandular hairs, visible with a x20 hand lens. Fingered Speedwell produces a kidney-shaped fruiting capsule that is longer than broad and is also covered with hairs.

Fingered Speedwell may be confused with other annual speedwells: Wall Speedwell *Veronica arvensis* is much more common and widespread and has bluntly-toothed leaf lobes, with sinuses that reach less than halfway to the midrib. The flower can be extremely similar in colour to Fingered Speedwell, but can be paler than Fingered Speedwell, or even pink or white. Spring Speedwell *Veronica verna* is almost as rare as Fingered Speedwell, and has a similarly bright blue flower. It can also grow alongside Fingered Speedwell, but tends to flower later and the glandular hairs on its upper stem have yellow tips visible with x20 hand lens. Breckland Speedwell *Veronica praecox*, can also be found in the same places, but the leaves are coarsely-toothed to shallowly lobed with the sinuses reaching less than half-way to the midrib (Figure 2).

Lifecycle and ecology

Fingered Speedwell is an annual plant, meaning it completes its whole lifecycle within a year (Figure 3). Seed germination generally occurs in early spring[1,2], although it may also germinate in mild, damp autumns following ground-disturbance. Fingered Speedwell preferentially germinates at cooler temperatures than many plants, an adaptation for early growth to avoid droughting in the summer[1]. However, its tendency to flower early should not be relied on for identification purposes. While there is a strong seasonality to its

Figure 1: Fingered Speedwell showing the distinctive deeply lobed leaves and bright blue flower © Andrew Gagg/Plantlife

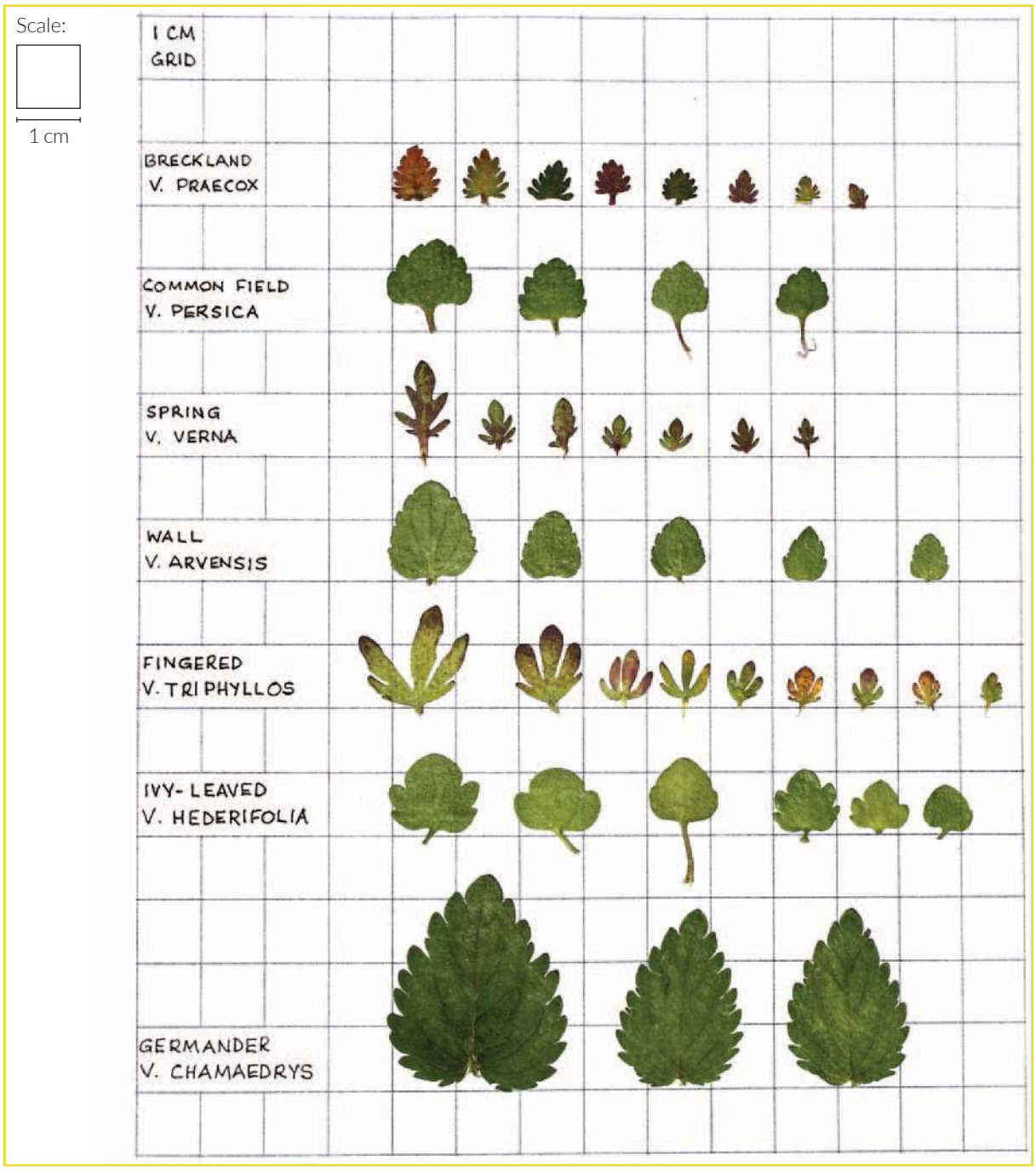

Figure 2: A photographic comparison of Fingered Speedwell leaves alongside the leaves of various other species of speedwell which often occur in the same habitats. The deeply-lobed leaves of Fingered Speedwell are highly distinctive © Norman Sills

lifecycle, it is greatly affected by weather. Therefore, it cannot be assumed that green or flowering plants found after April are not Fingered Speedwell, which is contrary to some guidance that claims that Fingered Speedwell is 'dead by May'[3]. In cool damp springs, the plants may flower into May and even June. Similarly, in warm, damp winters, they may be in flower as early as February.

Fingered Speedwell is described as a predominantly self-pollinating (facultatively autogamous) species. Self-pollination is the primary form of reproduction, but cross-pollination (allogamy) may also occur[5]. Where they are cross-pollinated, the flowers are probably visited by small solitary bees, in common with other speedwells[5], which may increase pollination rates and genetic diversity.

Local environmental conditions influence seed maturation and dispersal, which typically occur from April to June[2]. Plants die and rapidly disappear after

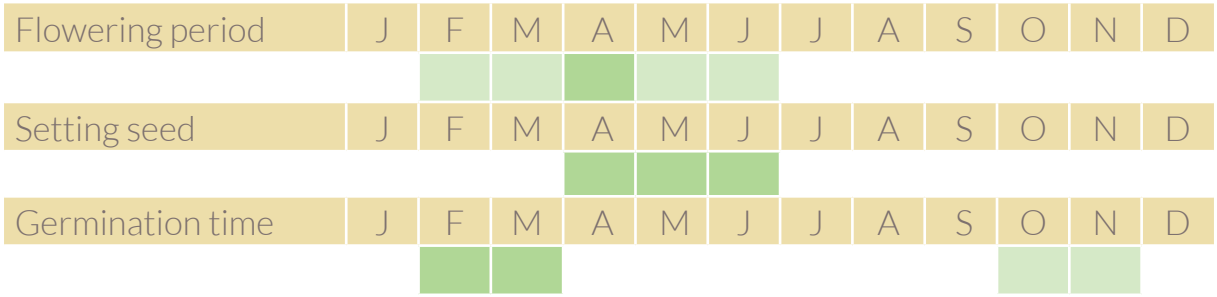

Figure 3: Flowering, germination and seed-setting periods for Fingered Speedwell

seed dispersal. Seed is not known to be adapted for widespread dispersal, so colonisation of new sites is likely to be restricted[1].

The longevity of Fingered Speedwell seed in the soil seed bank has not been established experimentally, although Fingered Speedwell seed has been found in the soil in years when no seed-producing plants were recorded, suggesting that the species is able to form a persistent soil seed bank[1,4]. Under optimal ex situ storage conditions Fingered Speedwell seed appears to be long-lived. The two UK collections held in the Royal Botanic Gardens (RBG) Kew's Millennium Seed Bank (MSB) have retained >95% viability after 25 years under storage conditions[4].

Seed dormancy describes a range of mechanisms that prevent seeds germinating even under favourable germination conditions. Dormancy may delay germination until the conditions are likely to support healthy plant growth and result in germination being staggered over multiple growing seasons, helping the population recover from damaging short-term impacts such as drought, disturbance or unfavourable management practices. The MSB holds germination data for four UK collections of Fingered Speedwell, and variation in embryo size was recorded during testing. This suggests that some embryos may not be fully developed at the point of dispersal, resulting in morphological dormancy. The environmental conditions required to promote embryo development and break morphological dormancy vary from species to species and have not been established experimentally for Fingered Speedwell. Exposing immature seed to warm summer temperatures promoted ripening and dormancy release in the related winter annual Ivy-leaved Speedwell *Veronica hederifolia*[6].

Figure 4: Bare ground is essential for Fingered Speedwell as it does not tolerate competition © Jo Joncs

Habitat

Fingered Speedwell is associated with disturbed, low nutrient soils and most commonly occurs in arable field margins but is occasionally recorded in other disturbed habitats including tracks, waste land and gravel pits, typically on calcareous or slightly acidic sandy soils[2,7,8].

Bare ground is essential as Fingered Speedwell does not tolerate competition with other vegetation[2] (Figure 4). It is a specialist of the unusual drift geology of the Brecks (Box 1) where the extraordinary nutrient poverty of the soils has led to the development of vegetation with a large component of specialist annuals, able to both exploit the commensurate lack of competition and conduct their lifecycles early in the year, before it becomes too hot and dry.

Fingered Speedwell has an Ellenberg Reaction value ('R') of 7[9] which assigns it a preference for soils which are 'weakly acid to weakly basic' and suggests that it is 'never found on strongly acid soils'. This is a little misleading because Ellenberg values are calculated by looking at the range of associate species with which a plant occurs. Fingered Speedwell associates with species

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 Fingered Speedwell populations

of sandy habitats, many of which are acidic. An Ellenberg analysis of arable fields in the Breck heaths would accordingly tend to assign a lower 'R' than expected from the soil chemistry, because despite being sandy the soil is calcareous.

Soil profile

Soil has been sampled at four Fingered Speedwell populations across two separate sites. Both of the sites are reintroduced populations as no plants have been found in recent years at the two known native sites. There is one colony of Fingered Speedwell at one of the reintroduction sites, and at the other site there are three distinct colonies. The low number of samples, and low number of populations of Fingered Speedwell, makes it difficult to draw any similarities between sites and further assessment would help us to understand the range of soil conditions in which this species grows.

Soil pH

The two sites differ markedly in soil pH. The solo population at one of the reintroduction sites was on a very acid soil of pH 5.3 whereas the soil at the three sub-populations on the second reintroduction site was alkaline and varied between pH 7.6 and pH 8. This initial assessment suggests that Fingered Speedwell is not restricted by soil pH.

Soil texture

The soil conditions for all three colonies of Fingered Speedwell was sand (Figure 5). Sand has a quick warming rate, warming earlier in the spring, which perhaps favours the early flowering Fingered Speedwell. It also has low to very low available water and rapid drainage which restricts the development of other vegetation. This may slow ecological succession to a large degree until a layer of humus can build up across the surface.

Proportion of bare ground

Surveys in 2018 at the three populations within one of

Texture triangle: Soil Survey of England Wales (UK)

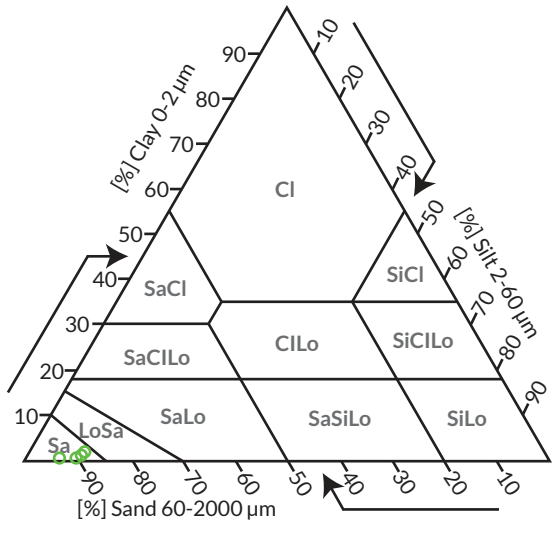

Figure 5: Soil triangle displaying the proportions of clay, silt and sand present at the four populations of Fingered Speedwell

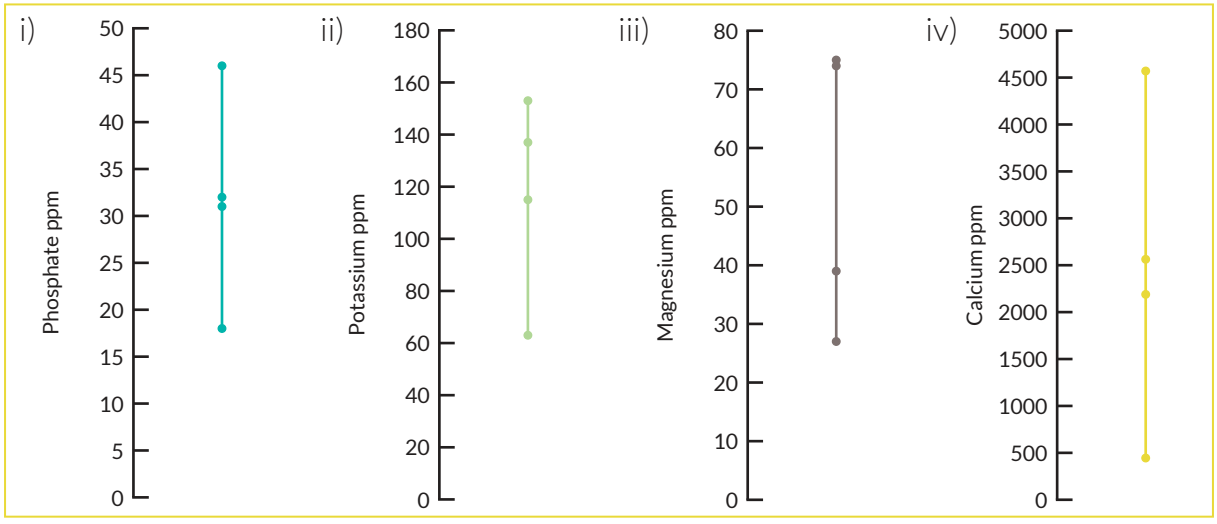

Figure 6: Major plant nutrients present in the soil at at four colonies of Fingered Speedwell spread across two separate sites: i) Phosphate, ii) Potassium, iii) Magnesium and iv) Calcium

the reintroduction sites suggest that there was much bare ground created by soil rotovation as part of the management of the site. Rotovation was not undertaken in 2019 and there were far fewer plants. This reflects the need for ground disturbance as part of management for Fingered Speedwell. In some years, presumably when competition is greater, most plants are found associated with the sparse vegetated steep/vertical/overhanging plough cut field edges.

Soil nutrients

Previously, Fingered Speedwell was understood to grow only on soils with low nutrients. However, the soil samples taken from the four colonies suggest otherwise (Figure 6).

Phosphate ranged between 18-46 ppm (Index 2.2-4). The greatest difference lay within the single site with three colonies, and the other reintroduction population lay within this range. The average phosphate level was 33 ppm (Index 3.3).

There was a difference between the two sites in potassium soil levels. The more acidic soil had lower available potassium at 63 ppm (Index 1.0) whereas the three colonies at the other reintroduction site had levels of 115-153 ppm. Average potassium level was 117 ppm (approximately Index 1.9).

Magnesium levels varied between 27-75 ppm (Index 1-2.4) with an average of 54 ppm (approximately Index 2.0). The single population on acid soil had the lowest level of Magnesium in the soil.

Unsurprisingly the population on acid soil with a pH of 5.3 had the lowest calcium with 445 ppm while the population on the area with the highest pH of 8 had the greatest level of calcium in the soil at 4570 ppm.

Although the sandy substrate means that soil nutrients are readily leached, phosphate can bind to soil particles and remain at higher levels for longer than nitrogen. This may promote vegetation growth in soils that are undisturbed, and may explain, at least in part, why population levels of Fingered Speedwell vary so much with management. The relatively high levels of these four essential plant macronutrients in the soil mean that they are unlikely to be restrictive factors on the growth of Fingered Speedwell, but the development of a cover of vegetation which is promoted by the high levels of macronutrients may restrict the germination and development of Fingered Speedwell through competition for light.

> Fingered Speedwell is a good indicator of ecologically important sites as it occurs [with] a wide variety of other species of interest

Vegetation communities

Fingered Speedwell is a good indicator of ecologically important sites, as it generally occurs in cultivated fields with very low nutrient status, which can support a wide variety of other species of interest, including species of concern such as Spring Speedwell. Many of the species

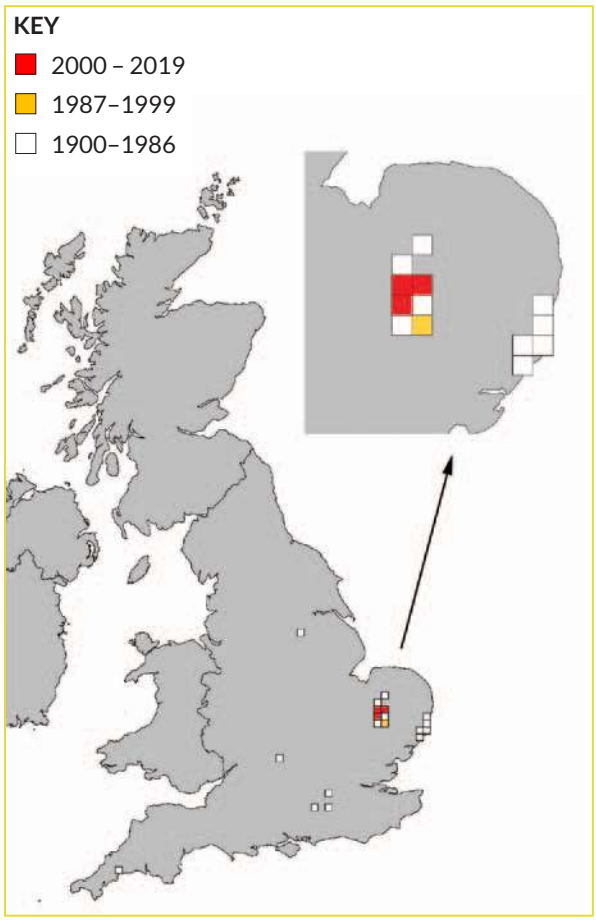

Figure 7: Fingered Speedwell distribution in Britain and Ireland. The data used to create this map has been provided under licence from the Botanical Society of Britain and Ireland (BSBI) and accessed from the Society's online database.

associated with disturbed, low nutrient habitats in the Brecks have undergone significant declines and the presence of Fingered Speedwell may indicate a significant assemblage of species of interest.

As Fingered Speedwell is an early flowering species and requires some form of soil disturbance to create suitable germination conditions and reduce competition, there are generally few other plants present in close proximity. However, other flowering annual plants present in the same habitat include Rue-leaved Saxifrage *Saxifraga tridactylites*, Common Cudweed *Filago germanica*, Corn Spurrey *Spergula arvensis*, Common Poppy *Papaver rhoeas*, Scarlet Pimpernel *Lysimachia arvensis* and Venus's-Looking-glass *Legousia hybrida*. It is also known to occur alongside other members of its genus, such as Breckland Speedwell *Veronica praecox*, Ivy-leaved Speedwell *V. hederifolia* and Wall Speedwell *V. arvensis*.

Distribution

Fingered Speedwell is considered an archaeophyte, despite its first record being from 1670. Although it has historically been recorded in Surrey, Oxfordshire, Hertfordshire, Essex, Yorkshire, Berkshire, Buckinghamshire, East Suffolk, East Norfolk and as far afield as Cornwall, it has not been seen outside the Brecks since 1970; the only exception is a casual record in South-west Yorkshire in 2008 (Figure 7).

In recent decades, Fingered Speedwell populations have dwindled and most have disappeared. Fingered Speedwell was previously known from 41 sites in the Brecks, but it had disappeared from half of these before the start of the 20th century. Many of these early losses appear to have been of transient populations, and are therefore perhaps of less concern, although the antiquity of the records and their lack of detail makes it difficult to be certain of this. Since the end of the 19th century, the plant has been found in a total of 21 sites, with an average of 7.4 sites (standard deviation = 1.83) being known in any one decade (Figure 8). This implies that the discovery of new sites compensates in part for disappearances but, since the 1970s, the number of sites has been consistently lower than the average and here have been no new discoveries for over 20 years.

Since 2000, the plant has been known from just 6 sites in three hectads in the Brecks of Norfolk and Suffolk. Of these, only two are native sites where the plant has not been deliberately introduced, and at one of these sites Fingered Speedwell has not been seen since 2004. The other native site is regularly monitored and has been affected by development and tree-planting, and no plants have been seen for the last four years.

The four other sites (sometimes regarded as just three sites, as two are within the same SSSI) are the result of

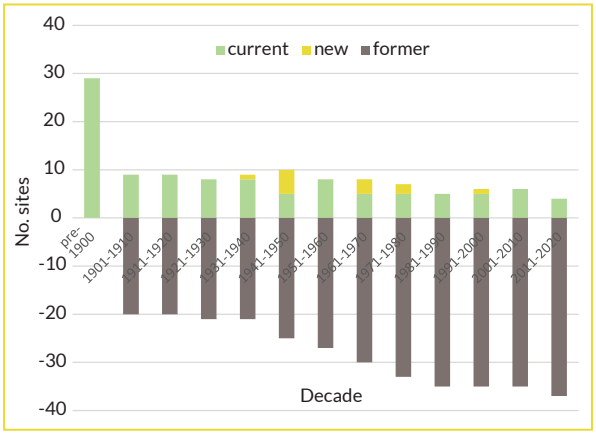

Figure 8: The number of extant and former sites for Fingered Speedwell, over the last 120 years, by decade

Population fluctuations

When suitable conditions are maintained for a series of years, very large populations of Fingered Speedwell may develop.

The plant was introduced at the Arable Weed Reserve in Weeting, Norfolk in 1972, and since the population had grown to over 1,400,000 by 2019 (Figure 9).

Populations can fluctuate wildly with changes in frequency of cultivation. The population at Cherry Hill was recorded as 10,900 in 2018 but then only one plant was found in 2019. This is not necessarily of concern as the plant is thought to have a persistent seedbank[1]. However, the benefits of annual cultivation can be seen at the Weeting Arable Weed Reserve, where the introduced population has increased more or less exponentially.

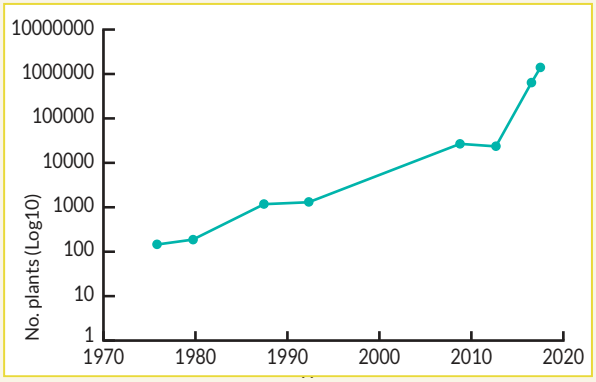

Figure 9: Population numbers at the Weeting Arable Weed Reserve in Norfolk. The number of plants is shown against a logarithmic scale.

deliberate reintroductions, and three have been successful in the longer term. One population had over one million plants in 2019 and is now the stronghold for the species.

Reasons for decline

The poor status of Fingered Speedwell may be attributed to a gradual loss of cultivated fields with a low nutrient status[2,8]. Spring cultivation can disturb plants before they are able to disperse seed[1] and several former sites have been lost to development[2,8]. Winter annuals, such as Fingered Speedwell, are also particularly vulnerable to herbicide sprays applied early in their lifecycle[1].

Populations in the first half of the 20th century seem to have been stable but in the latter half of the century there was a gradual decline in the number of sites, tying in with the advent of post-war agricultural improvement. Farming in the Brecks was traditionally a rather subsistence activity because of the severe poverty of the soils. The widespread application of fertilisers and herbicides, coupled with irrigation, has greatly increased the yield potential of Breck farms and, in so doing, has resulted in the loss of colonies in arable fields.

Some sites were probably lost to extensive afforestation in large parts of the Brecks, which rendered much of the landscape unsuitable for Fingered Speedwell, both directly through loss of habitat and indirectly through planting of shelterbelts which reduced the amount of remaining mobile sand. Much of this occurred on grass-heath but some also took place on arable land.

The Brecks is one of the worst areas in the UK for nutrient deposition from the atmosphere. This phenomenon raises the productivity of even the most impoverished soils and stimulates succession in the vegetation. On the grass-heaths, this leads to the development of a denser sward, the build-up of an organic topsoil, and reduction in soil mobility. This accelerates succession with a rapid loss of the open ground conditions required by Fingered Speedwell.

One of the largest former colonies of Fingered Speedwell, on the land surrounding Green Lane leading from Thetford to Kilverstone, is rumoured to have supported millions of plants before the area was developed for housing. This area was used for walking in stock to the market at Thetford. The tiny, and intermittent, population at Rosecroft Way is now the only remnant of this once large population, and even here, the remaining suitable habitat has been subject to tree planting.

> The poor status of Fingered Speedwell may be attributed to a gradual loss of cultivated fields with a low nutrient status

GB status and rarity

Fingered Speedwell has declined dramatically in the last few decades. It is classified as 'Endangered' on the Vascular Plant Red Data Lists for Great Britain[11], but raised to Critically Endangered for England[12].

Protection under the law

Fingered Speedwell is a Section 41 species of conservation concern under the 2006 Natural Environment and Rural Communities (NERC) act. It is also statutorily protected under Schedule 8 of the Wildlife and Countryside Act 1981; consequently, any collection of seed for reintroduction can only legally be done under a suitable licence from Natural England.

It also receives some measure of conservation protection 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 was used in English as early as 1572 and 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 includes superstitions among children that if they 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 very simply by counting the number of flowering spikes each year, but for two factors:

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

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

Habitat management

Suitable conditions for Fingered Speedwell have persisted in the past in the Brecks because of the extraordinary natural nutrient poverty of the soils themselves, but in modern times plants have been restricted to field corners and margins that only occasionally escape fertiliser dressing. The advent of agri-environment schemes that promote the cultivation of field margins, without subsequent dressing or cropping, has encouraged such conditions and allowed some populations to persist. One reintroduced population has greatly increased where the farmer has voluntarily carried out active management to conserve the species.

Suitable conditions for Fingered Speedwell have persisted in the past in the Brecks because of the extraordinary natural nutrient poverty of the soils themselves

There are several things to consider when managing habitat for Fingered Speedwell, that focus on providing opportunities to grow, flower and set seed as well as promoting persistence and spread to new areas. Plants are very vulnerable to competition from other vegetation and need to be able to exploit open germination conditions when and where they occur. The lifecycle can be over within a few weeks but in this time, particularly in early spring, plants may be vulnerable to drought.

Fingered Speedwell requires bare or disturbed ground, and the seeds need to come into close contact with the soil to germinate. Disturbance by agricultural machinery (e.g. ploughing, cultivation), passing vehicles, animal's hooves and rabbits are all known to generate conditions that Fingered Speedwell may exploit.

Areas with low nutrient status seem to be favoured by Fingered Speedwell. While Fingered Speedwell may persist in a moderately high-nutrient system where

Monitoring Fingered Speedwell

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 an optimal time to count plants, ideally when most are flowering and some setting seed.

Monitoring small numbers

Fingered Speedwell can be a small plant so 'getting your eye in' is important in order to spot individuals (Figure 10). 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 required to confirm the identification because Fingered Speedwell can easily be confused with several other species of speedwell with which it may grow. In addition to the leaf shape, Fingered Speedwell tends to stand upright, and is therefore easier to spot than Spring Speedwell.

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

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 acquire 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 present. Once plants have been located, carefully place a 1 m square quadrat frame on to part of the population and then count all the plants inside the quadrat on hands and knees. Often Fingered Speedwell is in a flinty area and a pad to kneel on is helpful! Where there are lots of plants within the frame, use something like barbecue skewers to mark each plant to avoid double counting. In dense vegetation, it is easy to miss the plants, 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 to know when sufficient quadrats have been counted to achieve a reliable estimate of numbers of Fingered Speedwell plants present.

Figure 10: Fingered Speedwell is often very small, making accurate population surveys a challenging task © Jo Joncs

competition from other plants is strongly suppressed, it is essentially a plant of ultra-low nutrient conditions.

Finally, plants need a means of dispersal. Seeds generally fall close to the parent plant but may be adapted for dispersal on the wind like a grain of sand. 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 on the hooves or skins of animals or in the guts of herbivores.

Ideal management for Fingered Speedwell on arable land involves annual cultivation in autumn (between October

and early December), with no more than a light topdressing of manure. Fingered Speedwell will grow within the crop, such as an autumn-sown cereal or within an uncropped cultivated area or plot. Physical abrasion during the cultivation process may be important in stimulating germination in the seeds.

> Sowing should be undertaken in the summer to mimic natural dispersion

Fingered Speedwell is believed to be at least moderately long-lived in the soil seed bank and may return with the reinstatement of management practices that provide adequate germination and establishment niches. However, the soil seed bank may be quickly exhausted if management allows buried seed to germinate but prevent the plants completing their lifecycle[1]. If the species has not been recorded recently or has failed to return under a favourable management regime, reintroduction is likely to be required.

Reintroduction

If seeds are kept in suitable conditions (see Storing Wild Flower Seed in *Further reading*), sowing should be undertaken in the summer from July onwards to mimic natural seed dispersion. In addition, sowing in mid to late summer would expose seed to the seasonal temperature cycles that may be required to promote embryo development and dormancy release before the cool germination temperatures prevail in autumn[4]. Seed should be sown on bare, recently cultivated ground with minimal competition from crops or other plants. 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.

Any seed harvesting should be undertaken under a Schedule 8 licence and should be done without damaging the original population. Plant material should not be collected for a reintroduction from a donor site if it will place that population at risk. The guidance is never to collect more than 20% of the seed from any healthy population and 10% of a vulnerable population, depending on seed viability. If this is not enough seed, 'bulking-up' may be required by growing the plant in cultivation for a year or two.

A general recommended seed sowing rate for plants like Fingered Speedwell is 100 seeds per m^2[2,13]. Higher seed rates could be used, 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[4]. It has been observed that where at least four individuals are present per square metre, seed production can reach 500/m^2 in productive years, although it is more often below 100/m^2 [1].

There is very little information about the site preparation, sowing rate and method used to broadcast the seed at the reintroduction sites, and only two reintroductions have been successful over the longer term. Thus, the reintroduction method suggested below is just a recommended course of action, and there might be other factors that are not known that may result in the success or failure of a reintroduction.

1 g of Fingered Speedwell seed contains approximately 2,336 individual seeds[4].

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.
Survey and ongoing management	
Adult/flowering plant survey.	Mid-May to Mid-June.
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.	Mid-May to Mid-June and ongoing to monitor the population.

Table 1: Reintroduction plan based on summer-autumn sowing

Reintroduction successes and failures

There have been six reintroductions, four of which were to new sites where Fingered Speedwell had not been previously recorded, and two were seed sown at sites with historical records of Fingered Speedwell. There has been one reinforcement of an existing population using seed.

The populations have fluctuated greatly in the reintroductions at Cherry Hill and Tuddenham Gallops, while at Weeting the population has steadily increased, becoming very large in recent years. The reintroduction at Langmere, however, was unsuccessful, with no records of plants following the sowing.

The reintroduction at Caudle Farm was undertaken in 1998, only three years after the population was last seen in 1995. This seems to have ignored the possibility that the plant might remain in the seed bank and re-appear in time. The reintroduced stand was augmented with a reinforcement two years later, but no plants have been seen since 2009. Although the species is currently considered extinct at Caudle Farm, there remains the possibility that it could reappear from the seed bank under the right management stimulus.

A number of translocations were undertaken in the Green Lane, Kilverstone area in the mid 1970s to reinforce the population of Fingered Speedwell. The reinforcement was driven by damage to the site by the construction of a new road. However, during the 1990s, the entire site was developed for housing. The population struggled on until 2017 when the last plant was seen. It is still too early to confirm whether Fingered Speedwell is genuinely extinct at Green Lane as the population may yet arise from the soil seed bank, but with each passing year this becomes less likely.

Areas for further research

Pollinators

Despite being primarily a self-pollinating species, some cross-pollination may occur, and this is likely to be enacted by solitary bees. However, this has not been confirmed and it is possible that other species groups or mechanisms may be involved. A study examining the pollination strategies and which pollinators may be involved would be instructive for informing conservation efforts.

The effects of habitat conditions on dispersal and survival

There is much still to understand about the dynamic landscape processes that influence populations of Fingered Speedwell. It has been suggested that the small size of the seeds is an adaptation for transport on the wind as part of sand dune movement, dropping to the ground, perhaps, at a threshold windspeed. Certainly, the distribution of the species elsewhere is allied to sand dune distribution; natural dune processes suppress competition from other plants, which favours Fingered Speedwell. The aridity of such soils (if they warrant that description) may also reduce seed losses from predation and attack by fungi; it would be useful to establish the significance of such assertions.

Rewilding may be potentially beneficial for this species, restoring large areas of open landscapes by supporting natural processes. This may inadvertently create suitable habitat away from sources of nutrients, that are maintained as bare ground through wind, drought and animal activity, either Rabbit or livestock. Further investigation could be undertaken into the potential of rewilding and its effect on Breckland plants, including Fingered Speedwell.

Rewilding may be potentially beneficial for this species, restoring large areas of open landscapes by supporting natural processes

Seed longevity

Given the high conservation value of Fingered 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.

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 11). 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.

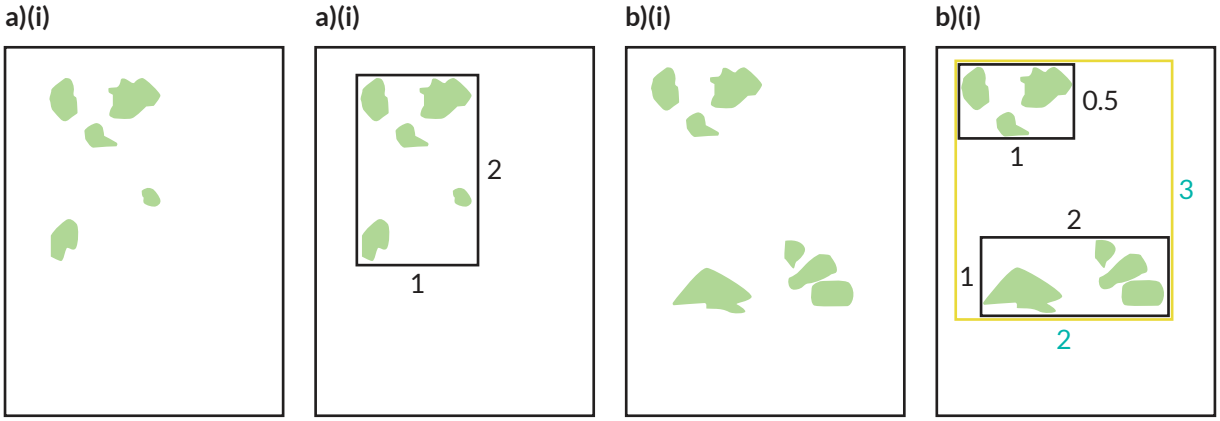

Figure 11: Measuring Area of Occupancy: a)(i) layout of population, (ii) Area of Occupancy = 1 x 2 = 2 m^2; b)(i) layout of a more scattered population (ii) two possible ways of measuring the Area of Occupancy: measuring two areas and totalling them, (1 x 0.5) + (2 x 1) = 2.5 m^2; measuring one larger 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

- *Population fluctuations* by Tim Pankhurst (Plantlife)
- *Monitoring Fingered Speedwell* by Jo Jones (Plantlife)
- *Reintroduction successes and failures* by Tim Pankhurst (Plantlife)

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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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