

Looking after

Interrupted Brome

Bromus interruptus

Ecology and Conservation Portfolio

**BACK
FROM THE
BRINK**



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At a glance

Common name: Interrupted Brome

Scientific name: *Bromus interruptus*

Habitat types: arable fields, particularly disturbed field margins; formerly occurred on fallow land, roadsides, waste ground and in hay meadows

Soil type: typically calcareous soils, but also neutral, sand and clay soils

GB status: Extinct in the Wild

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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

Interrupted Brome is a softly hairy, greyish-green, robust annual grass reaching 20-100 cm tall (though plants are usually under 50 cm). The flat leaves are up to 20 cm long and 5 mm wide tapering to a point. At the base of the leaf there is a blunt ligule up to 4 mm long. The oval spikelets usually form in clusters of three and individually measure approximately 10-17 mm in length, with the lemma bearing an awn up to 8 mm long. The entire flower head can reach 8 cm. The grouping of the spikelets makes the plant appear top-heavy and drooping¹. Interrupted Brome gains its name from the gaps that can sometimes be seen between the spikelets – a unique feature among brome grasses (Figures 1 and 2).

Interrupted Brome is very similar to other types of brome grasses, such as Soft Brome *Bromus hordeaceus*, but the grouping of the spikelets in the panicle (flower spike) is distinctive. Where there is doubt about identification, examination of the palea (the upper of the two bract-like scales enclosing each individual floret) may be necessary; this is split longitudinally almost to the base in Interrupted Brome².

Interrupted Brome is endemic to England but is thought to have become extinct in the wild. The only known populations have been reintroduced.

Lifecycle and ecology

Germination is generally considered to occur in autumn and spring, with autumn-germinating seeds forming earlier-flowering and more productive plants. Plants flower from May to July, sometimes extending into early autumn in warm, damp seasons, with seed dispersal in late summer (Figure 3). Spikelets do not seem to break-up when ripe, and the abundant seed is often retained causing seedlings to appear in small clumps³.

Anthers may protrude or be entirely enclosed within each floret (ibid.), suggesting both outcrossing and self-pollination can occur. Cleistogamy (self-pollination within unopened flowers) is a common strategy in other annual bromes^{4,5}.

Seeds appear to be short-lived in the soil, possibly less than a year, although the evidence for this is quite limited. Attempts to restore lost populations from the soil seed bank appear to have failed. However, plants have been reported appearing after an apparent

Figure 1: Interrupted Brome flower-head showing the distinctive arrangement of spikelets © Plantlife

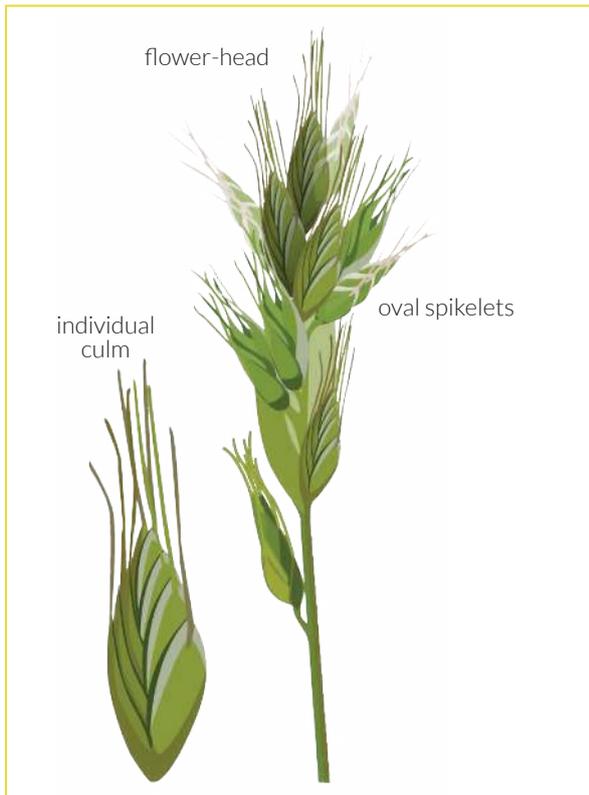


Figure 2: Illustration of an Interrupted Brome plant and seedhead. Illustration by cvansgraphic.co.uk © Plantlife



Figure 4: Interrupted Brome in a reintroduction plot at Ranscombe Farm Reserve © Plantlife

absence of up to two years at a reintroduction site at the Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust's (BBOWT) College Lake Nature Reserve⁶.

Seed stored under ambient conditions is reported to have died in four years⁷, although the seed can survive for long periods under optimal storage conditions, such as within the Royal Botanic Gardens Kew's Millennium Seed Bank. In these conditions, one collection retained 100% viability after 50 years of storage at 15% equilibrium relative humidity (eRH) at -20°C; and two 40-year-old collections retained >93% viability. In a test with less rigorous storage conditions, 87 out of 100 seeds germinated after 2 years of storage in dry conditions (i.e. with silica gel in a sealed plastic food storage container)

in a domestic fridge. Given the high conservation value of this species and the importance of the soil seed bank in the recovery and persistence of annual plant populations, it would be useful to conduct longevity or seed ageing experiments under natural conditions⁵.

Seed production is high and populations may potentially become self-sustaining relatively quickly with appropriate management. At Plantlife's Ranscombe Farm Reserve in North Kent, plots sown in 2015 have persisted, and the area occupied by the plants has expanded without any reinforcement sowing. However, it is notable that the population has declined from the initially high number of plants in the first year after sowing (Figure 4).

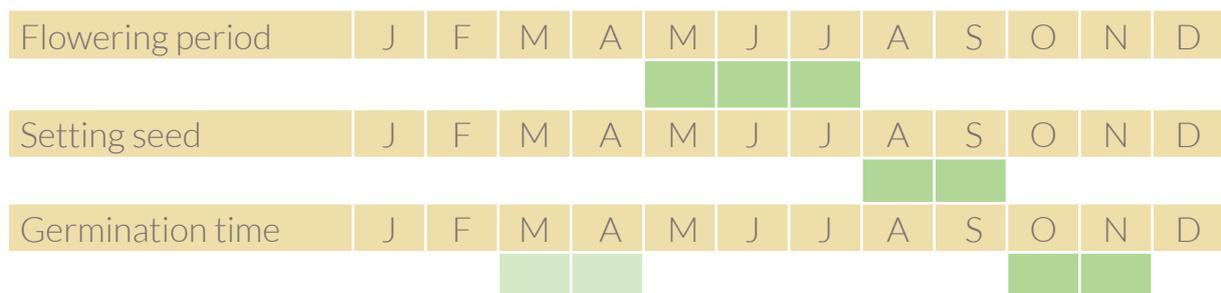


Figure 3: Flowering, germination and seed-setting periods for Interrupted Brome

Observations from reintroduction sites

The greatest body of evidence is from the introduction site at Whittlesford in Cambridgeshire farmed by Ashley Arbon MBE. The site lies within a few miles of the last known natural occurrence of the species and was the initial site sown in the 2004 reintroduction programme and its 2013 reprise.



Figure 5: Whittlesford Plot on 12th May 2016 as flowering commenced
© A. Arbon

In October 2013, c. 5,000 fresh seeds were hand sown over a 10 × 3 m plot. A smaller number of seeds retained from the first (2004) batch, which had been dry stored at room temperature, were sown in an adjoining area. Germination of the fresh seeds was noted within c. 7 days of sowing, while the dry-stored batch showed no germination. Population size was estimated at peak flowering in May 2014 by extrapolation from counts made from 10 randomly placed 1x1 m quadrats. This gave a mean of 1,004 plants with a recruitment rate of c. 20%. By late autumn 2014, the plants had set seed. The area was then harrowed with a grass harrow designed to scarify the surface. The dead material from 2014 was emptied from the implement and placed on a cultivated patch close to the original planting site 15 metres away. This small heap of dead material contained a few small upper spikelets that were reluctant to fall in the autumn; a watching brief was maintained to assess the importance (or not) of the retention and re-sowing of this fraction of the crop.

By March 2015 there were many seedlings. As the cultivation was minimal, most of the area was already

covered by perennial grasses. By early May 2015, the plants were in flower and occupying almost all of the original sown area. The dead material dragged away in 2014 obviously released some seed in transit and more plants occurred around the immediate area where tipped. Heavy rains in July 2015 saw the collapse of the heavy-headed culms, by then mostly mature. The adjacent crop was harvested in the first week of August. Due to the minimal cultivation of the marginal area, by autumn 2015 perennial herbaceous weeds and an increasingly dense local cover of Perennial Rye-grass *Lolium perenne* was present. This was considered to be potentially deleterious to the Interrupted Brome establishment and growth for the 2016 season. Accordingly, the area was cut very low and harrowed four times to break up and remove the Perennial Rye-grass.

Germination was noted to be good in autumn 2015 and plants survived the wet winter of 2015-2016 very well. However, in early spring, the entire plot was grazed down by rabbits to a height of 50 mm. Despite a gloomy prognosis for survival, there was much needed rain, with warm nights and days. This, together with rabbit control, saw the situation improve spectacularly. The Interrupted Brome started flowering in early-mid May with many hundreds of spikelets soon to produce anthers observed in the May survey (Figure 5).

With only limited intervention, it has been possible to maintain the species in the original sown area at a good density and plant vigour

The mean height to the top of the flowering shoots at that time was 170 mm due to the grazing pressure by rabbits. It was encouraging to note that even quite severe grazing had not killed the plants but caused the production of multiple and shorter culms.

The Interrupted Brome was sparse within the area dominated by Barren Brome *Anisantha sterilis*

where the dead material was dragged in 2014 but in the area of the original plot it was abundant (Figure 6).

The plot was subjected to the usual light cultivation in autumn 2016, but (as a trial) one small section was cultivated with a slightly heavier machine. Cultivation

seems to affect population numbers. It had previously been established that ploughing, either autumn or spring, has been found to reduce numbers of plants massively. In addition, the lightweight seedbed cultivator used at Whittlesford was also found to reduce the plant count significantly. It was concluded from the accumulated evidence that the spring-loaded tractor-mounted scratcher provided the best seedbed for autumn germination.

The site continues to offer the chance for small scale interventions on sections of the crop to inform future management. Comparing an unfertilised control

Evidence showed that the spring-loaded tractor-mounted scratcher provided the best seedbed for the optimal autumn germination

alongside the main area which receives artificial Nitrogen at 150 kg per hectare, it has been found that fertiliser greatly benefits the plants' vigour and also potentially the quality of its seed. It is however not always possible under conservation management stipulations for there to be fertiliser application at potential reintroduction sites.

To date, with only limited intervention (the control of the build-up of competing perennial species) and no augmentation, it has been possible to maintain the species in the original sown area at a good density and plant vigour while adjacent to a commercial crop.

Figure 6: The original plot on 2nd June 2016 © Fred Rumsey



Comparing responses on different soils and at different sowing times

At Ranscombe Farm Reserve, a number of small experimental plots were set up to test the response of Interrupted Brome to sowing on different soil types.

Initially, twenty plots, each measuring 2 x 2 m, were cultivated and then sown at a rate of 100 seeds/m², with ten plots being on shallow, chalky soil on a south-facing slope and ten on level ground on deeper soil derived from clay-with-flints. Sowing was carried out on 27th March 2019. That summer, no flowering was observed, and so it was assumed that the sowing had failed, and the plots were abandoned.

In the autumn of 2019, several new experimental plots were established. This time, four plots, each measuring 3 x 3 m were established on the chalky soil, and four on the clay-with-flints. The ground was lightly cultivated, loose vegetation raked off, and then each plot was sown at a rate of 100 seeds/m².

The plots were revisited in mid-May 2020, when it was noticed that the ten plots sown in spring 2019 on clay-with-flints all showed extensive flowering. Though the plots had been assumed to have failed, the field margin in which they had been sown had, by chance, not been cultivated as part of the previous routine autumn/spring management, and these plants presumably derived from germination in the previous year (the ten plots on the chalk had not escaped cultivation, unfortunately).

At the end of May 2020, all the experimental plots were surveyed by counting the number of flower-heads

present in a 1 x 1 m quadrat placed in the centre of each plot (Table 1). A sample of twenty plants was also collected for each of the treatments. For each treatment, the approximate mean tiller length was measured, and the number of seeds counted (or, in the case of the spring-sown plants, estimated by volume based on an initially counted sample of 1,000 seeds).

The plants which germinated in spring each produced a number of flowering stems, while autumn-sown plants only had one flowering stem

It is noticeable that the plants which germinated on clay soil in spring had branched to produce a number of flowering stems on each plant (more than 20 in some cases), while autumn sown plants only had one flowering stem. As a result, even though the individual plants were less dense in the spring-sown plots, there was a greater density of flower-spikes. Interestingly, the number of seeds per flower-head was almost the same, regardless of the treatment

or the size of the plant, so that overall productivity per unit area was determined by the density of flower-heads.

Interrupted Brome is generally considered to thrive best on chalk soils, and the data here suggests that the rate of production of mature plants from seed is highest on such soils, perhaps, in this case at least, because the more sparsely vegetated chalk soil offers less competition than the more densely vegetated clay soil. In this experiment, the population on the chalk therefore out-

	Treatment		
	Clay-with-flints Sown spring 2019	Clay-with-flints Sown autumn 2019	Chalk Sown autumn 2019
Number of plots	10	4	4
Mean plants per 1 m ² sample area	14.2	31.5	55.3
Approx. tiller length	75 cm	72.5 cm	55 cm
Mean flowering tillers per plant (n=20)	8.5	1	1
Mean flower-heads per 1 m ² sample area	120.5	31.5	55.3
Minimum flower-heads per 1 m ² sample area	39	21	36
Maximum flower-heads per 1 m ² sample area	379	55	84
Mean seeds per flower-head	47	45	46
Mean seeds per 1 m ² sample area	5664	1418	2539

Table 1: Results of experimental plot flower-head counts at Ranscombe Farm Reserve, collected in May 2020.

performed plants sown in autumn on the clay. However, it is clear from the spring-sown plots that Interrupted Brome can in fact do very well on the heavier, clay soil, with such populations proving to be substantially more productive than either of the autumn-sown populations.

It is not entirely clear what happened in the spring-sown plots. However, given the robust nature of the plants

produced, it could be that they germinated sometime in the spring, summer or early autumn, presumably while the vegetation was still fairly sparse, and certainly well in advance of the autumn-sown plants. However, they must have failed to reach flowering size during the first year of growth, and hence did not flower until the following year.

Response to lack of management

Following the reintroduction of Interrupted Brome to Aston Rowant NNR (Oxfordshire) and a wildflower meadow at Apex Leisure Park (Somerset), it became apparent that the species seems unable to persist in closed vegetation without disturbance through management.

This observation was tested at Cholderton Farm Estate, where, in October 2016, a c. 10 × 2 m strip on the margin of a recently harrowed arable field, was hand sown with c. 10 g of Interrupted Brome seed. This resulted in a



Figure 7: Interrupted Brome © Plantlife

dense, if patchy, relatively pure stand of the grass over the extent of the plot in summer 2017, with densities reaching 80+ flowering shoots/m² (Figure 7).

The field was left to go to pasture and grazed for a few weeks in early winter. By summer 2018, the vegetation within the field had formed a closed low turf while the adjacent uncultivated headland was a coarse False Oat-grass *Arrhenatherum elatius* dominated grassland with scattered tall forbs. Fewer than 10 plants of Interrupted Brome were detected at the interface between the vegetation types where some bare ground for establishment had occurred. The plants were mostly of very short stature with single flowering culms and short heads of few spikelets and seed set was thus very poor.

Similar management through the winter of 2018 resulted in the almost total loss of suitable habitat (a denser Perennial Rye-grass ley/coarser adjacent grassland was now completely closed). Somewhat surprisingly, three small Interrupted Brome plants managed to flower. Based on their location, it was assumed that they were the progeny of the previous year's plants rather than recruitment from the seed bank. Small-scale ground disturbances in the area of the plot, to establish if the dense crop of 2017 had laid down a seed bank which might be stimulated, was sadly not possible in spring 2020.

Evidence from a reintroduction site at Whittlesford (Cambridgeshire) suggests that the build-up of perennial grass species can occur rapidly, to the considerable detriment of Interrupted Brome, necessitating a low mow and repeated harrowing, at least biennially to maintain the open habitat required for initial establishment and early growth.

Habitat

Interrupted Brome is associated with agricultural crops and disturbed field edges, typically on calcareous soils derived from chalk or limestone but also on neutral, sand and clay sites. Historically it also occurred in hay meadows, on fallow land, roadsides and waste ground.

The species was particularly associated with sown fields of Sainfoin *Onobrychis viciifolia* which was grown for horse fodder and relied on regular sowings to maintain the crop. This may have benefited Interrupted Brome as there is evidence of the seed having been collected with the Sainfoin crop seed as a contaminant, and it is therefore likely that it would have been accidentally re-sown into suitable conditions for germination³.

Distribution

Interrupted Brome is endemic to the British Isles but was first recorded in 1849 at Odsey in Cambridgeshire (then Hertfordshire). It was subsequently not seen for another 40 years when it was rediscovered in a fallow field in Berkshire and was eventually formally named and described as a full species in 1895. By the 1930s, the plant was distributed quite widely in England, with records scattered through central and southern England and East Anglia. However, the plant had become virtually extinct by the 1960s, when searches of previously known sites revealed one remaining population on a field margin near Pampisford in Cambridgeshire. The species was last recorded at this site in 1972, and although a strip in the last remaining field was cultivated, no plants grew and seed harvested from this last population proved unviable due to mildew and aphids. Thus, with no known sites outside of England, Interrupted Brome was considered to have become globally extinct^{8,3} (Figure 8).

The comparative lateness of its discovery suggests the species may have been introduced as a seed contaminant from an unknown native range rather than having independently evolved in the British Isles. If this was true, the species would therefore be both a non-native neophyte and an endemic – a rare and counterintuitive circumstance – although there is little evidence to support this.

Reasons for decline

The main cause of decline for Interrupted Brome is likely to have been the improvement of seed cleaning. In addition, the mechanisation of the agricultural industry led to a decline in growing Sainfoin *Onobrychis viciifolia*



Figure 8: Interrupted Brome distribution across 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.

as the number of horses kept for labour declined. Other threats would also have been improved and more competitive crop varieties reducing the light and nutrients that were available for Interrupted Brome, which is a poor competitor, as well as increased use of artificial fertilisers and herbicides. However, the impact of these threats would only have affected populations still present following World War II when these advances in agriculture became widespread.

GB status and rarity

Extinct in the Wild.

Protection under the law

This species is included as a species of principal importance for the purpose of conserving biodiversity under Section 41 (England) of the Natural Environment and Rural Communities Act 2006 but does not have any legal protection.

Cultural connections

In an article published in *Nature* in Cambridgeshire in 1962⁹, Dr F. H. Perring described the curious cyclical history of Interrupted Brome, from its original collection in 1849 from a field at Odsey to its baptism as a new species by Hackel and Druce; through its rapid spread in Britain to its subsequent dramatic decline and possible extinction. He listed the only six records made



Figure 9: A seedhead of Interrupted Brome © Elizabeth Cook

of the plant in the previous 25 years, saying that it was imperative that the sites should be recorded the following year.

He ended his article:

"This call to help save a species which is in danger of becoming completely extinct is surely one of the strongest which can be made to a Naturalists' Trust. Druce (1927) records that Bromus interruptus is carved in stone on a corbel on the north side of the court of the University Museum in Oxford. Let us hope this is not to be its tombstone, and that in Cambridge we shall soon be able to celebrate its rebirth with living material growing in the Botanic Garden!"

Survey method

Individual plants should be counted in smaller populations of less than 100 individuals. Larger populations should be estimated by randomly sampling the population using a suitably sized (up to 1 m²) quadrat. In dense populations, identifying individual plants can be difficult, as plants tiller (branch) from the base. In this case, counting flower-heads provides an alternative, and gives an indication of productivity.

Habitat management

Cultivation shortly after seed dispersal in late summer or autumn is likely to provide optimal conditions for Interrupted Brome, allowing germination and establishment before winter (Figure 9). Cultivation should be shallow, to avoid deeply burying seed, so harrowing with a disc or spring harrow is ideal, and ploughing should be avoided. To avoid disturbing autumn-germinated seedlings, there should be no further disturbance until the following year. Interrupted Brome may also germinate in spring, suggesting periodic spring cultivation may be tolerated where necessary to control persistent weeds (primarily problem grasses which are usually autumn germinating), and to benefit other arable species.

If growing Interrupted Brome within a crop, reduced fertiliser application and a lower cereal drill rate using a variety that does not tiller can increase light levels for arable species. Reduced cereal sowing has been shown to increase rare arable species richness in cereal crops^{10,11}.

In non-arable habitats, disturbance should be carried out in autumn to maintain open ground and high light levels.



Figure 10: *Interrupted Brome* at Ranscombe Farm © Plantlife

Reintroduction

The foundation of conservation and subsequent reintroduction of this species began with Dr Phillip Morgans Smith (1941-2004), a lecturer in biology and ecology at Edinburgh University, who brought some Interrupted Brome plants to a conference of the then Botanical Society of the British Isles. He had a particular interest in Brome grasses and had harvested seed from Pampisford in 1963, and had been growing plants since then, but was unaware of its disappearance from the wild. Seed harvested from plants grown by Smith was grown on and bulked-up at Edinburgh and Cambridge Botanic Gardens, at Paignton Zoo, and in other collections. Ten collections of seed are now kept at Kew's Millennium Seed Bank^{3,12}.

Work by Kew has confirmed that, despite all the plants growing today deriving from Smith's initial collection, genetic variation is

high and there has been minimal genetic drift⁶, making reintroduction viable.

Initial reintroductions were undertaken in an arable plot at Aston Rowant National Nature Reserve, Oxfordshire, and a field headland at Whittlesford in Cambridgeshire. The population at Aston Rowant survived for a few years until the management was delayed due to poor weather and sheep gaining access to the plot, grazing all the seed heads of the plants. At Whittlesford, the population persisted for a few years until spray drift from a nearby field of beans destroyed the plants, and it did not reappear from seed. Unfortunately, there was little monitoring as the resources were not available to undertake any follow-up work after the initial reintroductions^{13,14,15,16}.

Ten collections of Interrupted Brome seed are now kept at Kew's Millennium Seed Bank

There have been more recent successful reintroduction attempts at BBOWT's College Lake Nature Reserve, Plantlife's Ranscombe Farm Reserve (Figure 10), and

Activity	Timing (month)
Autumn cultivation and sowing	
Prepare the seed bed to create bare ground with a fine tilth e.g. light cultivation or discing. Interrupted Brome produces better plants from autumn cultivation.	September-October
Mark out the corners of the plot(s).	September-October
Hand sow seed at a rate of approximately 100 seeds per m ² . Using a mix of seed and lime-free silver sand may help ensure the even distribution of seeds, though individual seeds are large enough that mixing with sand is not essential. Still conditions are necessary for sowing, as the seed is broad and light-weight and so easily picked up by the wind (see the Broadcast sowing method ¹⁸).	September-October
Lightly rake over the sown plot(s) to incorporate the seeds into the soil.	September-October
Spring cultivation and sowing	
Prepare the seed bed to create bare ground with a fine tilth e.g. light cultivation or discing.	February-March
Mark out the corners of the plot(s).	February-March
Hand sow seed at a rate of approximately 100 seeds per m ² . Using a mix of seed and lime-free silver sand may help ensure the even distribution of seeds, though individual seeds are large enough that mixing with sand is not essential. Still conditions are necessary for sowing, as the seed is broad and light-weight and so easily picked up by the wind (see the Broadcast sowing method ¹⁸).	February-March
Lightly rake over the sown plot(s) to incorporate the seeds into the soil.	February-March
Survey and ongoing management	
Adult/flowering plant survey.	May-June
Continued autumn cultivation of the reintroduction site.	September-October and ongoing if the reintroduction is successful
Annual adult/flowering plant survey.	May-June and ongoing to monitor the population.

Table 2: Reintroduction plans based on autumn or spring sowing.

private farms in Cambridgeshire and Wiltshire that have been sustained by re-sowing interventions. Some have failed for a variety of reasons, including poor weather (i.e. rainfall causing flooding and the growth of Field Horsetail *Equisetum arvense*); misadventure (i.e. illicit vehicles crossing the reintroduction site in winter crushing the plants); grazing by rabbits; or succession of the reintroduction site to perennial vegetation. The ideal would be for a population to become self-sustaining without further sowings, but this is still some way away and more information about the plant's ecology and suitable conservation management methods is probably still needed^{13,14,15,16}. Nonetheless, in 2019, plants were present at four of the five recent reintroduction sites listed above.

Sowing in early autumn is typically regarded as the optimal time, although larger and more productive plants can develop from spring-sown seed that do not flower in their first year, producing significantly more seed as they flower in their second year. Seed should be sown onto moist, bare ground when the

temperature is likely to remain at or above 10°C until germination is complete (Table 2).

An optimal sowing rate for arable plant reintroductions of 50-100 seed/m²¹⁷. Interrupted Brome does not display seed dormancy and a high proportion of viable seed exposed to suitable conditions may germinate. Therefore, lower initial sowing rates may produce good results and make optimal use of scarce seed, although a higher rate is likely to result in a larger population and promote more rapid development of a large soil seed bank. It is notable, however, that in sown populations at Ranscombe Farm Reserve, an initially low-density

population has slowly increased in number, while the numbers in an initial, much higher density, population rapidly declined.

1 g of dry Interrupted Brome seed contains approximately 382 individual seeds.

Early autumn is the optimal time for sowing although more productive plants can develop from spring-sown seed that do not flower in their first year

Reintroducing Interrupted Brome at Ranscombe Farm Reserve

In October 2015, seeds of Interrupted Brome were sown in two small patches at Ranscombe Farm Reserve. Both were on field margins on south-facing, chalky soil.

The sown material consisted of loosely broken-up spikelets, mixed with fine gravel, which was broadcast by hand on bare, cultivated ground, and then lightly raked in. Approximately 2,000 seeds were broadcast in one plot (Plot 1) over an area of around 10 x 2 m, while 1,000 seeds, or perhaps fewer, were sown in the second patch (Plot 2) over an area of around 5 x 1.5 m.

In each subsequent year, the plots were cultivated in October to produce bare ground with a fine tilth. This was done either by tractor-mounted disc-harrow as part of the farm's general arable margin maintenance or, where this could not be done at the appropriate time, by use of a power rotavator. No subsequent reinforcement sowing was carried out.

Each year, in a period between mid-May and mid-June, the population was monitored by carrying out a survey of the number of flower-heads, using a quadrat to sample denser populations, or a straight count where smaller numbers of plants were present. Numbers of plants were not counted, because of the difficulty of identifying individuals where plants were closely crowded and tillering. In more recent years, the precision of the sampling has been increased by using 10 randomly placed quadrats, their locations determined using random number tables (the area to be surveyed is measured in both width and length, and then pairs of

random numbers – one for distance along the length, and the other for distance across the width – are used as coordinates to place each sample).

In 2016, Plot 1 produced an estimated 9,000+ flower-heads (some 190 per m² over a surveyed area of 9 x 2 m), while Plot 2 produced just 146 flower-heads. Over the following four years, the population in Plot 1 declined to around 178 flower-heads, while the population in Plot 2 increased to around 3,100 flower-heads (Figure 10). This suggests that lower-density sowings may be more effective in the long term, though differences in the nature of the two plots may also have had an impact. The areas occupied by the plants have also changed: Plot 1 was originally sown over an area of around 10 x 2 m, but

occupied 16 x 3 m in 2020; Plot 2 started as 5 x 1.5 m, with plants occupying 58 x 6 m in 2020. Densities were therefore around 3.7 flower-heads/m² (Plot 1) and 8.9 flower-heads/m² (Plot 2) (Figure 11).

Each year, a number of seed-heads are collected, separated and cleaned, and then stored over silica gel in a domestic fridge, as both a safeguard against possible future failure and a source of seed for further reintroductions. In 2016, seeds were sown into additional plots on a north-facing arable field margin. Although these plots were initially successful, unfortunately, they were heavily grazed by rabbits in 2018 and were subsequently abandoned.

Results suggest that lower-density sowings may be more effective in the long term

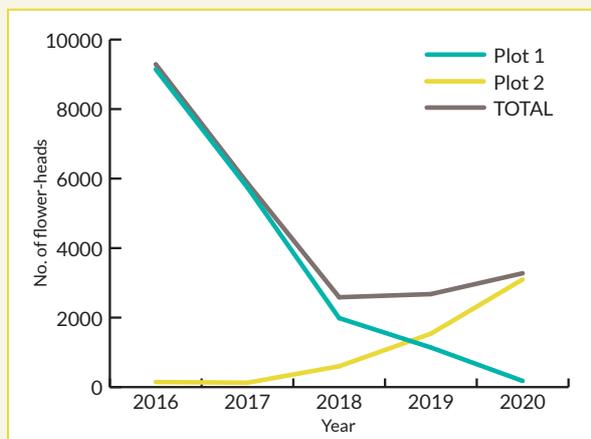


Figure 10: Changes in the number of flower-heads in two reintroduction plots over a 4-year period.

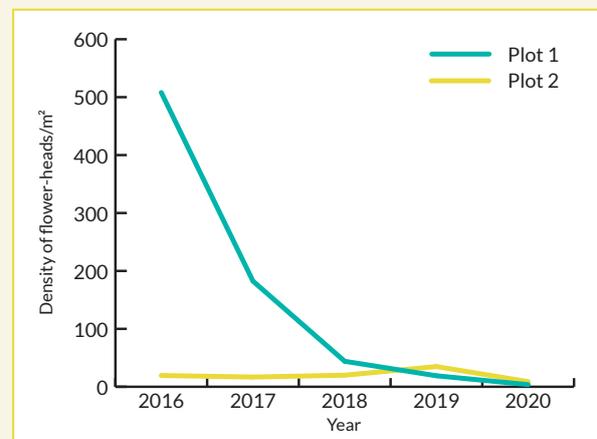


Figure 11: Changes in the density of plants in two reintroduction plots over a 4-year period.

Areas for further research

Seed longevity

Further research is required to elucidate the longevity of Interrupted Brome seed in the soil seed bank under a variety of conditions as this is currently poorly understood and would aid in the reintroduction process.

The effects of different seasonal sowing times

The relative merits of sowing seeds in the spring and autumn and how this might affect seed productivity

is another area which requires further research. Hitherto, autumn sowing has been recommended for Interrupted Brome, but the highly productive flowering of overwintering spring-sown plants demonstrated at Ranscombe Farm provides some evidence that it can act as a biennial. However, the spring-sown sites were not surveyed for non-flowering vegetative plants in their first summer, so it is unclear whether these germinated in spring/summer or remained as seed through summer to germinate in early autumn.

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Contributors



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Glossary

- Tiller – A lateral stem produced from near the base of a plant's stem.
- Tillering – The process of plants producing multiple lateral stems from near the base of the stem.
- Spikelet – The basic unit of a grass flower.
- Lemma – The lower bract of the floret of a grass.
- Awn – A hair- or bristle-like appendage.

Case studies

- *Observations from reintroduction sites* by Fred Rumsey (Natural History Museum), page 5
- *Comparing responses on different soils and at different sowing times* by Richard Moysé (Plantlife), page 7
- *Response to lack of management* by Fred Rumsey (Natural History Museum), page 8
- *Reintroducing Interrupted Brome at Ranscombe Farm Reserve* by Richard Moysé (Plantlife), page 13

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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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