

Response of broad-leaved cudweed *Filago pyramidata* to cultivation under Environmental Stewardship at Ranscombe Farm Reserve, Kent, UK

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SUMMARY

Broad-leaved cudweed *Filago pyramidata* is a UK Red List, Endangered plant with only seven extant sites. The most important of these is Ranscombe Farm, now a reserve managed by Plantlife. From 2005 onwards, Plantlife extended targeted cultivation for broad-leaved cudweed across existing arable land with the support of Natural England's Environmental Stewardship scheme. This led to the appearance and rapid spread of broad-leaved cudweed in new locations on the site and a population increase from a previous estimate of 60,000 to more than 3,000,000 plants.

BACKGROUND

Broad-leaved cudweed *Filago pyramidata* is a rare, annual plant associated with arable fields and other, regularly disturbed habitats (such as abandoned quarries, roadsides, paths and hedge banks) in south-east England (Rich 1995). It has formerly been found as a native plant at 240 sites in 123 10 km squares, but by 1993-94 was known only from seven sites in seven 10 km squares (Rich 1995). Because of this decline, it is included on the UK Red List as Endangered, protected under the Wildlife and Countryside Act 1981, and has been included on the government's list of species of principal importance for nature conservation in England (Habitats and species of principal importance in England).

Historically, one of the most important sites for broad-leaved cudweed in the UK is a single field at Ranscombe Farm in Kent, known as Kitchen Field, which forms part of the Cobham Woods Site of Special Scientific Interest (SSSI). This field has long been known as supporting an exceptionally rich arable flora, including corncockle *Agrostemma githago*, ground-pine *Ajuga chamaepitys*, blue pimpernel *Anagallis arvensis* ssp. *foemina*, stinking chamomile *Anthemis cotula*, dwarf spurge *Euphorbia exigua*, Venus's looking-glass *Legousia hybrida*, hairy mallow *Malva hirsuta*, prickly poppy *Papaver argemone* and rough poppy *Papaver hybridum*, as well as more common arable plants.

Kitchen Field is now part of the Ranscombe Farm Reserve, a 250 ha area of arable, woodland and grassland managed by Plantlife. Ranscombe Farm was established as a nature reserve in 2005 following its acquisition by a partnership of Plantlife and Medway Council. At the time of acquisition, the bulk of the arable land was farmed conventionally and Kitchen Field was the only known location for broad-leaved cudweed.

ACTION

Until 2005, Kitchen Field was the only part of the site managed specifically for arable wild plants, under an agreement with the then English Nature dating from 1985. From 2005 onwards, a number of areas previously under

conventional arable management were put into management for arable wild plants. Initially this consisted of two field margins on shallow, chalky soils (Longhoses margin and Twenty Acre margin) managed under a voluntary arrangement. In 2008, the whole of the site's arable land was entered into Environmental Stewardship. Around 1.17 ha of field margins, including those at Twenty Acre, were entered into management for rare arable plants under Entry Level Stewardship option EF11 (uncropped cultivated margins for rare plants; Anon 2010a). In addition, both Kitchen Field (4.6 ha) and Longhoses Field (3.9 ha) were entered into a form of the Higher Level Stewardship HG7 option (Anon 2010b) modified to incorporate previous management recommendations intended to promote populations of rare arable plants (Wilson 2003). These areas are shown in Figure 1, and their management summarised in Table 1.

The costs of the work were borne by the tenant farmer, who received the payments under Entry Level and Higher Level Stewardship. The headlands are included within Entry Level Stewardship (paid at a flat rate of £30 per hectare provided a particular package of works is delivered), while Kitchen Field and Longhoses Field are included under an option in the Higher Level Stewardship scheme, which pays £250 per hectare. Because the management work is carried out by the tenant farmer as part of other arable management work, it has not been possible to determine absolute costs. Although the arable land managed under Environmental Stewardship is largely on the less productive soil, the potential income to the tenant farmer from conventionally farming these areas (the gross margin minus the cost of field operations) has been estimated at £488 per hectare, substantially more than the £250 per hectare paid through Higher Level Stewardship (Silcock 2012). It is also an important economic consequence of the agri-environment measures that no harvestable crop (cereals: usually winter wheat or spring barley) has been produced from either Kitchen Field or Longhoses Field since at least 2011.

Rich (1995) gives a summary of population estimates for broad-leaved cudweed at Kitchen Field from 1984 to 1994. The survey method upon which these are based are not given, though it is understood that a 1994 population estimate was based on counting numbers of plants in five 2 x 2 m quadrats,

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Table 1. Areas managed for arable wild plants.

Location	Size	Pre-2005 treatment	2005-2008 treatment	2008-2012 treatment
Longhoes margin	0.23 ha (385 x 6 m)	Conventional arable management	Cultivated using minimum tillage, but not sown, in autumn 2005. Not cultivated in 2006. Cultivated again in autumn 2007.	Managed as part of Longhoes Field.
Twenty Acre margin	0.35 ha (585 x 6 m)	Conventional arable management	Cultivated using minimum tillage, but not sown, in autumn 2005. Not cultivated in 2006. Cultivated again in autumn 2007.	Cultivated in autumn using minimum tillage, but not sown and not treated with fertiliser or herbicide.
Southern Valley margin	0.59 ha (980 x 6 m)	Conventional arable management	Conventional arable management	Cultivated in autumn using minimum tillage, but not sown and not treated with fertiliser or herbicide.
Longhoes Field	3.9 ha	Conventional arable management	Conventional arable management	Cultivated in autumn using minimum tillage and sown, but not treated with fertiliser or herbicide.
Kitchen Field	4.6 ha	Autumn cultivation and sowing, using minimum tillage, with limited fertiliser and herbicide use	Autumn cultivation and sowing, using minimum tillage, with limited fertiliser and herbicide use.	Cultivated in autumn using minimum tillage* and sown, but not treated with fertiliser or herbicide.

* In autumn 2011, Kitchen Field was not cultivated. Instead, it was ploughed in spring 2012.

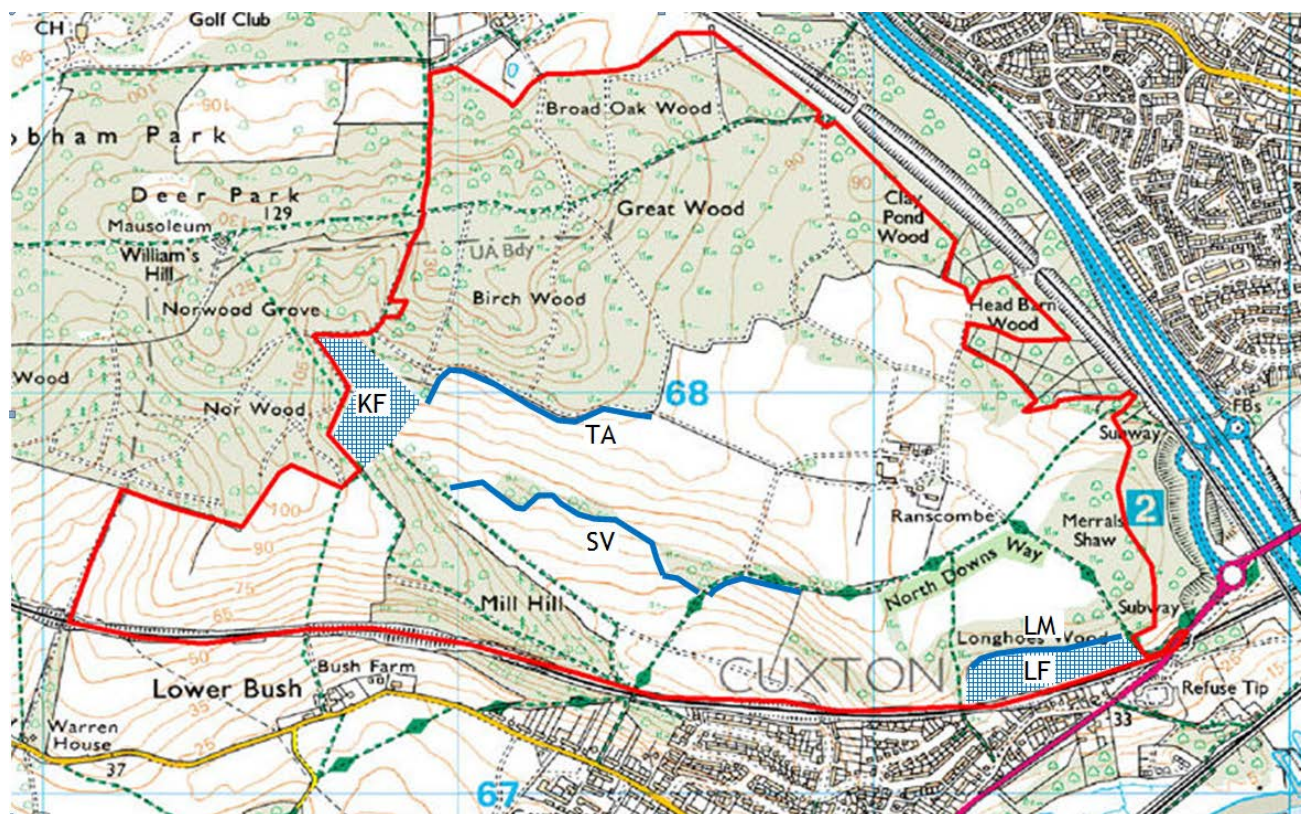


Figure 1. Treatment of fields and headlands mentioned in the text. Red outline: Ranscombe Farm Reserve; blue hatched areas: KF = Kitchen Field, LF = Longhoes Field; heavy blue lines: LM = Longhoes margin, SV = Southern Valley margin, TA = Twenty Acre margin.

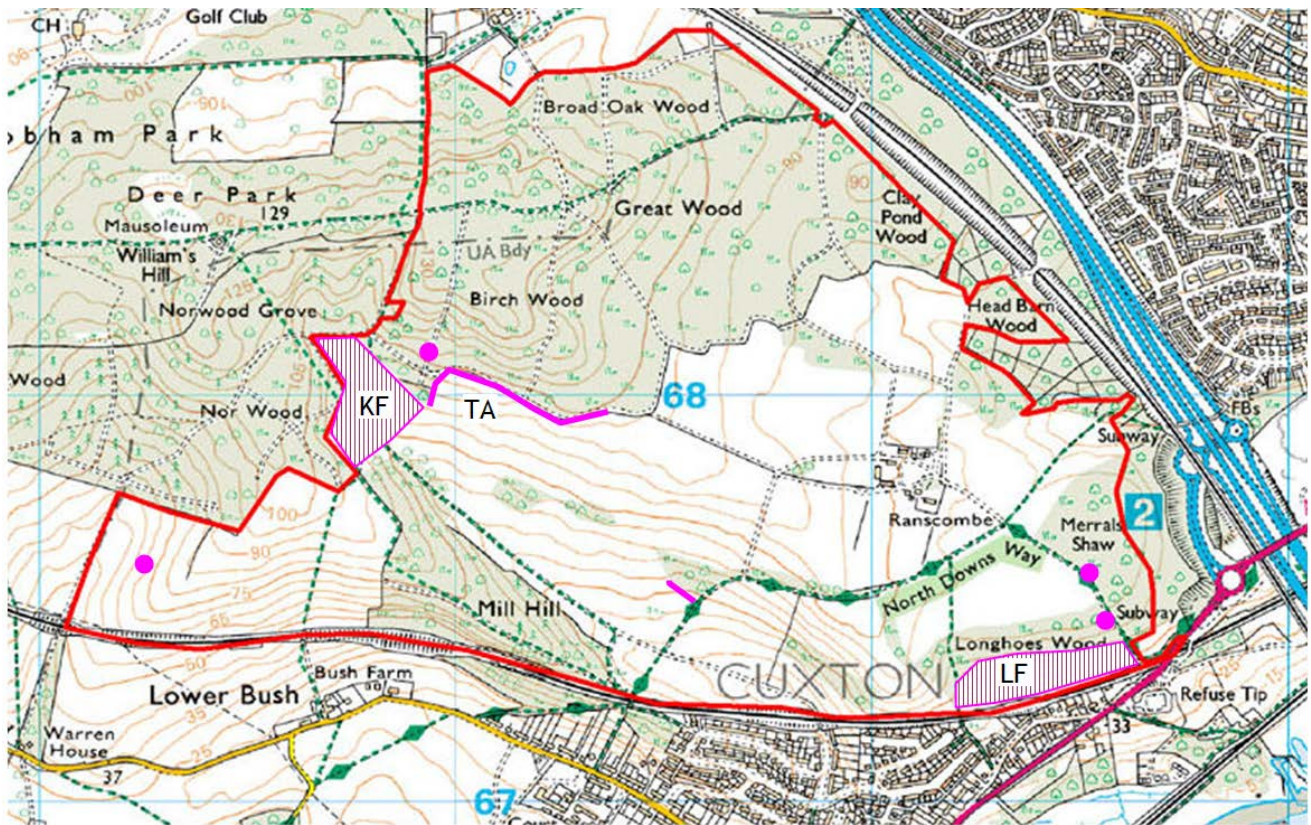


Figure 2. Distribution of broad-leaved cudweed at Ranscombe Farm Reserve in 2012. Red outline: Ranscombe Farm Reserve; hatched areas: fields in HLS - KF = Kitchen Field, TA = Twenty Acre, LF = Longhoes Field; pink lines show extent of broad-leaved cudweed in uncropped margins; pink spots show sites where small numbers of plants were found. Crown copyright 2012. All rights reserved. Ordnance Survey Licence No. 100032779.

and extrapolating the figures to the whole area occupied by the plant (Tim Rich, pers. comm.).

In summer 2012, surveys were carried out to establish the distribution of broad-leaved cudweed at Ranscombe Farm and to estimate populations in Kitchen Field and Longhoes Field. In Longhoes Field, this consisted of randomly placing fifty 0.5 x 0.5 m quadrats across the whole area of the field, counting individual plants, and extrapolating this to the whole area of the field. In Kitchen Field, where the population was less dense, forty-nine 0.5 x 0.5 m quadrats were randomly placed across a sample area of approximately 16,000 m². In both cases, all individual plants rooted within the quadrat were counted. No counts were made of populations in uncropped margins, but the length of the margin occupied by broad-leaved cudweed was established using a hand-held GPS. Data from Longhoes Field was transformed to log₁₀ before the mean (i.e. the geometric mean) and standard deviations were calculated; zero counts were ignored. Data from Kitchen Field remained highly skewed even after transformation to log₁₀; consequently, confidence intervals could not be assigned and only the arithmetic means could be calculated.

CONSEQUENCES

Prior to 2005, broad-leaved cudweed was only known at Ranscombe Farm from Kitchen Field, where an estimated 60,000 plants were present in 1994 (Rich 1995). The result of initially leaving the 6 m-wide, uncropped margins in Longhoes Field and Twenty Acre was the appearance, for the first recorded time, of broad-leaved cudweed in both fields. The

margins were left unmanaged from autumn 2005 and through 2006, and, in 2007, 'strong populations' of broad-leaved cudweed were noted in the margin of Twenty Acre, while the population in Longhoes Field was considered to consist of 'many thousands' of plants. (Anon 2007).

The distribution of broad-leaved cudweed at Ranscombe Farm Reserve in 2012 is shown in Figure 2. As well as extensive populations across both Kitchen Field (the site of the original population) and Longhoes Field, there were also significant populations along around 450 m of headland at Twenty Acre (thousands of plants) and around 75 m on a headland on the south-facing slope of the southern valley (dozens of plants). Individual plants or small groups of plants were also noted in open woodland and on the margin of an intensive arable field north of Longhoes Field, in open woodland north of Kitchen Field, and in an experimental chalk 'scrape' created within grassland in the south-west of the reserve (the scrape being over 500 m from the nearest known population).

The population of broad-leaved cudweed in Longhoes Field was especially dense, presenting difficulties in counting, particularly where very small plants were present and where plants grew particularly closely together. It was not uncommon to find small groups of plants growing so closely together that their stems appeared to arise from the same point on the ground, so that they could only be established as separate individuals by carefully pulling at one or two of the stems. Ten of the quadrats contained more than 100 individual plants, and one held an estimated 400 plants. However, the population was also patchy, with four quadrats holding no plants. The geometric mean number of plants/quadrat was 25, with a lower

Table 2. Population figures for Longhoses and Kitchen Fields.

Location	Pre-1994	1994	2007	2012
Longhoses Field	No data available. Apparently not known as a location for this species.	No data available. Apparently not known as a location for this species.	'many thousands'	3,040,000
Kitchen Field	500 (1985) 5,000+ (1987) 10,000+ (1988) 'large numbers' (1989) '100s of thousands' (1992) 'thousands' (1993)	60,000	No data	166,000

95% confidence limit of 17 plants and an upper limit of 38 plants/quadrat; this equates to 3,040,000 plants across the whole field, with lower and upper 95% confidence limits of 2,010,000 and 4,560,000 respectively.

In Kitchen Field, sampling of the 16,000 m² area produced an arithmetic mean of 2 plants/quadrat, equivalent to 7 plants/m². It is estimated that not more than half of Kitchen Field supports broad-leaved cudweed at the density of the sample area, suggesting a population of 166,000.

Non-target effects: A number of other important arable plant species have appeared within the areas managed under Environmental Stewardship. Longhoses Field now also supports corncockle, stinking chamomile, Venus's looking-glass, prickly poppy and narrow-fruited cornsalad *Valerianella dentata*; this last being present in many thousands. The headland in Twenty Acre also supports narrow-fruited cornsalad and stinking chamomile, and a single plant of corncockle was reported in 2012. In the southern valley headland, broad-leaved cudweed is associated with a small population of common cudweed *Filago vulgaris*. None of these plants was deliberately introduced.

A less welcome impact of cultivation under Environmental Stewardship has been the appearance of pernicious weeds including creeping thistle *Cirsium arvense* and perennial sowthistle *Sonchus arvensis*. The use of minimum tillage also appears to lead to the rapid establishment of perennial grasses and species such as black medick *Medicago lupulina*, which was abundant in Longhoses Field in summer 2012. Further work is planned to determine how this might best be managed.

DISCUSSION

Broad-leaved cudweed at Ranscombe Farm Reserve has responded rapidly to the application of appropriate agri-environment cultivation measures, supported by Natural England's Environmental Stewardship scheme.

The rapid appearance of large numbers of plants where previously unrecorded would suggest that these populations arose from buried seed. However, the occurrence of small numbers of plants along paths and in other isolated locations suggests incidental movement of seed by people, animals or vehicles might also be the source of any of the new populations.

Minimum tillage in the absence of herbicide not surprisingly leads to an increase in perennial plants, including pernicious weeds. Further work is planned at Ranscombe to compare the responses of perennial plants to different cultivation regimes.

Broad-leaved cudweed was historically known as a plant of arable farmland, and Rich (1995) suggests that increased nitrogen inputs, changes in timing of cultivation and the introduction of herbicides are all likely to have contributed to its decline in this habitat. The modified agri-environment measures implemented in Kitchen Field and Longhoses Field have sought to address these issues and have led to the increase and spread of broad-leaved cudweed populations, as well as other arable wild plants. However, they have also resulted in a decline in crop productivity such that no harvestable crop is now being produced. Having no crop on the areas managed for arable plants is not desirable at Ranscombe Farm, but is seen as less important than the increase in the sizes of wild plant populations. There is clearly a trade-off between farming profitability and wild plant population size, and there is some middle ground as, for example, management of cultivated, uncropped margins can maintain plant populations while minimising impact on crop production. It remains to be seen whether there is a balance which could be achieved across a whole field by reducing crop density, fertiliser inputs and/or herbicide use and, if so, how the costs of this compare with concentrating crop production and plant conservation in separate parts of the field.

ACKNOWLEDGEMENTS

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