# Good Practice Guidance for Reintroduction of Rare Arable Plants to Arable Farmland

## Introduction

Plants are the basis of all food-chains on land; without an environment that is rich in wild plants, we cannot hope to conserve and restore other wildlife. So, it is understandable that many people and projects look to restore flower-rich habitats by sowing wildflower seed. Sowing of seed may also be seen as a relatively easy way of restoring the fortunes of rare species.

Yet this approach carries some very real risks. It can displace plants that are already present or can alter the nature of existing habitats or communities of plants. It can result in the creation of uniform plant communities, based on the kinds of seeds available, rather than encourage locally distinctive assemblages of plants which reflect the local environment and local landscape history. Unusual forms or varieties of plants, or occasionally unusual species, may be introduced which, again, fail to reflect local conditions. It may even result in harm being done to existing populations of rare species. At the very least, it can distract attention from the root causes of species' decline and extinction in the countryside.

In the case of animals, release and reintroduction into the wild is always seen as very much the last resort, when there is no hope of a species recolonising its old range, even if environmental conditions are otherwise entirely suitable. It is important that a similar approach is applied to plants. To conserve wild plants and the other wildlife they support, the priority must be protection of the remaining pockets of wildflower richness; restoration of plant-rich habitats using natural regeneration from the soil seed bank; and linking flower-rich habitats across landscapes so that species can spread by natural colonisation, assisted by movement of livestock, wildlife and other natural processes.

Nonetheless, with continued reductions in local plant diversity[1], deliberate planting may be the only practical way to restore the wild plants that were once found on a particular farm or in a particular area of countryside. This document attempts to provide guidance on a 'good practice' approach to the reintroduction of plants in a way which respects the 'wildness' of wild plants, avoids the potential pitfalls associated with reintroductions, and carries the best chance of success. Getting it right is important: one study found that of 50 plant reintroduction projects which had been monitored for 10 years, 30 had failed after this time[2].

Note that this document specifically focusses on rare annual wild plants associated with arable farmland. Although much of the guidance is relevant to other plant species, different approaches may be necessary in the case of biennial or perennial plants or other habitats, such as heathland, grassland or woodland.

This document also relates only to what the International Union for Conservation of Nature define as a "reintroduction", which is the deliberate introduction of a species within its known geographical range. For the purposes of this document, this means the known range of the plant within the British Isles[3]. So, by this definition, it would still be reintroduction where seeds are sown on a site where the plant has never previously been known to occur, so long as there are places to the north, south, east *and* west where the species is still found or once occurred. This is important, as introductions *outside* the known range of a species (which might well be necessary at some stage in response to climate change) require a great deal more care and consideration of factors beyond the scope of this document.

This guidance is about reintroductions into the 'wild'. That is, where plants are reintroduced to the wider farmed landscape, with the intent of establishing a self-sustaining, wild population. In general, and with the exception of invasive species, the reintroduction of plants in gardens and other greenspace within built-up areas poses few risks and can be carried out without reference to this good practice guidance, provided that it is done legally and with full land-owner permission.

There is a great deal more information and detailed guidance on plant reintroductions in these publications:

- *Centre for Plant Conservation's Best Practice Guidelines for the reintroduction of rare plants*[4]
- *Plant Reintroduction in a Changing Climate*[5]

Both documents were used extensively in drawing up this good practice guidance document.

## Good practice guidance

### 1. Be certain that reintroduction is the best option

It is important always to remember that reintroduction is not an alternative to protecting a plant in the place and habitat in which it still occurs and is never the first in step in conserving even a critically endangered species. Please consider whether other types of management, particularly protection and management on the plant in its existing location, may be a better option with less risk of failure. Before you go ahead, make sure that reintroduction is the best option.

Remember that many arable plants have long-lived seed that can survive in the soil for decades. The first step in trying to restore rare species to arable farmland, or to land which was once under arable cultivation, should be deep cultivation of the soil to see what plants establish from buried seed[i].

[i] At Plantlife's Ranscombe Farm Reserve in Kent, applying appropriate management (typical arable cultivation, but without application of fertilizers or herbicides) led to the appearance of rare plants including narrow-fruited cornsalad, broad-leaved cudweed and corncockle, without the need for reintroduction.

Broad-leaved Cudweed © Cath Shellswell

Species listed under Schedule 8 of the Wildlife and Countryside Act 1981 are protected and it is an offence to intentionally pick, uproot or destroy any of these plants unless authorised to do so. In England, annual plants that grow in arable habitats that are included on the list are:

Field Cow-wheat *Melampyrum arvense*
Broad-leaved Cudweed *Filago pyramidata*
Red-tipped Cudweed *Filago lutescens*
Cut-leaved Germander *Teucrium botrys*
Grass-poly *Lythrum hyssopifolia*
Rough Mallow *Malva setigera*
Perfoliate (Cotswolds) Pennycress *Microthlaspi perfoliatum*
Ground-pine *Ajuga chamaepitys*
Greater Yellow-rattle *Rhinanthus angustifolius*

Only go ahead with the reintroduction where the plant has gone entirely from the area or where the threats to the plant's remaining populations are so severe and difficult to control that extinction is likely to be imminent. Do not go ahead if doing so could undermine the case for the protection of existing sites, or where you cannot be certain that the threats to the plant's long-term survival have not been minimised or managed at the reintroduction site.

Never go ahead with a reintroduction where this might threaten other species at the reintroduction site, either directly or through the management necessary for the reintroduced species. For example, it is important to know what plants are present at the reintroduction site, and, in the case of arable land, what plants might re-establish from buried seed if the right management is applied. Although arable plants generally respond well to annual cultivation, some have a strong preference for either spring or autumn cultivation: changing the timing of cultivation to suit the reintroduced plant might then result in decline or loss of existing plant species. In addition, the depth of cultivation may also be a factor in the long-term survival of a population.

**Have a clear plan for reintroduction**

It is good to a have a written plan for the reintroduction. This will help with communication both during the work, as well as afterwards when it will be useful in understanding what kind of reintroduction work and aftercare works best. In this respect, there is value in designing the reintroduction as an experiment where results can be measured.

The following are key issues which should be considered when planning a reintroduction:

- **Can it be done legally?** Certain plants are protected by law, so collection of seed would require a licence from the relevant statutory agency. For example, this would include species listed on Schedule 8 of the Wildlife and Countryside Act 1981[6]. Some sites are also legally protected, such as Sites of Special Scientific Interest. Land-owner permission should always be obtained.
- **What are the goals of the reintroduction?** A key goal will be establishing a self-sustaining local population of the plant species concerned. Could there also be wider benefits for biodiversity and people?
- **What risks might there be?** For example, a reintroduction might result in to unacceptable, negative effects on other species or habitats at the release site.
- **Have threats been reduced or eliminated at the reintroduction site?** For example, is the management of the reintroduction site suitable for the plant being reintroduced? Are there threats from grazing animals? For example, rabbits have proved a problem with some plant reintroductions.
- **Do you have enough information about the plant's biology and ecology?** Knowing the life history of the plant will be important in planning the reintroduction and also in understanding whether the work has been a success. It is particularly important to know about the seed biology, including maturation of the seed after being shed from the parent plant and dormancy processes, so that seed can be sown at the right time for germination.
- **How many plants or seeds are available and how many are needed?** 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, then you may need to 'bulk-up' the amount of seed by growing the plant in cultivation for a year or two. See below for some more information on selecting the right seed.
- **How will you know if the reintroduction is a success**? Some sort of monitoring will be necessary (see below for more information). It is recommended that arable plant reintroductions should be monitored for at least 3 years and if possible 10 years or more. Any monitoring should note that this is a reintroduction so that the data is acknowledged as being purposely sown rather than being a population that has been rehabilitated from buried seed in the soil seed bank.
- **What management will be needed, and how frequently?** Because the intention of a reintroduction is to create a self-sustaining population, you need to know what management will be needed long-term, how it will be carried out and who will carry it out.

Locally sourced seed is likely to be better adapted towards local conditions. Grassland plants grown from seed from the same region have been found to produce 10% more flowers and 7% more biomass compared with the same species but taken from further afield[7]. This fitness of plants reduces with increasing distance from seed origin and/or increasing climatic differences between the plant origins and reintroduction site. Although arable plants would originally have been transferred between sites in crop seed, there is a current debate about whether this is the correct practice to follow for rare plants now, as some populations have been relatively

isolated for a period of time. Good practice is always to use locally sourced seed wherever possible.

Seeds for a reintroduction should be from a location or locations that have similar environmental conditions to the reintroduction site. For instance, they should be from plants growing on similar soil and geology, with similar exposure to sun, similar rainfall, etc. The chances of success can also be increased by using material from a number of locations, so that the seeds have greater genetic diversity while still representing the local gene pool.
In general, it is recommended that seed from existing collections is used in the first instance, where this is available, rather than collecting new seed from the wild. Where seed needs to be 'bulked-up' by growing plants in cultivation then it is important to be careful to maintain the genetic variability of the source material and avoid the easy temptation of growing seeds on from the most obviously vigorous and productive plants. In any case, keep a record of the source of any material used for a reintroduction.

Research suggests that successful reintroduction is likely to need an initial population of more than 50 adult plants. Where seed is used, then this could mean using as many as 5,000 seeds in the first instance, to allow for a germination rate which could be as low as 1%. A larger initial population is more likely to be successful, but never use all your source material in a reintroduction, and always keep some back in case of failures.

**3. Make sure the reintroduction site is suitable**

When choosing a suitable reintroduction site, look for similar environmental conditions (such as the existing plant community, aspect, shade, soil type, climate, etc.) to places where the species is currently thriving. Site selection makes a real difference to the success of a reintroduction project, so there is value in considering a range of potential sites and choosing the best of these.

Always pick a site which is protected in the long-term from any threats likely to affect the reintroduced species, and where it is possible to maintain suitable habitat management.

Until recently, the seed biology of Pheasant's-eye was not well understood. We now know that the May-June flowers produce immature seed that is shed from late June onwards. The seed rests on top of the soil where it continues to ripen in the summer warmth. The seed does not mature if there is not enough summer warmth, and it needs to be sown before the end of July to naturally ripen. Artificial ripening has been successfully undertaken by heating the seed at constant temperatures for a sustained period of time.

Pheasant's-eye © Cath Shellswell

Choose a site where there is room for the reintroduced species to increase in number and to spread. If a large enough area is available, then sowing seed or transplanting individual plants in small patches throughout the recipient area, instead of in one large block, may increase the chance of spread. It is even better if the site is close to or linked with similar adjacent habitat, so that there is a greater chance of spread to new locations.

Never reintroduce plants to a site unless you have the full consent of the land-owner: land-owners and managers will need to be supportive of the reintroduction and of any associated future management. You may even want to have a written agreement to set out things like who is responsible for what work.

Where the reintroduction involves designated sites such as Sites of Special Scientific Interest, then consultation with the relevant statutory agency will be necessary, and their written permission must be obtained.

**4. Carry out the necessary aftercare and monitoring**

Have a plan for the long-term, so that the type and timing of management work has been considered before the reintroduction takes place. In the early stages, management may need to be quite detailed and specific, and might even include initial watering of seeds to promote germination or weeding during the initial stages of plant establishment.

For annual plants, some monitoring will be needed every year to check on the success of the reintroduction. In the first few years, at least, this will involve counting or estimating the size of the population and also measuring how far it has spread beyond the area initially sown. Monitoring is easier to do if the seeds are sown into clearly identifiable areas, with plots marked, mapped or identified in relation to permanent site features. This will make it easier to find the locations in subsequent years so that plants can be counted, and also make it very easy to see where plants have spread beyond the initially sown area. Small numbers of plants can be counted individually. For larger populations, a population can be estimated by measuring its extent (width x length) and then placing a number of 1x1 m quadrats at random locations within the area; the average count per quadrat can then be multiplied up to give a total estimate. Be careful to use random numbers to place the quadrats and count as many quadrats as you can to get the most accurate estimate[ii] or use a running average if this is easier.

Monitoring should be carried out for at least three years and ideally for a decade or longer. Monitoring will need to be more thorough where a population is not increasing and spreading, and especially where it is declining. Where a population quickly increases and spreads, it is reasonable to reduce the intensity of the monitoring work, for example, using less precise population estimates, rather than population counts. Once a population is clearly well established and thriving, it may only be necessary to monitor every few years to check there have been no major changes.

[ii] At Plantlife's Ranscombe Farm Reserve in Kent, estimates of populations of reintroduced Interrupted Brome are made by roughly measuring the length and width of the area occupied by the plants using a tape measure. Then a series of random co-ordinates (so many metres along the length, and so many metres across the width) for quadrats are identified using the random number generating formula in Microsoft Excel.

If monitoring shows that the reintroduced population is not doing well, then it is important to understand if this is related to management and adapt the management if needed, and whether further seed is needed in order to reinforce the population.

Whatever the outcome, there is tremendous value in keeping good written records of the initial reintroduction and of the management and monitoring. Having this information will allow results to be shared, which will help with future management and reintroduction work by yourself and by others. So consider lodging any monitoring data with your local Biological Records Centre or county botanical recorder or local botanical recording group (see https://bsbi.org/local-botany for details).

---

[1]Plantlife (2012) Our Vanishing Flora. https://www.plantlife.org.uk/uk/our-work/publications/our-vanishing-flora. Last accessed 23/11/2020.

[2] Dalrymple, S.E. *et al*. (2012) A Meta-Analysis of Threatened Plant Reintroductions from across the Globe. In Maschinski, J. & Haskins, K. E. (eds). 2012. Plant Reintroduction in a Changing Climate. Center for Plant Conservation. Island Press, Washington. pp. 31-50.

[3] BSBI, BRC, UKCEH and JNCC (undated) Online Atlas of the British and Irish. https://www.brc.ac.uk/plantatlas/. Last accessed 23/11/2020.

[4] Maschinski, J. and Albrecht, M.A. (2017) Centre for Plant Conservation's Best Practice Guidelines for the reintroduction of rare plants. Plant Diversity 39: 390-395.

[5] Maschinski, J. and Haskins, K. E. (eds). 2012. Plant Reintroduction in a Changing Climate. Centre for Plant Conservation. Island Press, Washington.

[6] Wildlife and Countryside Act 1981 Schedule 8 List https://www.legislation.gov.uk/ukpga/1981/69/schedule/8. Last accessed 12/11/2020.

[7] Bucharova, A., Michalski, S., Hermann, J., Heveling, K., Durka, W., Hölzel, N., Kollmann, J. and Bossdorf, O. (2017) Genetic differentiation and regional adaptation among seed origins used for grassland restoration: lessons from a multispecies transplant experiment. Journal of Applied Ecology, 54; 127–136.