Keeping the wild in wild flowers? – further comment

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I was pleased to read the note by Kevin Walker in BSBI News 133 in which he discusses the BSBI perspective on the use of seed of native species to create and restore plant communities in the wild. He presents a very balanced and well-reasoned account, building on the sound guidance provided by Flora locale (2016) and Plantlife (2016). To this I would like to add further comment, from the perspective of a farmer, and as a grower of native seeds (Wildseed, 2016).

To seed or not to seed?

Our native flora has changed over time due to factors acting on species loss, gain and adaptation. Over the last 100 years there has been net loss of native species diversity as the landscape has changed from one dominated by species rich agricultural grasslands and arable, to a landscape now dominated by species poor grasslands and arable. Species richness is now largely confined to non-intensive managed grasslands on poor land, and around infrastructure, such as motorways. The principal cause of change has been agricultural intensification and built development. The policy response has been to strengthen the network of protected areas, and elsewhere, create and restore species rich grasslands. Delivery has been mainly via a succession of agri-environment schemes and planning obligations. The Environmentally Sensitive Areas (ESA) Scheme (from 1987) sought to improve species diversity of grasslands by management alone, and had mixed results. The Countryside Stewardship Scheme (from 1991) supported the use of native seed to create species rich grassland on former arable land. More

recently, Higher Level Stewardship (from 2003) has also supported arable reversion, as well as the sowing of seeds to diversify existing species poor grassland. These schemes, and the work of individuals and organisations across the British Isles, have contributed to biodiversity (Pywell *et al,* 2012).

Genetic effects

Genetic robustness is central to the survival and well being of our native plants (Gregory *et al,* 2006). Populations of species will survive better if they are composed of well adapted ecotypes that are also sufficiently genetically diverse to be able to evolve in response to environmental change. The main threat to genetic robustness is small population size and restricted gene flow. Three other factors, "genetic swamping" "outbreeding depression" and "invasive aliens", may, or may not, be a threat to wild populations. These factors should not be dismissed, nor seized upon to justifying an extreme precautionary approach to sowing seed.

- "Genetic swamping" proposes that genes from an introduced population replace genes in an established wild native population by shear force of numbers through introgression. This seems unlikely as all genes are subject to natural selection in the wild. Unfit genes are at a disadvantage, so called "neutral genes" may introgress at random, and fit genes are at an advantage, all regardless of the quantity of "genetic swamping". For example, unfit genes, such as for red flower colour in *Primula vulgaris* (Primrose) or white flower colour in *Centaurea nigra* (Common Knapweed) do not survive the force of natural selection in the wild, despite repeated opportunities for introgression. "Genetic swamping" is an interesting concept, but there is little evidence that it occurs in the wild.

- "Outbreeding depression" proposes that wide crosses between introduced and established populations within species break up

adaptive gene clusters, and result in loss of vigour in the established population. However, outbreeding in most species is normal and desirable, generating heterosis. It is the reason wild flowers have flowers. Unfit recombinants (outbreeding depression) arise repeatedly, but these recombinants are subject to the force of natural selection and will not survive in the wild. There is little evidence that "outbreeding depression" operates in the wild.

- "Invasive aliens". The threat from invasive aliens is often exaggerated. Our native flora (c1,400 species) is of necessity "invasive" in the wild in the British Isles, all species having successfully moved north following the end of the last ice age. Our alien flora (c100,000 species) is almost completely confined to cultivation in domestic and botanic gardens. These alien species, with a few exceptions, are ill adapted to the British Isles, are not self-sustaining in the wild and are not invasive. They rarely survive outside the confines of botanic or domestic gardens, and are largely absent from the wild countryside.

Small population size and restricted gene flow, as a consequence of habitat destruction, remain the major threats to the native flora of the British Isles. It is reasonable to conclude that grassland restoration and creation, using seeds, has not aggravated the loss of native species diversity, but has contributed to reducing it.

Is local always best?

Common garden experiments and reciprocal transplant experiments over many decades have demonstrated home site advantage among ecotypes of many species studied (Bucharova *et al,* 2016). So local is often better. However, local may be measured as physical distance or ecological distance. Mortimer (2016) found that ecological distance, rather than geographic distance, was the preferred criteria for selecting ecotypes of *Lotus corniculatus* (Bird's-foot Trefoil) for use in grassland restoration.

The shorter the ecological distance between the place of wild origin of the seed and the receptor site, the greater will be the match between the traits of the ecotype and the demands of the site. Distinct ecotypes often co-exist side by side. The Park Grass Experiment at Rothampstead, established in 1856, consists of adjacent plots receiving different management treatments. The plant communities in these plots have evolved over time and now adjacent plots support genetically distinct ecotypes of *Anthoxanthum odoratum* (Sweet Vernal-grass) (Silvertown *et al,* 2006). Similarly, hedgerow and in-field ecotypes of *Centaurea nigra* (Common Knapweed) can exist side by side and exhibit differences in flowering time, leaf shape etc. So, it is more important to match the ecology of the donor site and the recipient site, than it is to source material from a geographically local site. In addition, it is important and desirable to use plant material that has the plasticity and genetic variability required to respond to wider conditions and to a changing environment.

Diverse methods and diverse meadows

Wells *et al* (1981), in setting the standard for grassland creation, stated that the species used should be native, common, widespread and attractive. This has been adhered to since, and those involved in grassland creation and restoration are aware of and respectful of sensitive species and sensitive locations. This has guided the work of restoration. Every project and every site is different, and every meadow created is unique. Below are a few examples of the range of methods used and the diversity of projects undertaken:

- "Brush harvested seed". Brush harvested seed from a high quality donor site that is well matched with a recipient site can produce species rich grasslands that, after 10-15 years, cannot be distinguished from the donor site. This method has been widely used on farmland across England funded under Higher Level Stewardship.

- "Local seed". High quality donor sites for brush harvesting are often not available. An alternative is to collect stock seed of the required native species from nearby wild populations. The stock seed is then bulked up under cultivation and the seed produced sown onto the receptor site. This method was used on The Channel Tunnel approaches, on Baldock Bypass, and in other projects.

- "Site specific seed". Most projects are site specific and are sown with a tailored seed mixture to suit the conditions and requirements of the site. For example, a floodplain type seed mixture was sown on arable land in Northamptonshire and after six years produced species rich grassland with a reasonable fit to MG4. This site is now designated as a Local Wildlife Site (Rothero *et al* 2016).

- "General purpose seed mixtures". Some sites, due to location, have no or few restrictions on what may be sown other than soil type, and often in these cases a general purpose mixture, based on common and widespread native species, may be appropriate.

Creating or restoring species rich grasslands usually requires the sowing of seed. Subsequently, natural processes guide the evolution of the grassland towards a stable structure, with no two grasslands being the same at maturity. Smith (2010) suggests that this process may take 6-14 years from the first introduction of seed. The structure of these created grasslands, and the continuity of favourable management, allow other species to establish within them, particularly those with seed capable of long distance dispersal (such as species with dust like seed). Further, species with restricted seed dispersal (such as *Primula veris,* Cowslip) are able to use restored grasslands as "stepping stones" for gene flow, linking populations as pollinators forage across the landscape.

How wild is wild?

The degree of wildness is the extent to which natural processes, over time, shape populations, species, communities and landscapes. Of course, meadows are not completely wild, they are the result of the interaction between farming processes, wild plants and natural processes. In this respect there is no difference when comparing the wildness of a restored meadow with that of an existing species rich un-improved meadow. Both are created and maintained in good condition by seeding, harrowing, rolling, mowing, grazing etc., and both are shaped by the interaction with natural processes. However, wildness, generally, accumulates over time, and an old meadow may be expected to be more "wild" than a young meadow, all other factors being equal. So, established meadows and restored meadows are both wild, the difference is one of degree.

Conclusion

Destruction of native grasslands in the British Isles is long past the tipping point at which recovery by natural regeneration alone can heal wounds. In todays' countryside natural regeneration has a role confined to restoring small fragments adjacent to species rich communities from which seed can spread naturally. Elsewhere, on all but the very poorest soils, favourable management alone will not turn semi-improved grassland, or bare soil, into species rich grassland. This is the lesson learnt from the ESA scheme. On the other hand, the sowing of native seeds, combined with favourable management, will reliably create species rich grasslands. This is not a surprise to farmers. It has long been common practice to collect hay feeder sweepings to patch up gateways and poaching. And in times past, and for centuries, travelling seed merchants thrashed barn-stored hay for meadow seeds, these seeds being sold on to farmers wishing to restore or put down meadows. Times and priorities have changed, of course. Native meadow seeds are still valued however, but no longer for the fodder they can grow, rather for the biodiversity and habitat they can create.

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