Implications of Commercial Wildflower Plantings for Wild Populations: A Multi-Criteria Framework for Species Risk Assessment

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LAIDLAW FOUNDATION

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1 Introduction

Commercial wildflower planting is increasingly used to support biodiversity but may unintentionally disrupt pre-established/wild populations (Barry & Hodge, 2023).

- Seed mixes often lack ecological alignment with local genotypes and habitats.
- Cultivated origins and human selection (e.g. for early germination) may alter genetic integrity (Heiser, 1987).
- Provenance is frequently disregarded, introducing non-local genotypes (Mijnsbrugge et al., 2010).
- Locally adapted plants typically perform better under regional conditions (Kiehl et al., 2014).
- Hybridisation between commercial and wild populations can lead to:
- Genetic homogenisation (Burton & Burton, 2002)
- Reduced genetic diversity and fitness (Bischoff et al., 2010; Keller et al., 2001)
- Maladaptive gene inheritance due to geographic and genetic isolation

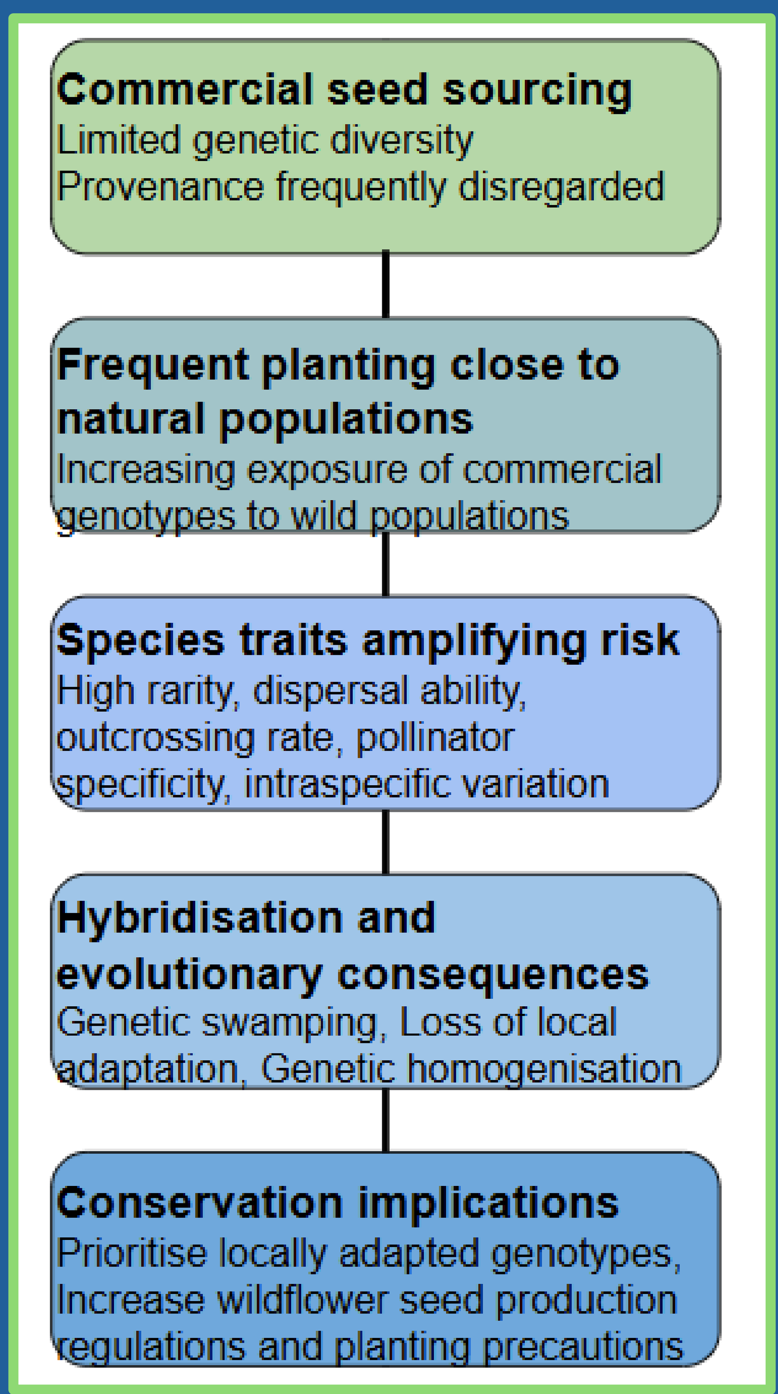

Figure 1. Flow chart introducing the consequences and implications of planting commercially sourced seed

2 Aims

- To evaluate hybridisation risk between wild and commercially sourced populations of wildflower species used in recent restoration and biodiversity initiatives.
- To identify the species most vulnerable to intraspecific introgression using a multi-criteria scoring framework based on seven ecologically relevant traits: planting frequency, species rarity, proximity to natural populations, intraspecific variation, dispersal ability, outcrossing rate, and pollinator specificity.
- To assess broader hybridisation risk by incorporating supplier and council practices, and planting frequency–rarity relationships.

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3 Methods

Figure 2. Map of Britain showing the locations of the councils that this study's data was sourced from.

•Species Screening

120 native wildflower species were assessed for planting frequency (via council websites and emails) and rarity (using BSBI distribution maps).

•Spatial Filtering

30 candidate species were refined based on proximity to Sites of Special Scientific Interest (SSSIs) where natural populations are present.

•Trait-Based Risk Assessment

Four key traits: intraspecific variation, dispersal ability, outcrossing rate, and pollinator specificity were compiled from EcoFlora (Fitter & Peat, 1994), BSBI species accounts (Forbes, 2012), and published scientific literature.

•Composite Scoring

A weighted sum method (Tofallis, 2014) was used to generate hybridisation risk scores, incorporating four normalization techniques (Vafaei et al., 2022) and two weighting approaches (Zhu et al., 2020).

•Cluster Analysis

A hierarchical dendrogram identified high-risk species clusters for final selection and review.

•Literature Review

The top seven species were reviewed to assess genetic vulnerability and restoration implications.

4 Results

•Seven species were identified as highest risk for hybridisation based on composite scores:
Origanum vulgare, *Rhinanthus minor*, *Daucus carota*, *Centaurea scabiosa*, *Anthyllis vulneraria*, *Silene flos-cuculi*, and *Geranium pratense*.

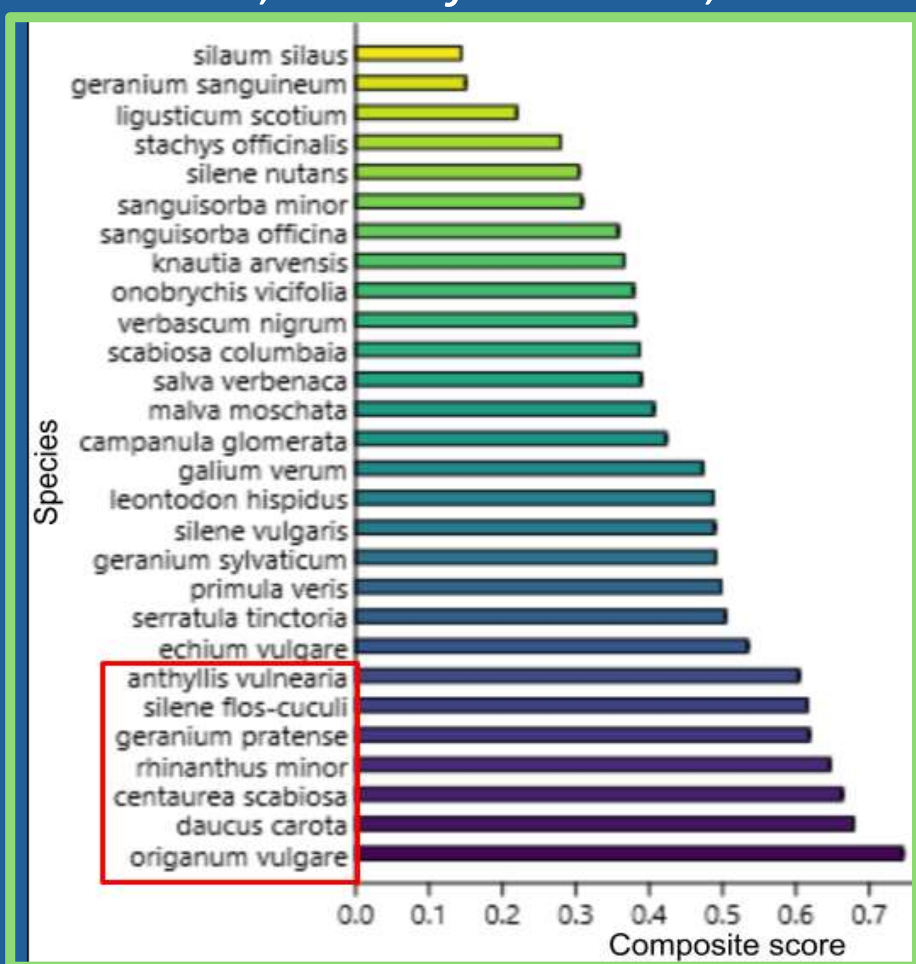

Figure 3. Bar graph showing the final 28 species composite scores with the top seven species highlighted (red box)

Figure 4. Example species: *Origanum vulgare*- identified as highly variable with a high outcrossing rate.

(Amédée Masclef, Public domain, via Wikimedia Commons)

•The literature review revealed species-specific evidence of:
-Interspecific introgression , population differentiation , local adaptation , broader gene flow and ecological connectivity

•Broader hybridisation risk was evident in limited regulation in wildflower seed production, but not so much in considering that:
-Most suppliers lacked provenance safeguards. However, 44% of councils used suppliers with genetic diversity and/or provenance considerations
-A strong negative correlation was found between species rarity and planting frequency, suggesting that frequently planted species may pose lower immediate genetic risk due to wider distribution and population buffering.

5 Conclusions

- A multi-criteria scoring framework was developed to assess hybridisation risk across 28 wildflower species.
- Generalised hybridisation risk was also assessed across the full cohort, revealing broader ecological vulnerabilities.
- Seven species: *Daucus carota*, *Geranium pratense*, *Origanum vulgare*, *Centaurea scabiosa*, *Anthyllis vulneraria*, *Silene flos-cuculi*, and *Rhinanthus minor*, emerged as particularly high-risk.
- These species reflect wider concerns around genetic diversity, population fragmentation, spatial proximity, and provenance mismatch in restoration.
- To safeguard the integrity of wild plant populations, restoration must evolve to a scientifically grounded practice that respects the genetic and ecological complexity of the species it seeks to conserve.