DECLINING WEEDS; BENEFICIARIES AND VICTIMS OF AGRICULTURE

- Many European annual weeds tend to be poor competitors in habitats that support rapidly growing or perennial species.
- They are usually associated with disturbed habitats and environmental stress.
- Many originated in the Mediterranean region and are at their climatic limit in Britain.
- Some species are almost completely absent from non-agricultural habitats in modern Britain.
- Their populations have fluctuated widely in the past million years, but now the distribution and frequency of many weed species in Britain is entirely dependent upon opportunities provided by a particular type of agriculture.

HISTORY

Early post-glacial;	Temporarily high populations of annual species on open habitats left by retreating ice.
Late post-glacial;	Climax vegetation mainly of forest established, annual species declined and became restricted to areas with thin soils, or soil disturbed by animals and erosion. Many 'weed' species very rare? Continuous invasion of plants from southern Europe curtailed by decline of open habitats and rapid climate change that flooded the North Sea and English Channel.
8000 BC-3000 BC;	Forest clearances for agriculture began to open areas to re-invasion by annual plants. Some plants adapted to disturbed soils were pre-adapted to agricultural habitats and again became common as 'agricultural weeds'. Co-evolution of weeds and crops began (seed size, life cycle, dormancy). Some weed species repeatedly co-introduced with crop seed from Europe.
3000 BC-AD 1900	Weed pressure necessitated tall crops, crop rotation, high labour input, spring sowing. Low pressure on land use and low intensity of agricultural inputs maintained abundant disturbed, low competition habitats for weeds.
1900-1950	Increased incentives for agricultural production. Increasing understanding of agricultural sciences. Land drainage, liming, fertiliser use and crop breeding intensified the effectiveness of crop competition with weeds. Chemical weed control introduced and 'hormone'-susceptible dicotyledons severely impacted.
1950-1980	High profitability of arable crops, effective herbicides and fungicides, accelerating crop breeding and mechanisation strongly influenced the agro-ecological balance to the detriment of weeds. The obvious results were the virtual disappearance of *Agrostemma githago* and *Centaurea cyanus* and a decline in *Papaver spp*. Short-term fluctuations of weed populations in response to prevailing techniques: • 'minimum tillage' increased opportunities for perennial and biennial weeds and favoured species with non-dormant shallow germinating seeds, • continuous winter cereal production and decline of crop rotation reduced the survival value of seed dormancy and favoured autumn-germinating and grass weeds but had negative impact on spring germinating species,

- Reliance on substituted urea herbicides increased the frequency of *Viola arvensis, Veronica persica* and *Galium aparine*.

1970-1980 Conservationists began to recognise the extent of decline of many weed species. Concern that decreases in frequency of even 'common weeds' have wide ecological effects such as reduced brood survival of ground-nesting birds, as well as an interest in preventing the local extinction of 'rare weeds'.
In Britain, 24 out of a total number of 159 endangered higher plant species were weeds (Wilson, 1999). In Germany the proportion of endangered weeds is greater, 118 out of a total of 250-300 endangered higher plant species (Eggers, 1997).

1980-1990 Initiation of research, large-scale trials and government funding for measures to conserve declining populations of weeds in Britain and Germany

CAUSES OF THE DECLINE IN FREQUENCY OF SOME WEED SPECIES

In any plant community, the frequency of species present is a result of their adaptation to the balance of factors affecting that community. Thus it is not always possible to correlate progressive changes in frequency of a particular species (as opposed to local extinction) with a specific environmental variable. It is probable that the decline in frequency of many weed species is a result of a combination of several (probably agronomic) factors affecting that species.

Many weeds that were characteristic of agricultural environments are able to exist in non-agricultural situations only in relatively scarce habitats, such as mole-hills, thus a change in agricultural practice can result in them becoming rare to the point of local extinction. This may be particularly so for weeds near the geographical limits of their range. However, a decline in frequency of widespread and formerly common weeds may have wider ecological significance due to their function in supporting a web of other organisms. Thus the recent decline in grey partridge brood survival is ascribed in part to the paucity of invertebrates present on the dicotyledon weeds which were formerly abundant in cereal fields.

Some of the agronomic changes associated with the decline of weed species are:

CHANGES OF CROP SPECIES. Some weeds are largely dependent upon the ecology of a particular crop and are eliminated from an area if the crop ceases to be grown there.
'Flax weeds' *Cuscuta epilinum, Silene linicola*

IMPROVED SEED CLEANING. Better machinery removes seeds of weeds with non-dormant seeds that tended to be dependent upon being harvested and sown with the crop.
Lolium temulentum, Agrostemma githago, Bromus secalinus.

IMPROVED CROP HYGIENE. Parasitic species declined rapidly in the early 20th century.
Cuscuta europaea, Cuscuta epithymum.

CHANGE TO AUTUMN SOWING OF CEREALS. Weeds which establish in spring and have slow initial growth are disadvantaged.
Galium spurium, Chrysanthemum segetum, Galeopsis tetrahit.

IMPROVED CROP VARIETIES AND CROP MANAGEMENT. Crops have been bred to establish rapidly and utilise all incident light at an early stage. Combined with effective crop management, soil preparation, early sowing, pest and disease control, optimum fertiliser application, drainage and liming, they shade out later germinating and slower growing weeds.
Aphanes arvensis, Ranunculus arvensis, Scandix pecten-veneris.

ELIMINATION OF LESS INTENSIVELY CULTIVATED AREAS. Fields are no longer left out of cultivation for a season. Patches which are difficult to cultivate are either improved or planted with trees. Thus habitat for thermophiles and other late germinating species has been eliminated.
Ajuga chamaepitys, Silene conica, Ranunculus sardous.

HERBICIDES. Species susceptible to hormone herbicides declined rapidly in Northern Europe in the 1950s to 1960s.

Papaver spp. Centauria cyanus, Anthemis arvensis

Later, substituted-ureas and selective graminicides reduced the frequency of grass weeds, although so far none have yet become rare as a direct result of herbicide use.

Poa trivialis, Bromus commutatus

A CHALLENGE FOR AGRICULTURALISTS AND CONSERVATIONISTS IS TO AGREE THE EXTENT TO WHICH EACH WEED SPECIES IS TO BE PERMITTED TO DECLINE AND TO DEFINE THE CONDITIONS THAT RELIABLY MAINTAIN ITS POPULATION AT THAT LEVEL.

WITH A WIDER PERSPECTIVE, A SOCIAL CHALLENGE IS TO DETERMINE IN WHICH SITUATIONS, AND TO WHAT EXTENT, AGRICULTURAL MANAGEMENT PRACTICES SHOULD BE INFLUENCED BY OBJECTIVES CONCERNING CONSERVATION OF WILD SPECIES AND HABITATS.

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