The impact of agriculture on the Devon flora

Devon is quintessentially an agrarian landscape typified by a patchwork of small fields crisscrossed by mature dense hedgerows, some of which date back 2,000 years or more and, unlike the rest of the UK, Devon maintains a high density of these hedgerows. Historically these field systems were a mixture of arable and pastureland making up a farming community composed of extensive low input mixed farming systems. The grasslands in these mixed farms would have been composed of a suite of grass species and herbaceous plants (forbs), and many of these pastures would have been species-rich meadows like the culm grasslands in mid-Devon and the rhôs pastures on Dartmoor. These historic low input grasslands would have supported traditional livestock such as the South Devon, Ruby Red, British Shorthorn and other more traditional breeds of cattle, plus sheep that fair well on low input systems (Burchett and Burchett 2011). To support their livestock enterprises, farmers would have grown a range of arable and fodder crops and would have rotated these crops around their holdings. Conventionally these crops would have been, what farmers call, weedy crops. However, these so-called weeds were actually the co-evolution of a community of plants termed arable flora that are typified by annuals and short-lived perennials. Many of these plants were introduced to our landscape over time and were mainly controlled by rotating crops from cereals to broadleaf fodder crops, allowing the farmer to manage the weeds via seed rates, hoeing and some limited selective application of herbicides. Another element to the development of the arable flora was the switch from spring-sown cereals to winter-sown cereals. Until around the 1960s cereal production was predominately spring-sown, which favours many annual species as they have two seasons for germination thus maintaining a healthy population of annual plants across the landscape.

When considering the composition of flora in the farming system two important ecological terms can be applied. In the grasslands the herbaceous plants are mainly long-lived perennials that produce a good number of offspring (seeds) and we term this phase the reproductive phase. But these grassland perennials actually

South Devon cow and calf.

spend the lion's share of their life history in the vegetative phase or mature phases. Ecologically such plants are termed k-selected and have evolved a life history trait that permits them to succeed in the intensively competitive and stable environment of permanent pasture. Such plants could be termed competitors using Grimes (1977 & 1979) life history theory. Conversely the arable habitat being dominated by frequent disturbance has led to a community of flowering plants that have a short vegetative phase but a relative long and productive reproductive phase (flower and seed set) are termed r-selected species and align with Grime's (1977 & 1979) ruderal strategy. This confers an evolutionary fitness for life in the highly disturbed arable environment. These two life-history distinctions are fundamental concepts in understanding the impact that changes in agricultural practice has wrought on the flora of Devon.

Over the last 50 years or so there have been huge advances in the application of technology in the agricultural sector ranging from plant breeding, agrochemicals, machinery, shifts in production systems (i.e. spring-sown cereals to winter-sown cereals), major changes in policy infrastructure and shifts in the economic patterns across the agricultural sector. These changes have had a profound impact on farming systems that, as expected, have resulted in changes to the floristic composition of rural Devon. A good number of these changes have had a detrimental impact on the diversity and abundance of flora in the agricultural landscape pushing many plants to the brink of extinction within the arable habitat. One such group belong to the Caryophyllaceae and from the genus *Silene*, species such as Night-flowering Catchfly *S. noctiflora* and Small-flowered Catchfly *S. gallica* have declined in both their range and abundance, much due to the use of broad-spectrum herbicides, and possibly also as a result of a switch from spring-sown to winter-sown crops. These plants are able to germinate in both spring and autumn, thus a winter-sown cereal with judicial weed control will result in the decline of these species over time. Another casualty of the intensification of arable environment is the decline in the population of Corn Marigold *Glebionis segetum* amongst cereals. It matures slowly, is easily controlled by weedkillers in cereals, and is no longer found in winter wheat crops. It is more difficult to control in root crops and may still be locally abundant in unsprayed corners, summer fallows and marginal strips managed within Higher Level Stewardship (Braithwaite, Ellis & Preston 2006). *G. segetum* is listed as vulnerable on the British Red List and very few of the populations recorded in Devon since 2000 are associated with cereal crops. Since germination of this species is mostly restricted to spring it will most likely continue to decline without a reversion to spring-sown cereals.

Contemporary issues

In the last 20 years or so a number of policy initiatives have been developed under the Common Agricultural Policy (CAP) to help mitigate the worst effects of agriculture on the natural environment. Starting with the Less Favoured Area scheme in 1975, then in 1987 the introduction of the Environmentally Sensitive Area Scheme (ESA), which evolved into the Countryside Stewardship Scheme (CSS) in 1991 to the contemporary schemes of the 21st century known as agri-environment schemes like the Entry Level (EL) and Higher Level Schemes (HLS). All the above schemes aim to help farmers and landowners to adopt new approaches to their farming such as a return to spring-sown cereals, the protection of hedgerows and the development of 2 m and 6 m field margins. A number of these schemes have had some success – in particular the application of CSS and HLS in South Devon along the Site of Special Scientific Interest (SSSI) between East Prawle and Start Point. Application of CSS and HLS along this coastal strip has resulted in a significant increase in the population of Cirl Buntings. This has been a complicated long-term project involving many landowners adopting a range of management measures such as spring-sown barley. In the early years of this project it was believed that applying spring-sown barley to small areas of the farm on a permanent site basis would result in an increase in the diversity and abundance of arable flora. This however was not the case as these permanent spring-sown sites became dominated by grass species as the result of farmers using selective broadleaf herbicides and, of course, the shift from a truly ruderal habitat to one mimicking competitive grassland, this occurs as many farmers now use minimal tillage operations to cultivate their arable land.

Over the last 20 years farmers have been encouraged to adopt minimal tillage operations across their arable sites to reduce soil compaction and subsequent soil erosion caused by the more traditional mole board plough. Minimal tillage does not fully invert the soil like the traditional plough but just gently cultivates the soil

Naturally regenerated plant community on the uncropped margin of a cereal field as part of a Higher Level Stewardship scheme near Dawlish.

incorporating the arable stubble into the surface soil horizons, which stabilises soil and reduces compaction and erosion. However, this has negative implications for r-selected arable flora, which prefers greater disturbance. Using minimal tillage results in stable surface soils but fails to mix the soil seed bank and overtime the flora of these minimal tilled fields starts to favour the more competitive perennials. This is quite evident at West Pentire in Cornwall where the application of minimal tillage has resulted in the surface soil horizons actually developing a compacted surface pan (Burchett and Burchett 2011) and the dominance of the site by aggressive species such as Black Medic *Medicago lupulina*, although an annual, this plant actually prefers short perennial grasslands. Indeed young saplings of Hawthorn *Crataegus monogyna* can be seen 6 m into the crop from the field boundary. What has occurred at this site is the continuous use of minimal tillage has favoured the development of a perennial like habitat where the seeds of *M. lupulina* are released into the surface soil horizon ready to germinate in the next season. As *M. lupulina* is a competitive plant it rapidly swamps the site and suppresses important species such as the catchflies. To recover the situation the use of a traditional plough would be advised.

A final issue with arable flora has been the application of arable reversion projects in sensitive sites like the East Prawle/Start Point SSSI. Along this coastal strip and many more sites like it across Devon and Cornwall, numerous small coastal fields were traditionally cultivated to grow a range of crops such as potatoes, cauliflower and even some cereals. However, during the 1990s a number of these very valuable arable sites were transformed into grasslands under agri-environment schemes such as the CSS as part of philosophy of arable reversion. The aim of this was to increase the range of species-rich grass meadows, but 10 years or more down the line, these grasslands under arable reversion have a floristic composition that is not to dissimilar to a mesotrophic grassland – a very common grassland in the UK. Sadly for the arable flora this is disadvantageous because the application of arable reversion favours competitive k-selected species over the less numerous ruderal r-selected species of the arable habitat. On the face of it criticism of the arable reversion schemes may seem negative but it should be remembered that arable flora has co-evolved with extensive arable agriculture

Bracken-dominated landscape by the Devonport Leat on Walkhampton Common.

over many decades and this is what would have dominated these small, relatively flat, fields along the coastal strips of Devon and Cornwall, not grasslands.

Moving away from the arable flora another impact of modern farming systems can be seen on Dartmoor. This is the reduction in livestock and the subsequent explosion of aggressive competitive species such as Bracken *Pteridium aquilinum*, Western Gorse *Ulex gallii*, European Gorse *U. europaeus* and Purple Moor-grass *Molinia caerulea*. Over the last 10 to 15 years a number of issues have led to the decline in livestock on our moorlands, such as economic sustainability and changes to stocking rates. This has led to many farmers actually leaving the livestock industry across the uplands and moorlands of Britain, and Devon is no exception. There is no doubt that in the 1980s there were too many grazers on Dartmoor, which has had a negative impact on key flora such as the Ericaceae. However, removing livestock has also created problems by releasing the grazing pressure on the competitive species resulting in a rapid spread of the aforementioned plants across the moor. This is detrimental to the diminutive heath species, as large blocks of moorland have become dominated by extensive stands of *P. aquilinum*, *Ulex* spp. and *M. caerulea*, which suppress regeneration of important heath species. This situation has now been widely recognised but is very difficult to turn around due to the poor economic returns on small traditional breeds that would do well on these sites.

In conclusion the impact of agriculture on the flora of Devon has both negative and positive influences and we should remember that agriculture has been in the UK for many thousands of years. During most of this period farming has developed at a generally slow and extensive pace allowing time for both plants and animals to coevolve with the farming systems. But profound and rapid changes started to appear across the farming sector at the start of World War Two and the pace of these changes rapidly increased in the last 50 years. Consequently natural ecosystems have been compromised, thus flora and fauna struggle to adapt to the pace of such changes resulting in declining populations of key groups like the arable flora.

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