THE CHANGING FLORA OF SOMERSET: THE RETREAT OF COLD-CLIMATE PLANTS

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Abstract

For more than 10,000 years, cold-climate plants have survived at or near the southernmost limit of their ranges in Somerset. Tracking the chronology of these species over the last two centuries reveals that all is not well: some 31% of the total number of recorded species are extinct, and a further 52% are now represented by generally low populations in less than 1% of 2km squares. The rare species, protected by conservation management, maintain a tenuous foothold. Yet of the 17% of cold-climate species that are widespread, most are retracting in distribution northwards, away from unfavourably arid conditions. The demise of the cold-climate plants is part of the evidence for the changing flora of Somerset.

INTRODUCTION

At the maximum of the last glaciation, around 16,000BC, the edge of the polar ice sheet was perilously close to Somerset: it engulfed most of South Wales, but never bridged the Severn estuary lowland. Then the northern hemisphere tilted fractionally nearer the sun and the climate ameliorated, alternating for a time between warm and cold, before the final retreat of severe weather about 8,000BC. Enormous volumes of water, hitherto locked in the ice sheet, were relinquished to the sea and Somerset's high plateau lands gradually lost elevation. Today Dunkery Beacon on Exmoor stands at 519m and Beacon Batch on Black Down, in the Mendip Hills, at 325m above mean sea level.

Before the permafrost melted, summer warmth caused the surface layers to thaw. In thin, waterlogged soils steppe-tundra vegetation, an assemblage not found in Britain today, emerged annually, flourished briefly, and disappeared beneath a protective covering of snow. During the great thaw, frost-shattered rock and immature soils were flushed down from the high plateaux that girdle and bisect the Somerset Levels and lowland, creating a wide range of ecological habitats. Many more species extended their ranges northwards, jostling for position amongst the cold climate plants surviving the warming climate. The small-stature, cold-climate species, poor competitors in this burgeoning green mantle, faced marginalisation or outright extinction. Today climate change is likely to jeopardise further the survival of these species in Somerset.

THE PALAEOBOTANICAL RECORD

The archaeological records for the cold climate period, south of the ice sheet, have been collated and interpreted (West 2000), giving an overview of regional vegetation. However, archaeological records for the flora of Somerset for the Glacial and Post-glacial periods are very scarce. The record from Walton Moor in the Gordano Valley, between Clevedon and Portishead, (Jefferies *et al.*1968) gives some indication of the vegetation cover before the great thaw. The pollen array discovered in the coarse, yellow-grey detritus mud overlying basal sand, deposited during the Late-glacial period, prior to 8,000BC, has been identified to genus level.

The herbaceous species of Walton Moor belong to wide-ranging habitats. Grasses, *Poaceae*, dominate the non-tree pollen counts and Sedges *Carex* spp., are present throughout the period. Pollen of Mugwort *Artemisia*, Rock-rose *Helianthemum*, and Plantain *Plantago*, indicate drier habitat; Meadowsweet *Filipendula,* Valerian *Valeriana*, and Water-milfoil *Myriophyllum*, are characteristic of wetland; open water is indicated by Bur-reed *Sparganium*, Bogbean *Menyanthes,* and Pondweed *Potamogeton*. The pollen count for herbaceous plants is greatly in excess of that for woody species. Only Birch *Betula,* Pine *Pinus*, Willow *Salix*, and Juniper *Juniperus,* are represented.

Two of the identifiable Walton Moor species are now extinct in Somerset. Jacob's-ladder *Polemonium caeruleum*, has retreated northwards to the scree and rock-ledges of the Peak District and Yorkshire Dales. Common Juniper *Juniperus communis*, was a rare native in the county. The last known stand, north of Frome, was destroyed by ploughing around 1965 (Green *et al.*1997).

COLD-CLIMATE SURVIVORS OF THE PRESENT DAY

Given the extreme rarity of pollen assemblages for this period in Somerset, another method of determining the affinities of contemporary species would be valuable. We can compare Somerset species with flora farther afield. As early as the mid-19th century, Miss Gifford (1855) explained the assemblage of plant species on Exmoor in terms of their international distribution. Earlier work has been refined and standardised by Preston and Hill (1997), grouping species by major biome category. The biomes of the cold-climate plants are defined as:

• *Arctic-montane*: north of the tree-line or above the tree-line (on mountains), or both.

• *Boreo-arctic Montane*: in both Arctic-montane and Boreal-montane areas.

• *Boreal-montane*: in the coniferous forest zone, either in the Boreal zonobiome or in mountains further south or both.

Matching Somerset records with species listed for the cold biomes brings together just 29 cold-climate survivor species (Table 1).

The demise of the cold-climate species came with a warming climate; ground water evaporated and soils rapidly warmed, matured and deepened, and annual biomass production increased enormously. By 7,500BC the climate was warm, by 7,000BC it was also dry. Tall plants prospered and forest developed across favourable terrain. Easily suppressed small stature, cold-climate flora became restricted in range to habitats where inter-species competition appears to be low: the infertile uplands, rock scree, thin, often heavily mineralised soils over bedrock, acidic wetland and sand dunes (Table 2). In Somerset, virtually all of the cold-climate species are severely limited in range. These small populations survive in isolation from each other and from more continuous distributions farther north.

TABLE 1: COLD-CLIMATE SURVIVOR SPECIES IN SOMERSET

Arctic-montane	
Diphasiastrum alpinum	Alpine Clubmoss
Boreo-arctic Montane	
Huperzia selago	Fir Clubmoss
Equisetum variegatum	Variegated Horsetail
Empetrum nigrum	Crowberry
Vaccinium vitis-idaea	Cowberry
Vaccinium uliginosum	Bog Bilberry
Eriophorum vaginatum	Hare's-tail Cottongrass
Carex dioica	Dioecious Sedge
Leymus arenarius	Lyme-grass
Boreal-montane	
Cryptogramma crispa	Parsley Fern
Minuartia verna	Spring Sandwort
Drosera anglica	Great Sundew
Viola lutea	Mountain Pansy
Arabis scabra	Bristol Rock-cress
Thlaspi caerulescens	Alpine Penny-cress
Andromeda polifolia	Bog-rosemary
Vaccinium oxycoccus	Cranberry
Vaccinium myrtillus	Bilberry
Pyrola minor	Common Wintergreen
Saxifraga hypnoides	Mossy Saxifrage
Potentilla erecta subsp. *strictissima*	(Tormentil)
Alchemilla filicaulis subsp. *vestita*	(Lady's Mantle)
Euphrasia scottica	(Eyebright)
Pinguicula vulgaris	Common Butterwort
Potamogeton alpinus	Red Pondweed
Trichophorum cespitosum	Deergrass
Carex curta	White Sedge
Carex lasiocarpa	Slender Sedge
Listera cordata	Lesser Twayblade

Categories are those of Preston and Hill (1997)
Non-specific names in brackets

TABLE 2: CURRENT STATUS OF COLD-CLIMATE PLANTS

Habitat and Species	Extinct/ at risk	Status North*	South*
High, wet moorland			
Huperzia selago	TL	X1884	4
Diphasiastrum alpinum	X	-	X1927
Vaccinium oxycoccus		-	11
Vaccinium uliginosum	TL	-	1
Euphrasia scottica	X	-	X1918
Eriophorum vaginatum		X1986?	57
Trichophorum cespitosum		X1981	70
Listera cordata	TL	-	6
High, dry heathland			
Empetrum nigrum		-	15
Vaccinium myrtillus		3	225
Vaccinium vitis-ideae	TL	X1837	1
Wet, peaty moorland /pools			
Drosera anglica	X	-	X1952
Andromeda polifolia	X	-	X1920
Pinguicula vulgaris	X	X1875	X1928
Potamogeton alpinus	X	-	Xc1896
Carex dioica (neutral to base-rich)	TL	-	1
Carex curta (acidic)	X	-	X1791
Carex lasiocarpa (base-rich to poor)	TL	-	1
Wet, rocky woodland			
Pyrola minor	X	X1912	X1896
Rock ledges and scree			
Cryptogramma crispa	X	-	X1976
Arabis scabra	T	1	-
Saxifraga hypnoides	TL	-	1
Thin soils over rock			
Minuartia verna	TL	-	2
Viola lutea	TL	-	2
Thlaspi caerulescens	TL	2	1
Potentilla erecta subsp. *strictissima*	TL	-	1
Alchemilla filicaulis subsp. *vestita*		22	95
Dune slack			
Equisetum variegatum	TL	X1951	1
Leymus arenarius		2	9

Key

X	Extinct *c*. 1897 date of late record
T	Threatened. This species is represented in fewer than twelve 2km squares in Somerset
L	Thought to have low population numbers
N	North Somerset and Bath and North East Somerset districts
S	West Somerset, Sedgemoor, Mendip, Taunton Deane and South Somerset districts
*	These areas conform to those covered by the most recent floras (Green *et al.* 1997; 2000)
-	No records found
12	Represents the number of 2km squares in which the species is represented in Somerset

The chronology of Somerset's cold-climate species over the last 200 years demonstrates impressively high losses. Of the 29 species in the historical record from 1791, no less than nine are totally extinct. A further 15 species are jeopardised by their extremely restricted ranges, ie they are represented in less than 1% (twelve) of the county tetrads (2km squares) and nine of these species have just one station. Only five of the 29 species are represented in more than 1% of tetrads, with Crowberry distributed across just 15 tetrads. The most widespread species is Bilberry with 5.4% coverage.

THE RATE OF SPECIES EXTINCTION

The actual dates of extinction for species are rarely known; Table 2 chronicles the dates of the last reports. On the assumption that these species became extinct within a decade (more likely to be true where records are more numerous) we can gain an insight into the rate of extinctions (Table 3).

TABLE 3: RATE OF EXTINCTIONS

	Somerset		
Decade	**North**	**South**	**County wide**
Pre 1850	1	1	1
1860	–	–	–
1870	1	–	–
1880	1	–	–
1890	–	2	1
1900	–	–	–
1910	1	2	2
1920	–	2	3
1930	–	–	–
1940	–	–	–
1950	1	1	1
1960	–	–	–
1970	–	1	1
1980	2	–	–
1990	–	–	–

The years 1910–1930 register the worst losses: Common Wintergreen (1912), (Eyebright) *Euphrasia scottica* (1918), Bog-rosemary (1920), Alpine Clubmoss (1927) and Common Butterwort (1928) all fall in this decade. Rainfall was very low for the 1880s and 1890s, gradually rising thereafter (Meterological Office 2005). Increased aridity would have adversely affected populations of all these species, making them prone to extinction in exceptional weather conditions. There was little rainfall in the summer of 1908. The 1910s and 1920s generally had very mild winters (Parker *et al.*1992), encouraging early spring growth and greater inter-species competition. There were also record-breaking long, hot summers, notably in 1911 and 1921 (Horton 1995).

THE HUMAN FACTOR AND EXTINCTION OF SPECIES

For centuries drainage for agriculture and peat cutting has been carried out on the Somerset Levels peat moors. Peat cutting strips off the active upper layer of the raised bog and creates deep trenches. This draws water down from the upper layers, resulting in drought conditions for surrounding raised bog. Conversely, water is also drawn up through the bog to sustain new vegetation cover, less sensitive to drought, contributing to ground-water depletion. On upland areas of Somerset, enclosure and agricultural improvement have reduced species richness. In the Mendip Hills, open-cast mining for lead has caused irreversible change in topography, drainage and soil structure. Available historical records reveal the chronology of species affected by these changes:

Bog-rosemary is considered to be particularly abundant in peat that marks the first stage of recovery of active Sphagnum bog growth, after a phase of dryness and arrest (Godwin 1975). This species was a feature of the peat moors and considered by Chapman to be 'very abundant' in the 1860s (White 1912). Peat cutting and drainage led to the cessation of active Sphagnum bog growth and steep decline for Bog-rosemary. The last reliable sighting from the peat moors was in 1920 (Green *et al.*1997) and from Black Down in the Mendips in 1928 (Green *et al.* 1997).

Crowberry has been found in Levels deposits from about 5,000BC (Godwin 1975) but does not appear in later records. Murray (1896) is quite clear about human enterprise and loss of habitat for Crowberry on Exmoor: 'Little of this plant is now to be found …, as on that side of Dunkery (the southern) the enclosures now reach within a short distance of the summit; but on the north face it is very abundant.'

Dioecious Sedge was recorded for the Somerset Levels from 1855. In 1912 White expressed his concern. 'This delicate little sedge is usually met with in the wettest quaking sphagnum bogs; and that kind of habitat is becoming scarcer wherever one goes'. It is now to be found only on the Blackdown

Hills, a retreat to high ground. In northern England and Scotland it is widespread at moderate to high latitudes. **White Sedge** was reported by Sole (Collinson 1791) in old turf pits about Burtle Moor but is now extinct in the county and absent from much of England. **Slender Sedge** is now confined to Street Heath Nature Reserve on the Somerset Levels.

Lead mining over many centuries at Priddy Mineries on the Mendip Hills has had a direct effect upon two species that is impossible to quantify, given repeated disturbance of the site. Isolated amongst the vigorous vegetation that dominates much of the nature reserve are abandoned spoil heaps. Here sharp drainage and toxicity of the thin soils provide a habitat niche for **Spring Sandwort** and **Alpine Penny-cress**, far south of their other stations. Both are better represented on the metal-rich soils over limestone of northern England.

TRENDS IN RETREAT TO HIGH GROUND

Some Somerset species, on the southern edge of their ranges, have been known only from upland Exmoor and have always been considered rare. **Fir Clubmoss**, **Mountain Pansy** (appearing sporadically and reported since 1901), and **Lesser Twayblade**, described by Miss Gifford (1855) as 'On Dunkery, the rarest…' have long been known. (**Tormentil**) *Potentilla erecta subsp. strictissima* and **Bog Bilberry** are recent finds.

Of extinctions, historical records reveal **Alpine Clubmoss**, a rarity on Dunkery on Exmoor, and the only representative of the Arctic-montane biome, died out around 1927. **Great Sundew** has been recorded in the county since the 18th century (Collinson 1791), Sole citing it in 'swampy places on Black down' (meaning the range of hills in the south west). St Brody (1856) mentions it on Shapwick Moor on the Levels, and Murray (1896) considered it plentiful in the bog at Chard. Losses from lower sites place it only on Britty Common on the Blackdown Hills, a retreat to higher ground, where it was last sighted in 1952. **Parsley Fern**, another rarity of high Exmoor, succumbed in the severe drought of 1976.

Cranberry was reported by Sole (Collinson 1791) from the Glastonbury and Burtle turf moors. In 1904 Roper (White 1912) discovered a patch at Priddy on Mendip, but by 1981 Roe describes Cranberry as very rare, and now to be found only in the blanket bogs of Exmoor.

(**Lady's Mantle**) *Alchemilla filicaulis* subsp. *vestita*, is reported (Green *et al.* 1997) to have declined in the north and south of the county since Roe's survey (Roe 1981) but to be holding its own in the west, on the Quantocks and Exmoor. It is very localised on the drier Mendip Hills.

Hare's-tail Cottongrass was abundant on some parts of the Somerset Levels (Clark 1856–7), in bogs at Priddy Mineries on the Mendip Hills, Witham in the east, and Weston-in-Gordano in the north-west (White 1912). It is now locally common only on Exmoor, a marked contraction in range to higher sites. It is a common component of wet peaty moorlands further north.

Deergrass was considered plentiful on the Levels by Clark (1856–7) and rather common, by Murray (1896) as it is today, further north. It was to be found in the Blackdown Hills, Quantocks and was plentiful on the Mendips. Today it is described by Green *et al.* (1997) as common on Exmoor and also Hadden Hill, Upton, but rare on the Blackdown Hills and very rare on the Quantock Hills and the Mendips.

It is not only the rare species that are caught up in this trend. Drought–tolerant **Bilberry** was widespread and abundant across much of Somerset in the 19th century. Murray (1896) reports that at Holford, on the Quantock Hills, the children's school holidays were determined by the ripening of the fruit. Large quantities were harvested and sent to Manchester to be used in dyeing. It is still 'common on Exmoor, Brendon, Quantock and Blackdown Hills. Rare and declining away from the above areas and now only found in small numbers' (Green *et al.* 1997), indicating retreat from lower sites.

HIGH AND DRY ON ROCKY OUTCROPS

Mossy Saxifrage, the forerunner of a plethora of garden varieties (the top of Mendip garden walls are still damp enough to sustain it), was a well-known plant of Cheddar Gorge in the Mendip Hills from earliest records. Dillenius reports it in 1726. The site at Black Rock succumbed to the drought of 1976 and remaining sites suffered in the drought of 1995. Indications are that in the past, whilst it grew well on the high, limestone debris and ledges, it also readily colonised scree near road level. Aridity has resulted in this tiny population clinging to the high, shaded ledges, threatened by encroaching trees. This population is unique in Somerset and further north it is generally to be found between 200m and 760m (Preston *et al.* 2002), placing Cheddar in the low altitude range for this species.

Characteristically intolerant of competition is **Bristol Rock-cress**, representing the Mediterranean-montane biome. It flourishes on rock ledges on both the Bristol and Somerset side of the Avon Gorge. Bristol Rock-cress has been known since the 17th century; it was collected by John Ray in 1686 (Green *et al.* 2000). Despite predations by plant collectors and its very restricted range it maintains strong population numbers. It grows as a native nowhere else in Britain and on the continent is found in the mountains of Spain, southern France and the Jura.

SANDY SHORELINES

On the coastal fringe is a tiny population of **Variegated Horsetail**. Changing environmental conditions, encouraging dense, vigorous vegetation on long-stable sandy soil around its only station at Berrow, has brought it to near-extinction (Green *et al.* 1997).

The species that benefits from the unstable dunes along the Somerset coastline is **Lyme-grass**. It has the ability to colonise, then stabilise, at least in the short term, blown sand. Competition in this environment is low and great mounds of sand, topped by the blue-grey spikes of Lyme-grass, characteristic of the Severn estuary coastline, are a rare sight elsewhere on the southwest peninsula.

CONCLUSION

For more than 10,000 years, the cold-climate plants of Somerset have survived at or near the southernmost limit of their ranges. Heat and aridity, changing vegetation patterns often by widespread destruction of semi-natural habitat, life alongside their wide-tolerance contemporary species, challenges from vast numbers of species new to the county have not ousted them.

Yet over a period of little more than 200 years there has been a drastic decline both in species and their distribution. Nine, 31%, of the original 29 survivor species have met with extinction, mostly in the years 1890–1980. Furthermore, surviving species demonstrate inexorable retraction in range from their historical sites on the Somerset Levels, Mendip Hills and Quantock Hills to higher, wetter ground. Fifteen, 52%, of the cold-climate species are now represented by generally low populations, distributed in less than twelve, 1%, of 2km squares. Just five species, 17%, are well distributed. Virtually all of these species have a clear chronology of retreating distribution.

Many of the remaining species grow on designated nature conservation sites where habitat destruction and species eradication are prohibited. Nevertheless, as in the great thaw that followed the last glaciation, the changing climate will be the determining factor in the fate of the remaining 20 survivors of cold-climate Somerset.

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