

Appendix 1 Ecological attributes for 20 common species of a) limestone grasslands and b) lowland heathlands

a) Limestone grassland species

Species	Bp	Be	Cp	Ca	Cm	Gv	Gh	Hip	Hh	Hp	Lic	Lc	Ml	Pr	Rf	Sm	Tr	Vc	Vs	Vh
Distribution	S	S	S	S	s	-	S	-	S	S	s	-	S	S	s	S	-	-	-	S
Soil pH	7c	7c	7a	7c	7d	5d	6c	7c	7b	7c	7a	7c	7a	6c	4b	5c	5c	7c	6d	7c

b) Lowland heathland species

Species	Bt	Cv	Dm	Df	Ec	Et	Gs	Hy	Ja	Jb	Js	Mc	Ps	Pe	Pa	Ra	Ss	Ts	Ue	Vm
Distribution	-	-	-	-	sw	sw	sw	sw	S	-	sw	-	sw	-	-	-	s	sw	sw	e
Soil pH	3b	3a	3	3a	3b	3b	3b	5b	5c	5a	3b	W3	4b	4b	3b	4c	3	2	2	3a

Key to species abbreviations:

a) Limestone grassland species

Bp, Brachypodium pinnatum; Be, Bromus erectus; Cp, Clinopodium vulgare; Ca, Convolvulus arvensis; Cm, Crataegus monogyna; Gv, Galium verum; Gh, Glechoma hederacea; Hip, Hieracium pilosella; Hh, Hypericum hirsutum; Hp, Hypericum perforatum; Lic, Linum catharticum; Lc, Lotus corniculatus; Ml, Medicago lupulina; Pr, Potentilla reptans; Rf, Rubus fruticosus; Sm, Sanguisorba minor; Tr, Trifolium repens; Vc, Veronica chamaedrys; Vs, Vicia sativa; Vh, Viola hirta

b) Lowland heathland species

Bt, Betula spp.; Cv, Calluna vulgaris; Dm, Dactylorhiza maculata; Df, Deschampsia flexuosa; Ec, Erica cinerea; Et, Erica tetralix; Gs, Galium saxatile; Hy, Hypericum pulchrum; Ja, Juncus acutiflorus; Jb, Juncus bulbosus; Js, Juncus squarrosus; Mc, Molinia caerulea; Ps, Polygala serpyllifolia; Pe, Potentilla erecta; Pa, Pteridium aquilinum; Ra, Rumex acetosella; Ss, Senecio sylvaticus; Ts, Teucrium scorodonia; Ue, Ulex europaeus; Vm, Vaccinium myrtillus

Appendix 2 Attributes of the established phase for 20 common species of a) limestone grasslands and b) lowland heathlands

a) Limestone grassland species

Species	Bp	Be	Cp	Ca	Cm	Gv	Gh	Hip	Hh	Hp	Lic	Lc	Ml	Pr	Rf	Sm	Tr	Vc	Vs	Vh
Established strategy	SC	SC/CSR	S/CSR	CR	SC	SC/CSR	CSR	S/CSR	S/CSR	CR/CSR	SR	S/CSR	R/SR	CR/CSR	SC	S	CR/CSR	S/CSR	R/CSR	S
Canopy structure	S	S	L	L	L	L	S	R	L	L	L	L	L	L	L	S	R	L	L	R
Leaf phenology	Ea	Ea	Ep	Sa	Sa	Ea	Ea	Ea	Ep	Ep	Ea	Sa	Ea	Ep	Ep	Ea	Ea	Ea	Sh	Ea
Flowering time & duration	JUL 1	JUN 2	JUL 3	JUN 4	MAY 2	JUL 2	MAR 3	MAY 2	JUL 2	JUN 4	JUN 4	JUN 4	MAY 4	JUN 4	JUN 4	JUN 2	JUN 4	APR 4	MAY 5	APR 2

b) Lowland heathland species

Species	Bt	Cv	Dm	Df	Ec	Et	Gs	Hy	Ja	Jb	Js	Mc	Ps	Pe	Pa	Ra	Ss	Ts	Ue	Vm
Established strategy	C/SC	SC	S	S/SC	S	S	S	S	SC	SR/CSR	S	SC	S	S/CSR	C	SR/CSR	R/CSR	CSR	SC	SC
Canopy structure	L	L	L	S	L	L	L	L	S	S	R	S	L	S	R	S	L	L	-	L
Leaf phenology	Sa	Ea	Sa	Ea	Ea	Ea	Ea	Ea	Sa	Ea	Ea	Sa	Ea	Sa	Sa	Ea	Sa	Ep	Ea	Sa
Flowering time & duration	APR 2	AUG 2	JUN 2	JUN 2	JUL 2	JUL 3	JUN 3	JUN 3	JUL 3	JUN 4	JUN 2	JUN 3	MAY 4	JUN 4	AUG 3	MAY 3	JUL 3	JUL 3	MAR 3	APR 3

Appendix 3 Attributes of the regenerative phase for 20 common species of a) limestone grasslands and b) lowland heathlands

a) Limestone grassland species

Species	Bp	Be	Cp	Ca	Cm	Gv	Gh	Hip	Hh	Hp	Lic	Lc	Ml	Pr	Rf	Sm	Tr	Vc	Vs	Vh
Agency of dispersal	UNSP	ANIM a	UNSP	* UNSP	ANIM i	UNSP	* UNSP	WIND p	WIND c	WIND c	UNSP	UNSP	UNSP	* UNSP	ANIM i	UNSP	ANIM a	UNSP cw	UNSP	ANIM e
Dispersule weight	5	5	2	6	6	2	3	1	1	1	1	4	5	2	5	4	3	1	6	5
Germination requirements	-	-	Dry	Scar	Warm + Chill	-	Dry	Dry	Dry, Wash	Wash	Chill	Scar	Scar	Un class	Scar + Chill	Dry	Scar	-	Scar	Chill

b) Lowland heathland species

Species	Bt	Cv	Dm	Df	Ec	Et	Gs	Hy	Ja	Jb	Js	Mc	Ps	Pe	Pa	Ra	Ss	Ts	Ue	Vm
Agency of dispersal	WIND w	WIND cm	WIND cm	ANIM a	WIND cm	WIND cm	UNSP	WIND c	ANIM m	ANIM m	UNSP	UNSP	ANIM e	UNSP	WIND m	UNSP	WIND p	UNSP	ANIM e	ANIM i
Dispersule weight	1	1	5	2	1	1	3	1	1	1	1	3	4	3	5	2	2	3	5	2
Germination requirements	-	-	Orchd	-	Chill Heat Scar	?Dry	-	Dry	-	-	-	Chill	Chill	Warm	-	Dry	Dry	-	Scar	-

Key to abbreviations used in appendices

Appendix 1 Ecological attributes

Distribution in N Europe

The symbols utilised are as follows. *Restriction with respect to latitude*: S, largely restricted to southern areas and absent from parts of both northern Britain and Scandinavia; s, similar to S but distributed throughout either northern Britain or Scandinavia; W, largely restricted to NW Europe with distribution centred on the Atlantic seaboard; w, distribution similar to W but extending a considerable extent into central regions; e, more widespread in NE than NW Europe. Species without well marked geographical restriction are marked '-'.

Soil pH

The data take the form of a numeral indicating the modal class for the species, followed by a letter indicating the number of pH classes in which the frequency of the species exceeds 50% of that in its modal class. Thus, 7a would indicate that the species is most frequent within the range 7.0-7.9 and has range of only one unit.

Appendix 2 Attributes of the established phase

Established strategy

Abbreviations are as follows: *primary strategies* C, competitor; R, ruderal; S, stress-tolerator; *secondary strategies* CR, competitive-ruderal; SC, stress-tolerant competitor; SR, stress-tolerant ruderal; CSR, C-S-R strategist. Strategy types intermediate between these seven are also recognized e.g. CR/CSR.

Canopy structure

The following classes are recognized: R, rosette (leaves confined to basal rosette, or to prostrate stem); S, semi-rosette (stems leafy but with the largest leaves towards their base); L, leafy (no basal rosette, leaves of approximately equal size all the way up the stem); -, leaves small, reduced to scales or spines, with the stem as the main photosynthetic organ.

Leaf phenology

The following classes are recognized: *Canopy seasonal*, (S): Sa, aestival (duration of canopy from spring to autumn); Sh, hibernal (mainly autumn to early summer). *Canopy evergreen*, (E): Ea, always evergreen; Ep partially evergreen.

Flowering time and duration

Here the time of first flowering and its duration are presented. The month of first flowering is abbreviated to its first three letters and is immediately followed by the span, in months, of the flowering period, e.g. 'Jun3' refers to a species flowering from June to August.

Appendix 3 Attributes of the regenerative phase

Agency of dispersal

The following abbreviations are used: ANIM, dispersal by means of animals; *dispersal as a direct consequence of food gathering* : ANIMi, an ingested berry; ANIME, seeds with an elaisome; *dispersal adhesive* ANIMA, dispersule with an awn, or with spiny calyx teeth; ANIMm, dispersal adhesive through the secretion of mucilage; WIND, wind-dispersed; WINDm, dispersule minute; WINDp, dispersule plumed or wrapped in woolly hairs; WINDc, seeds small and shed from a capsule, held above the level of the surrounding vegetation; WINDw, seeds winged or strongly flattened; UNSP, unspecialized, with morphological features facilitating dispersal absent or undetected.

Dispersule weight

The following classes are identified: 1, weight less than or equal to 0.20 mg; 2, 0.21-0.50 mg; 3, 0.51-1.00 mg; 4, 1.01-2.00 mg; 5, 2.01-10.00 mg; 6, greater than 10 mg.

Germination requirements

Treatments required to achieve a high percentage of germination are abbreviated as follows: Chill, chilling; Dry, dry storage at room temperature; Orchid, fungal symbiont necessary for establishment in the field; Scar, scarification (many species with hard-coat dormancy also respond to chilling); Warm, warm moist incubation; Wash, water washing to remove inhibitor in seed coat. Species capable of immediate germination are identified as '-'. 'Unclassified' species lack the capacity for immediate germination, but the dormancy-breaking mechanism(s) have not been identified.