H6
Erica vagans-Ulex europaeus heath

Synonymy
Erica vagans-Ulex europaeus 'Mixed Heath' Coombe & Frost 1956*a p.p.*; *Ulici maritimi-Ericetum vagantis* (Géhu 1962) Géhu & Géhu 1973 *emend.* Bridgewater 1980; *Erica vagans-Ulex europaeus* heath Hopkins 1983 *p.p.*

Constant species
Agrostis canina ssp. *montana*, *Carex flacca*, *Erica cinerea*, *E. vagans*, *Filipendula vulgaris*, *Ulex europaeus*, *U. gallii*, *Viola riviniana*.

Rare species
Agrostis curtisii, *Allium schoenoprasum*, *Erica vagans*, *Juncus capitatus*, *Scilla verna*, *Trifolium bocconei*.

Physiognomy
The *Erica vagans-Ulex europaeus* heath is a distinctive kind of sub-shrub vegetation, but one that is rather variable in its floristics and structure, a feature recognised in Coombe & Frost's (1956*a*) epithet of 'Mixed Heath'. In fact, as defined here, the community excludes some of the vegetation which these authors and also Hopkins (1983) considered as falling within their *Erica-Ulex* heaths, but it still encompasses stands which differ quite markedly from one another, variation which can be related partly to edaphic and local climatic factors and partly to treatment, especially the frequency and intensity of burning. The influence of the former factors can be seen in the ordered differentiation of the sub-communities; the effects of treatment tend to cross-cut this variation, resulting in complex mosaics of vegetation in all stages of regeneration.

The most obvious constant feature of the community is the mixed canopy of sub-shrubs in which *Erica vagans* and *Ulex europaeus* are the usual co-dominants, a combination which is not confined to this kind of heath but which is most often found here. In newly-burned stands, the cover of these and the other sub-shrubs can be low, with masses of new shoots sprouting from half-buried stools. And in extreme environmental conditions, where this heath is found as the *Festuca* sub-community over summer-parched soils in exposed situations, even old stands can have small, scattered wind-pruned bushes no more than 1 dm high and with a total cover of less than 20%. Generally, however, the canopy grows taller than this, most often 3–6 dm high, even more in sheltered sites, and is much more extensive, covering 60–90% of the ground. In the immediate aftermath of fires, *E. vagans*, which regenerates rapidly, may be the most prominent species but, with the passage of time, *U. europaeus* matches it in cover and height and usually overtops it after 7 or 8 years.

The two other constant sub-shrubs, *U. gallii* and *E. cinerea*, can also be present in some abundance though, except where sheltered, they tend to be shorter in stature than the above and, indeed, in very dense covers, *U. gallii* can be totally supressed. *Calluna vulgaris* is also rather poorly represented in such stands and in some recently-burned tracts, so much so that, overall, it fails to achieve constancy and, even in the more open kinds of heath, its cover tends to be low. In those rare stands which have escaped burning for long periods, the sub-shrubs can become degenerate and leggy, and are occasionally accompanied by brambles and *Prunus spinosa*, features which give the vegetation some of the character of *Ulex-Rubus* or *Prunus* scrub, as in Coombe & Frost's (1956*a*) 'old Mixed Heath' and in stands which Hopkins (1983) described from Kynance. The persistence of *E. vagans*, a long-lived species which can outlast *U. europaeus* perhaps five-fold, can help separate such transitional vegetation.

In contrast to the *E. vagans-Schoenus* heath, *E. tetralix* is only occasional overall here and is very much confined to the *Molinia* sub-community of wetter soils, where high frequency of *Molinia caerulea* itself, and of *Schoenus nigricans*, *Serratula tinctoria* and *Sanguisorba officinalis* also give some indication of a floristic overlap with this other major kind of *E. vagans* heath. By and large, however, the two communities are well marked off

from one another in their associated floras: apart from the sub-shrubs which they have in common, only *Carex flacca*, *Potentilla erecta* and *Polygala vulgaris* occur at all frequently in both heaths and the prevailing element among the herbs here comprises plants of well-drained, moderately base-rich soils. Some of these species are also quite well represented in the more mesophytic kinds of *U. gallii-Agrostis* heath, and the *E. vagans-Ulex* heath shows some measure of continuity with that vegetation, particularly where it extends on to loess-contaminated soils in the *Agrostis* sub-community. In general, however, *A. curtisii* is not a common plant here.

Apart from *Carex flacca*, *Polygala vulgaris* and *Potentilla erecta*, the most common and distinctive herbs of the *E. vagans-Ulex* heath as a whole are *Viola riviniana*, *Filipendula vulgaris*, *Stachys betonica*, *Hypochoeris radicata*, *Agrostis canina* ssp. *montana*, *Dactylis glomerata* and, here on the Lizard, extending further into the inland heaths than usual, *Scilla verna*. In stands burned relatively recently, where the sub-shrubs have not yet coalesced into a more or less continuous canopy, most of these species will be found and sometimes they can form a fairly extensive and luxuriant understorey. With the increasing shade and accumulation of litter that comes with age, however, the flora becomes more and more confined to areas between the bushes, and then very attenuated, such that older stands have just a few scattered individuals of the more tolerant species, *Carex flacca*, *Stachys*, *Viola*, *Filipendula* and *Scilla*, plants of the last two often looking particularly etiolated and with much reduced flowering.

On shallower soils, where more inhospitable edaphic conditions keep the sub-shrubs in check, richness among the associated flora can be maintained even where burning is infrequent, especially if grazing also helps keep the herbage short. Then, the above species can be joined by *Festuca ovina*, *Thymus praecox*, *Lotus corniculatus*, *Galium verum*, *Jasione montana*, *Danthonia decumbens* and *Brachypodium sylvaticum* with, in the *Festuca* sub-community, a long list of further preferentials, some common, some just occasional, but together constituting a vegetation which looks very different from the stands dominated by tall sub-shrubs. In such heath, too, which is generally situated close to the cliff tops, some species more characteristic of maritime vegetation can occasionally figure, *Plantago maritima*, for example, together with *Genista pilosa*. In this scheme, however, heath in which such plants occur consistently with *E. vagans*, and often with much reduced frequencies for *U. europaeus* and *U. gallii* (what both Coombe & Frost (1956*a*) and Hopkins (1983) called the *Genista* variant) is considered as part of the *Calluna-Scilla* heath.

In the seasons immediately after burning, a different and more chaotic kind of diversity is to be seen in the flora that develops among the regenerating sub-shrubs and the new shoots of the characteristic perennial herbs of the community. In the first autumn and spring, the most obvious feature is often the abundance and variety of ephemerals on the stretches of open ground. Some of these, such as *Aira caryophyllea* and *Centaureum erythraea*, are species which also find a place in bare patches within mature stands; others, such as *Cochlearia danica*, *Trifolium striatum*, *T. bocconei*, *Euphrasia tetraquetra* and various *Cerastium* spp., seed in from the more open heaths and therophyte vegetation around rocky cliff tops; yet others are widespread weed species like *Anagallis arvensis*, *Cardamine hirsuta*, *Myosotis arvensis*, *Spergula arvensis*, *Poa annua*, *Senecio vulgaris*, *Sonchus oleraceus* and *Cirsium vulgare*, or more local ephemerals which find occasional representation in various kinds of open vegetation, such as *Aphanes microcarpa*, *Erodium maritimum* and the introduced *Coronopus didymus*. These may then be succeeded, before the heath regains its characteristic balance of woody and herbaceous plants, by a temporary abundance of sub-community preferentials like *Molinia* or *A. curtisii* or community occasionals such as *Leucanthemum vulgare* or *Holcus lanatus*. Mixtures of various of these species were characteristic in Hopkins (1983) of a 'recently burned heath nodum'.

The continuing frequency of burning and the dense shade and thick litter in older stands both tend to inhibit the development of any extensive cryptogam flora in the *E. vagans-Ulex* heath, either on bare soil or growing corticolously on degenerate woody plants. No bryophytes or lichens occur commonly throughout, though *Hypnum cupressiforme s.l.* can sometimes be found, particularly in the shorter swards characteristic of the *Festuca* sub-community, where *Cladonia* spp. can also be well represented.

Sub-communities

Typical sub-community: *Erica vagans-Ulex europaeus* 'Mixed Heath', Typical, Regenerating and Old forms Coombe & Frost 1956*a*; *Erica vagans-Ulex europaeus* heath, Typical variant and recently-burned nodum and *Agrostis curtisii* variant Hopkins 1983 *p.p.* Typical *E. vagans-Ulex* heath shows the complete range of floristic and structural variation related to burning of this vegetation but, in stands a few years into the regeneration cycle, there is usually a well-developed sub-shrub canopy, several decimetres tall and with high cover, in which *E. vagans* and *U. europaeus* usually predominate with smaller amounts of *E. cinerea*, *U. gallii* and *Calluna*. *Viola riviniana*, *Carex flacca*, *Filipendula vulgaris*, *Stachys betonica* and *Potentilla erecta* are the commonest herbs and there are frequently some tufts of *Agrostis canina* ssp. *montana* and *Dactylis glomerata* with occasional *Anthoxanthum odoratum* or even locally

abundant *A. curtisii*. Richer stands can have occasional records for *Geranium sanguineum* and *Teucrium scorodonia*, the only preferential dicotyledons here, and also for *Festuca ovina*, *Scilla verna*, *Thymus praecox*, *Polygala vulgaris*, *Hypochoeris radicata* and *Lotus corniculatus* but, with increasing age, even the constant herbs of the community begin to thin out, leaving little more than a dense woody cover. Among leggier sub-shrubs, *Rubus fruticosus* agg. and *Prunus spinosa* can occasionally be found, or sparse *Pteridium*.

***Festuca ovina* sub-community:** *Erica vagans-Ulex europaeus* 'Mixed Heath', Typical form Coombe & Frost 1956*a p.p.*; *Erica vagans-Ulex europaeus* heath, *Festuca ovina* variant Hopkins 1983. In this sub-community, the abundance and height of the sub-shrub canopy are generally less than in the typical form: their total cover is often below 50% and they commonly attain less than 2 dm with, in more extreme cases, small, discrete bushes, wind-pruned and sometimes with obvious signs of droughting, confined to the deeper soils of crevices in the underlying bedrock. With their vigour thus inhibited, the associated flora tends to be richer here, particularly where it is grazed, when the vegetation can present the appearance of a varied grassy sward forming a mosaic among the bushes. Apart from *Potentilla erecta*, the common herbs of the community are all well represented and, compared with the typical kind of heath, *Festuca ovina*, *Thymus praecox*, *Scilla verna*, *Hypochoeris radicata*, *Polygala vulgaris* and *Lotus corniculatus* show consistently higher frequencies. In addition, *Danthonia decumbens*, *Koeleria macrantha*, *Aira caryophyllea*, *Carex caryophyllea*, *Galium verum* and *Leontodon taraxacoides* are strongly preferential with, occurring less commonly, *Jasione montana*, *Anthyllis vulneraria*, *Daucus carota* and *Holcus lanatus*. Other occasional herbs include *Hypericum pulchrum*, *H. humifusum*, *Pedicularis sylvatica*, *Festuca rubra*, *Plantago maritima* and *Centaureum erythraea*. In the more open conditions, cryptogams are rather better represented than usual, with *Hypnum cupressiforme s.l.* frequent, *Trichostomum brachydontium* and *Weissia* spp. occasional, and various *Cladonia* spp. common, particularly *C. impexa*, *C. fimbriata*, *C. furcata* and *C. subrangiformis*.

***Agrostis curtisii* sub-community:** *Erica vagans-Ulex europaeus* 'Mixed Heath', Typical form Coombe & Frost 1956a *p.p.*; *Erica vagans-Ulex europaeus* heath, *Agrostis curtisii* variant Hopkins 1983 *p.p.* Apart from occasional occurrences in otherwise fairly orthodox stands of the Typical sub-community, *A. curtisii* is largely confined to this kind of *E. vagans-Ulex* heath and it can be very abundant here, especially after burning. *Molinia*, too, is frequent, and the two grasses sometimes dominate beneath the usually rather open canopy of *E. vagans*, *E. cinerea* and the two gorse spp. *Calluna* is unusually scarce in this sub-community but *E. tetralix* can occasionally be found. Among the herbs, too, there are some obvious omissions with *Viola riviniana* totally absent and *Filipendula vulgaris* scarce. *Danthonia decumbens* and *Potentilla erecta*, on the other hand, occur very frequently, *Stachys betonica* and *Serratula tinctoria* are common and, more strikingly preferential, *Hypericum pulchrum*, *Viola lactea* and *Polygala serpyllifolia*.

***Molinia caerulea* sub-community:** *Erica vagans-Ulex europaeus* 'Mixed Heath', *Molinia caerulea* variant Coombe & Frost 1956*a*; *Erica vagans-Ulex europaeus* heath, *Molinia caerulea* variant Hopkins 1983. *E. vagans* and *U. europaeus* retain high frequency and abundance here, with generally smaller amounts of *U. gallii*. Both *E. cinerea* and *Calluna* have somewhat reduced frequencies and covers but more striking in this element of the vegetation is the constant presence of a little *E. tetralix*. In stands not recently burned, the sub-shrub canopy shows the kind of vigorous growth usual in the Typical sub-community but here the most distinctive feature in the associated flora is the occurrence beneath of *Molinia*, usually not strongly tussocky but quite often abundant. The shade of the sub-shrubs and the thick *Molinia* litter depress the rich development of other herbs and generally only *Carex flacca*, *Viola riviniana*, *Potentilla erecta* and *Stachys betonica* occur with any frequency among the community species. Preferentially, however, there can be a little *Serratula tinctoria*, *Sanguisorba officinalis*, *Schoenus nigricans* and *Carex pulicaris*.

Habitat

The *E. vagans-Ulex* heath is confined to the Lizard in Cornwall where it is characteristic of free-draining brown earths, usually quite base-rich but calcium-poor and fairly oligotrophic. Edaphic variation and local differences in the generally warm and sunny oceanic climate have a strong influence on floristic diversity within the community but treatments, especially burning and, to a lesser extent, grazing, also have a marked effect on the composition and physiognomy of the vegetation. Preferential cultivation of the more fertile soils developed over gabbro and schists mean that the community survives most extensively over serpentine and many tracts of this unique vegetation type are now included within statutory or voluntary reserves.

This community occurs within the same part of Cornwall as the *E. vagans-Schoenus* heath, an area of Britain with a strikingly oceanic climate (Coombe & Frost 1956*a*, Malloch 1970, Hopkins 1983). Here, on the Lizard, the winters are very mild, with accumulated temperatures between December and March of more

than 55 day-degrees C (Page 1982) and usually less than 20 frosts annually (*Climatological Atlas* 1952), resulting in an almost year-round growing season (Fairburn 1968). The summers are warm, with mean annual maximum temperatures around 26 °C (Conolly & Dahl 1970), and insolation is high. This, coupled with the fact that precipitation, which stands at about 900 mm annually, shows a clear minimum in spring and early summer (Meteorological Office 1977), means that there is a marked potential water deficit at this time of the year (Malloch 1970, Hopkins 1983).

The direct influence of these climatic features can be seen in the general composition of the community. Along an east–west axis of floristic variation among our heath types, the *E. vagans-Ulex* heath, like the *E. vagans-Schoenus* heath, continues the Oceanic West European trend that can be seen already in the widespread south-western *U. gallii-Agrostis* heath where *U. gallii*, together with *E. cinerea* and/or *E. tetralix* maintain a strong representation. And again, here, there is the distinctive high frequency and abundance of *E. vagans*, for which this community provides the second of its two major loci in Britain, continuing the oceanic trend that runs on into Ireland where *E. mediterranea* and *E. mackiana* figure in the heaths, and representing a link with the 'Lusitanian' flora of more southerly parts of the western seaboard of Europe (Matthews 1955).

For the most part, however, it is interactions between climate and the soil parent materials that control the floristic distinctions between the two most important kinds of *E. vagans* heath and which help distinguish this community from other types of sub-shrub vegetation. For, whereas the *E. vagans-Schoenus* heath is essentially a community of wet, base-rich soils, the profiles here, though of roughly similar pH (generally between 5 and 7), are typically free-draining. The parent materials beneath the two heaths are often identical but the *E. vagans-Ulex* heath extends but a short way on to the flat and gently-undulating ground of the Lizard hinterland where seasonally-waterlogged stagnogleys predominate on the drift-free areas (Coombe & Frost 1956*b*, Hopkins 1983, Staines 1984). Rather, it is typically found over steeper, shedding slopes, the kind of ground that is of little extent over much of the plateau of the peninsula where the valleys are wide and shallow, but which becomes much more extensive around the coves where the streams cut down sharply to the sea, and which runs too around much of the cliff tops of the headland. The distribution of this community within the Lizard is thus predominantly coastal, though it is not strictly speaking a maritime heath and is replaced on slopes exposed to salt-spray by the *Calluna-Scilla* heath (see below).

The characteristic soils of such situations are well-drained and loamy, sometimes showing a clear differentiation of a B horizon, when they can be classed as brown earths, but quite often comprising a fairly homogeneous A horizon over rotting bedrock, when they should more strictly be termed rankers (Avery 1980): for the most part, they probably fall within the Kynance and Black Head series mapped within the Lizard Croft Pascoe association (Staines 1984, Findlay *et al.* 1984). Over the schists and gabbro of the headland, however, such profiles are moderately lime-rich and fairly fertile so, around Predannack and Lizard Point, where the former rock is exposed, and north of Coverack, where the latter runs to the sea, many stretches have been taken into cultivation, except where the topography has proved too intractable. Mostly, then, the *E. vagans-Ulex* heath survives over serpentine, where the brown earths and rankers are more oligotrophic, and where the exchange complex is dominated by magnesium rather than calcium, though where, free of drift contamination, base-status remains high.

However, it is not the particular ultrabasic character of the profiles that has the most obvious influence on the vegetation, but rather their generally base-rich and free-draining nature, although, combined with other environmental features on the Lizard, this does produce some rather peculiar effects. First, there is the prominence of *U. europaeus* which, over the headland, is one of the best single indicators of the distribution of these profiles out of reach of heavy salt-spray deposition (Coombe & Frost 1956*a*). In no other kind of heath on the Lizard, indeed throughout Britain, is it so consistent a member: in many areas, of course, more free-draining soils have been even more extensively brought into cultivation, such that *U. europaeus* now most often marks out places where disturbance has brought some amelioration of highly impoverished and/or waterlogged conditions within heath communities where it would not normally find a place. In fact, this is sometimes the case on the Lizard itself and the *E. vagans-Ulex* heath as a whole can sometimes indicate old areas of cultivation, boundaries and tracks on more ill-drained parts of the plateau.

Then, there is the move in the associated flora away from the waterlogging-tolerant assemblage characteristic of the *E. vagans-Schoenus* heath. *E. cinerea*, for example, largely replaces *E. tetralix* here and *Molinia*, *Schoenus*, *Serratula* and *Sanguisorba* are all of restricted occurrence. These species occur together with the typical plants of the *E. vagans-Ulex* heath only in the *Molinia* sub-community which represents one extreme of this kind of heath. It is characteristic of more gentle slopes and deeper soils than usual (Hopkins 1983) and extends the distribution of the community some way on to the flatter cliff tops and valley surrounds, where the brown earth soils are still free-draining but gently flushed or where there is some slight gleying below. Even in this vegetation, however, *Molinia* and *Schoenus* do not have the strong structural influence that they exert in the *E.*

vagans-Schoenus heath where they are markedly tussocky: perhaps this is because here fluctuation of the ground waters never breaches the soil surface (Hopkins 1983).

By and large, however, it is more mesophytic plants, tolerant of oligotrophic soils which are circumneutral or fairly base-rich but not lime-saturated, that characterise the community. Species such as *Carex flacca*, *Viola riviniana*, *Filipendula vulgaris*, *Agrostis canina* ssp. *montana*, *Stachys betonica*, *Dactylis glomerata*, *Polygala vulgaris*, *Lotus corniculatus*, *Festuca ovina* and *Thymus praecox* all fall into this category and constitute the core of the associated herbaceous flora. They are of fairly diverse floristic affinities and some are much more catholic than others, though interestingly those other vegetation types where they occur together occupy similar edaphic environments, as in those grasslands over limestones where moderately high rainfall induces some slight surface-leaching of calcium.

In the Typical sub-community, it is these species which provide the characteristic enrichment to be seen in stands of moderate age. In the *Festuca* sub-community, the *E. vagans-Ulex* heath extends towards another edaphic extreme, where the slopes attain the steepest occupied by the community and the soils become most shallow and sharply draining. Indeed, the rankers which predominate here often become parched in the dry and sunny spring and early summer, so the sub-shrubs are often confined to deeper pockets of soil within crevices in the underlying bedrock, have their vigour held in check and are sometimes killed in years of severe drought (Hopkins 1983). It is the consequent lack of shade from the bushes and the limited accumulation of litter that are partly responsible for the increased richness of the associated flora in this kind of *E. vagans-Ulex* heath, because species which would normally succumb early to canopy closure can maintain themselves, even in the absence of burning. Such conditions, together with the generally impoverished character of the soils and the grazing of the herbage by stock, help produce a relatively short sward, in which the species characteristic of the Typical sub-community increase in frequency and where there is a more strongly preferential appearance of a variety of other herbs found in oligotrophic and fairly base-rich pastures: *Galium verum*, *Carex caryophyllea*, *Koeleria macrantha*, *Plantago lanceolata*, *Leontodon taraxacoides*, *Anthyllis vulneraria*, *Danthonia decumbens*. Open patches of dry soil also provide a niche for *Jasione montana*, *Aira caryophyllea* and *Centaureum erythraea* and among the cropped turf there are more frequent records for *Hypnum cupressiforme s.l.*, for acrocarps of dry soils like *Trichostomum brachydontium* and *Weissia* spp., and for *Cladonia* spp.

It is probably also the reduced competition arising from such factors in this kind of *E. vagans-Ulex* heath that helps maintain the frequency of *Scilla verna* further away from the immediate vicinity of the cliff tops in the Lizard than happens elsewhere. Certainly, salt-spray deposition has little if any effect here. The strong and frequent westerly winds do extend maritime influence some distance inland on the more exposed coasts of the headland but deposition dies away quickly on moving away from the cliffs (Malloch 1970) and, though the amount of sodium in the soils of the *Festuca* sub-community is often greater than in the Typical kind of heath (Hopkins 1983), it is nothing like the concentrations found beneath the *Calluna-Scilla* heath. However, floristic transitions between the communities can be seen in what both Coombe & Frost (1956*a*) and Hopkins (1983) termed the *Genista pilosa* variant of *E. vagans-Ulex* heath, but what is here considered as part of the *Calluna-Scilla* heath. *E. vagans* can run some way into this vegetation but *U. europaeus* and, to a lesser extent, *U. gallii* are reduced by their sensitivity to salt-spray (see below).

Although the flora of the *E. vagans-Ulex* heath is never really markedly calcicolous, the base-rich character of the serpentine maintains at least some influence throughout the community and, on the Lizard, a pronounced shift to calcifuge sub-shrub vegetation is associated with the occurrence of a mantle of acid superficials, local Crousa Gravels and the more widely distributed loess, on which the *U. gallii-Agrostis* heath is characteristic. The *Agrostis* sub-community of the *E. vagans-Ulex* heath represents a transition to such vegetation over some of the deepest and most base-poor profiles on to which the community extends. It is concentrated around the heads of the cove valleys and around the rock outcrops on the inland valley sides where, over fairly gentle slopes, there seems to have been some loessial contamination. It can also be found over old 'lazy beds' where intermixing of serpentine and loess may have occurred (Hopkins 1983).

Superimposed upon this fairly well-defined pattern of soil-related variation, there is the impact of treatments, particularly burning. On the Lizard, deliberate burning now occurs only within the enclosed heathy pastures and in the cliff-top grazings but, even there, fires are frequently started out of season and are badly controlled. Over the open inland heaths, fires are accidental, though quite frequent and mostly occurring in summer. Of the different kinds of *E. vagans-Ulex* heath, it is the Typical, *Agrostis* and *Molinia* sub-communities that are most frequently affected, because of their extensive woody canopies and often thick accumulations of litter which, in the pastures, reduce the grazing value of the land and which, even in normal springs and summers, become tinder-dry and very fire-prone. The *Festuca* sub-community, with its discontinuous cover of bushes and little litter, does not need clearing so often

and, when ignited accidentally, is not so likely to be completely consumed, despite the often parched character of the ground.

The detailed effects of burning depend very much on the frequency and intensity of the fires and the character of the particular kind of heath that is burned (Coombe & Frost 1956*a*) but, in general, it repeatedly rejuvenates the vegetation, setting back any tendency to succession (see below) and offers a chance for temporary exploitation of the cleared ground by opportunists among the usual heath flora and a wide variety of adventives. *E. vagans* is often the first of the sub-shrubs to respond to fire, producing new shoots 1–2 dm tall in the same season as a spring burn though flowering a little later than usual from September to November (Coombe & Frost 1956*a*). The gorse species also sprout readily from surviving stools, though their response is a little slower and the soft young shoots are often consumed by stock. Unlike *E. vagans*, however, both the gorses readily regenerate from seed.

In the first autumn and spring after burning, it is often the abundance and variety of the ephemerals that catch the eye and then there can be a phase in which *E. cinerea* becomes prominent or some of the grasses, notably *A. curtisii* or *Molinia*, both of the latter able to remain dominant for some considerable time. As these wane, but before the canopy of sub-shrubs becomes extensive, the perennial herbs of the community make their most plentiful and varied contribution to the vegetation, thereafter becoming sparser and, in many cases, being totally extinguished.

In the enclosed heaths and on the cliff tops, grazing by stock can also play some part in maintaining the vegetation, though it is difficult to assess its role exactly because it occurs either in conjunction with burning (as in the enclosures) or where edaphic conditions themselves tend to produce similar effects as grazing (as on the cliff tops). But its major effects will be felt on the younger shoots of the gorse spp., and on *Calluna*, an important consideration during the early stages of regeneration, and on the herbaceous element of the community. *E. vagans*, *E. cinerea* and the tougher, older shoots of the gorse spp. are rather unpalatable (indeed, this is probably an important reason why the community subsists so well in the pastures) but, where there are stretches of grassy sward, the community can provide a valuable bite and grazing can perhaps help maintain mosaics of bushes and herbaceous vegetation and keep the latter element diverse.

Zonation and succession

The community occurs in mosaics and zonations in the open and enclosed heaths of the Lizard where transitions can be related to variations in soil moisture, base-status and trophic level and the amount of salt-spray deposition. The effects of burning and, to some extent, grazing are superimposed on to these patterns and, except in extreme edaphic and climatic conditions, these factors probably play an important part in maintaining the sub-shrub vegetation against successional change.

The floristic contrasts between the two major kinds of *E. vagans* heath, the *E. vagans-Ulex* and the *E. vagans-Schoenus* types, developed in relation to the degree of drainage impedence in base-rich soils, is sometimes expressed as a zonation between the communities, over ground that becomes more gently sloping and more prone to seasonal waterlogging within the shallow drainage basins and over the undulating surface of the plateau itself. In such situations, the *Molinia* sub-community of the *E. vagans-Ulex* heath may form a transition zone between the vegetation types, *E. tetralix* and *Molinia* appearing first, then *Schoenus* increasing in frequency, but *U. europaeus* maintaining its cover quite well. Then, with the move into the *E. vagans-Schoenus* heath, the latter fades, together with many of the attendant herbs, and *Schoenus* and *Molinia* begin to show the strongly-tussocky structure typical of seasonally-inundated ground, *E. cinerea* and *Calluna* becoming confined to the tussocks and the runnels developing their characteristic rich flora. Sometimes, where there is a switch from serpentine to gabbro or in sites where there has been some disturbance, the *Molinia-Potentilla* mire may occur within such sequences. In such vegetation, *Molinia* is strongly dominant over the somewhat more fertile soils, but *Schoenus* can be found occasionally and both *E. vagans* and *U. europaeus* can occur rooted in the tussocks. Separating this kind of vegetation from transitional heath stands can present some difficulties.

The other quite common type of gradual zonation occurs where the base-rich parent materials which give rise to the free-draining brown earths supporting *E. vagans-Ulex* heath are overlain by banks of acid loess. Where contamination with such aeolian material is only slight, the *Agrostis* sub-community is characteristic but this can give way to *U. gallii-Agrostis* heath over deeper deposits. Then *E. vagans* peters out fairly quickly, *U. europaeus* becomes confined to disturbed areas and the fairly rich assemblage of associates is replaced by a restricted suite of more calcifugous plants.

Neither the *U. gallii-Agrostis* nor the *E. vagans-Schoenus* heaths are often found running continuously up to the maritime heath zone of the Lizard because the soils of which they are most characteristic are mainly confined to the inner parts of the peninsula. On more fertile gabbro and schist soils, moreover, the maritime sequence is often truncated above the *Calluna-Scilla* heath by cultivated land bounded by an enclosure wall. On the serpentine, however, where the soils are more oligotrophic, the zonation can run uninterrupted from

the maritime heath on to the plateau. In such transitions, which are especially well developed on the more exposed west coast of the Lizard and, more locally, around the cove valleys, the *E. vagans-Ulex* heath typically occupies a position inland of the *Calluna-Scilla* heath. *E. vagans*, which is mildly salt-tolerant, can extend some way in to the *Viola* sub-community of the maritime heath, though the gorse spp., particularly *U. europaeus*, become much patchier with increasing exposure until eventually it is *Calluna* and *E. cinerea* that are providing the bulk of an often stunted and wind-pruned sub-shrub cover. But, apart from the appearance of *Plantago maritima*, there is considerable continuity between the herbaceous element of the *Festuca* sub-community of the *E. vagans-Ulex* heath, the usual cliff-top type, and the *Viola* sub-community of the *Calluna-Scilla* heath, with species like *Festuca ovina*, *Scilla verna*, *Viola riviniana*, *Carex flacca*, *C. caryophyllea*, *Polygala vulgaris*, *Koeleria macrantha*, *Plantago lanceolata*, *Hypochoeris radicata*, *Lotus corniculatus* and *Thymus praecox* all occurring in both. *Genista pilosa* can be quite a good marker of the transition and both Coombe & Frost (1956*a*) and Hopkins (1983) used this species to name the vegetation of this intermediate zone. Where the zonation continues inland from the *E. vagans-Ulex* heath into the *E. vagans-Schoenus* and *U. gallii-Agrostis* types, the sequences constitute some of the most extensive and valuable tracts of coastal sub-shrub vegetation that we have.

On the rocky cliff tops, where parching of the soils in spring and summer, inherent infertility, exposure to wind and grazing all contribute to the inhospitable character of the environment, the *Festuca* sub-community may represent a natural climax kind of *E. vagans-Ulex* heath (Hopkins 1983). In other situations, however, it is burning and grazing which ultimately maintain the vegetation as a plagioclimax, though the poor quality of the serpentine soils and the shortage of seed-parents over much of the headland would probably make succession to scrub slow. As noted above, older stands of the community do show some transitional features to *Ulex-Rubus* or *Prunus* scrubs, though Coombe & Frost (1956*a*) considered that progression from heath to the latter was not clearly supported by field evidence.

Distribution

The *E. vagans-Ulex* heath occurs only on the Lizard in Cornwall, where the Typical and *Festuca* sub-communities occur mostly towards the coastal fringe, the *Molinia* sub-community more extensively inland.

Affinities

Like the *E. vagans-Schoenus* heath, this community was first described in detail by Coombe & Frost (1956*a*) and subject to phytosociological scrutiny by Hopkins (1983). This account relies heavily on the data of the latter but, although agreeing with these workers in according this heath a central place among the range of sub-shrub vegetation in this part of Britain, it draws the bounds of the community a little tighter. Essentially, the *E. vagans-Ulex* heath of this scheme corresponds with the Typical, *Festuca*, *Molinia* and *Agrostis* variants of Hopkins (1983) but transfers the *Genista* variant to the *Calluna-Scilla* heath, a community which has a wider distribution but which, on the Lizard, provides a further locus for *E. vagans*.

And, as with the *E. vagans-Schoenus* heath, there is some difficulty in locating this second major *E. vagans* community within phytosociological frameworks of heath variation. In a British context, this kind of vegetation is certainly unique in its floristics but there is little to justify considering it as widely separated from other *Erica cinerea* and *Ulex gallii* heaths of the south-west: it grades to both the *U. gallii-Agrostis* and *Calluna-U. gallii* heaths, showing particularly strong continuity with the latter, and could be grouped with them in the Ulicion gallii des Abbayes & Corillion 1949. Such an affiliation would emphasise the phytogeographical position of the community on an east–west axis of variation, in particular stressing the separation of this vegetation from the *U. minor* heaths further east. Were more weight to be given to the presence of *E. vagans*, the community could be placed in a group like Géhu's (1975) Ulici-Ericion ciliaris, an alliance of heaths confined to the far west of England and north-west France, with small outliers in Ireland (White & Doyle 1982).

Other authors have stressed the position of the *E. vagans-Ulex* heath along a north–south axis down the western seaboard of Europe. On such a view, the community is seen by some, not as a most southerly member of the Ericion cinereae heaths, but as the most northerly representative of the Ericion scopariae, the euoceanic southern alliance which, running down through France, Spain and Portugal gives way around the Mediterranean to the maquis (Böcher 1943, Coombe & Frost 1956*a*, Gimingham 1972). Certainly, in contrast to the *E. vagans-Schoenus* heath, this community does have obvious counterparts on the European mainland, like the Breton vegetation described by Gadeceau (1903) and Géhu & Géhu (1973), though these heaths can lack *U. gallii* and a variety of other *E. vagans-Ulex* species and they also often contain *E. ciliaris*; the *Ulici-Ericetum vagantis* of Géhu & Géhu (1973) is also distinctly more maritime than most British vegetation with *E. vagans* (see also Bridgewater 1970).

Further south, in the western French Pyrenees, Vanden Berghen (1973) has described a *Pteridio-Ericetum vagantis* which, despite its dominance by bracken, maintains a variety of floristic features in common with the *E. vagans-Ulex* heath (see also Jovet 1941). This was placed

in the Ericion umbellatae, though, from Iberian studies by Braun-Blanquet *et al.* (1964), Rodriguez (1966) and Braun-Blanquet (1967), Hopkins (1983) considered the community only peripheral to this alliance. This last author, too, saw the floristic trend running on into the more Continental *E. vagans-E. cinerea-U. minor* heath described by Duvigneaud (1966) from south-east France and suggested that all these communities might be united in a new alliance characterised by *E. vagans*, *E. cinerea*, *Filipendula vulgaris*, *Genista pilosa*, *G. tinctoria*, *Serratula tinctoria*, *Stachys betonica* and *Viola riviniana*.

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Floristic table H6

	a	b
Erica vagans	V (5–8)	V (1–8)
Ulex europaeus	V (2–9)	V (1–5)
Erica cinerea	V (2–8)	V (2–5)
Ulex gallii	IV (1–6)	IV (1–6)
Carex flacca	IV (1–5)	III (1–5)
Viola riviniana	V (1–4)	IV (1–3)
Agrostis canina montana	IV (1–5)	IV (1–4)
Filipendula vulgaris	IV (1–5)	IV (1–4)
Rubus fruticosus agg.	II (1–3)	I (1)
Teucrium scorodonia	II (1–5)	I (1–2)
Prunus spinosa	II (1–4)	I (1)
Geranium sanguineum	II (1–5)	
Pteridium aquilinum	II (1–2)	I (1)
Polygala vulgaris	II (1–3)	V (1–3)
Thymus praecox	II (1–3)	V (2–6)
Scilla verna	II (1–2)	V (1–3)
Hypochoeris radicata	II (1–2)	V (1–4)
Hypnum cupressiforme	II (2–5)	V (1–5)
Lotus corniculatus	II (1–3)	IV (1–4)
Dactylis glomerata	III (1–4)	IV (1–5)
Danthonia decumbens	I (1–3)	IV (1–4)
Festuca ovina	I (1–2)	V (1–7)
Galium verum	I (1–3)	V (1–3)
Carex caryophyllea	I (1–2)	V (1–4)
Plantago lanceolata	I (2–3)	V (1–5)
Leontodon taraxacoides	I (1–4)	V (1–4)
Koeleria macrantha	I (1–2)	V (1–5)
Aira caryophyllea	I (3)	IV (1–3)
Jasione montana	I (2–3)	III (1–3)
Anthyllis vulneraria	I (2–3)	III (1–4)
Daucus carota	I (1–2)	III (1–3)

c	d	6
V (4–6)	V (5–7)	V (1–8)
V (4–8)	V (4–7)	V (1–9)
V (2–6)	IV (2–5)	V (2–8)
V (1–6)	V (2–5)	IV (1–6)
IV (1–3)	V (1–3)	IV (1–5)
	IV (1–3)	IV (1–4)
V (1–5)	II (1–3)	IV (1–5)
II (1–2)	II (1–2)	IV (1–5)
I (1–3)		I (1–3)
I (1–3)		I (1–5)
		I (1–4)
		I (1–5)
		I (1–2)
II (1–2)	II (1–3)	III (1–3)
I (2)	II (1)	III (1–6)
II (1–3)	I (2)	III (1–3)
I (1)		III (1–4)
I (2–3)		III (1–5)
II (1–2)		III (1–4)
		III (1–5)
IV (1–3)	I (2)	III (1–4)
I (1)	I (1)	III (1–7)
I (1–2)	I (1)	III (1–3)
I (1–2)		II (1–4)
I (1–2)		II (1–5)
I (1)		II (1–4)
		II (1–5)
		II (1–3)
		II (1–3)
		II (1–4)
		II (1–3)

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Holcus lanatus	I (1–4)	III (1–3)
Cladonia impexa	I (1–3)	III (1–5)
Hypericum humifusum	I (2)	II (1–3)
Cladonia fimbriata	I (3)	II (1–3)
Festuca rubra	I (1–3)	II (1–3)
Trichostomum brachydontium	I (1)	II (1–3)
Weissia sp.	I (3)	II (1–2)
Cladonia furcata		II (1–3)
Dicranum scoparium		II (1–3)
Cladonia subrangiformis		II (2–4)
Plantago maritima		II (1–3)
Centaurium erythraea		II (1–2)
Potentilla erecta	III (1–4)	I (2–3)
Molinia caerulea	I (2–3)	
Serratula tinctoria	I (1–4)	II (2–5)
Agrostis curtisii	I (1–4)	I (1)
Carex panicea	I (2–3)	I (1–3)
Hypericum pulchrum	I (1)	II (1–2)
Viola lactea	I (2)	I (1–2)
Polygala serpyllifolia		
Erica tetralix	I (1–2)	
Sanguisorba officinalis	II (1–4)	I (2)
Schoenus nigricans		
Carex pulicaris	I (1–2)	
Stachys betonica	III (1–3)	IV (1–3)
Calluna vulgaris	III (1–5)	IV (1–6)
Brachypodium sylvaticum	I (1)	III (1–2)
Pedicularis sylvatica	I (2–3)	II (1–3)
Anthoxanthum odoratum	II (1–3)	II (1–4)
Leucanthemum vulgare	II (1–3)	II (1–3)
Agrostis capillaris	I (1–2)	I (1–4)
Hypnum jutlandicum	I (2)	I (1–3)
Solidago virgaurea	I (1)	I (1)

		II (1–4)
		II (1–5)
		I (1–3)
		I (1–3)
		I (1–3)
		I (1–3)
		I (1–2)
		I (1–3)
		I (1–3)
		I (2–4)
		I (1–3)
		I (1–2)
V (2–4)	V (1–3)	III (1–4)
IV (2–7)	V (3–7)	II (2–7)
III (1–3)	III (2–3)	II (1–5)
V (3–7)		II (1–7)
IV (1–3)		II (1–3)
IV (1–2)		II (1–2)
III (1–3)		I (1–3)
II (1–3)		I (1–3)
II (4–5)	V (1–5)	I (1–5)
	IV (2–4)	I (1–4)
	III (3–4)	I (3–4)
I (2–3)	II (3)	I (1–3)
IV (1–4)	III (1–3)	III (1–4)
I (2–4)	III (3–4)	III (1–6)
	II (1–2)	II (1–2)
II (1–3)		I (1–3)
		II (1–4)
		II (1–3)
I (1)		I (1–4)
	I (1)	I (1–3)
		I (1)

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Floristic table H6 *(cont.)*

	a	b
Campylopus paradoxus	I (2)	I (2)
Pimpinella saxifraga	I (1–2)	I (1)
Number of samples	38	30
Number of species/sample	16 (6–27)	34 (26–48)
Vegetation height (cm)	39 (12–75)	18 (6–32)
Vegetation cover (%)	97 (82–100)	83 (45–100)
Slope (°)	15 (0–36)	20 (0–72)
Soil pH	5.8 (4.8–7.1)	6.5 (5.8–7.3)

a Typical sub-community
b *Festuca ovina* sub-community
c *Agrostis curtisii* sub-community
d *Molinia caerulea* sub-community
6 *Erica vagans-Ulex europaeus* heath (total)

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c	d	6
		I (2) I (1–2)
13 19 (12–25)	7 15 (11–20)	88 24 (6–48)
31 (12–46) 97 (75–100)	34 (26–43) 100	29 (6–75) 92 (45–100)
10 (0–66) 5.4 (4.8–6.4)	3 (0–8) 6.0 (5.2–6.4)	15 (0–72) 6.1 (4.8–7.3)

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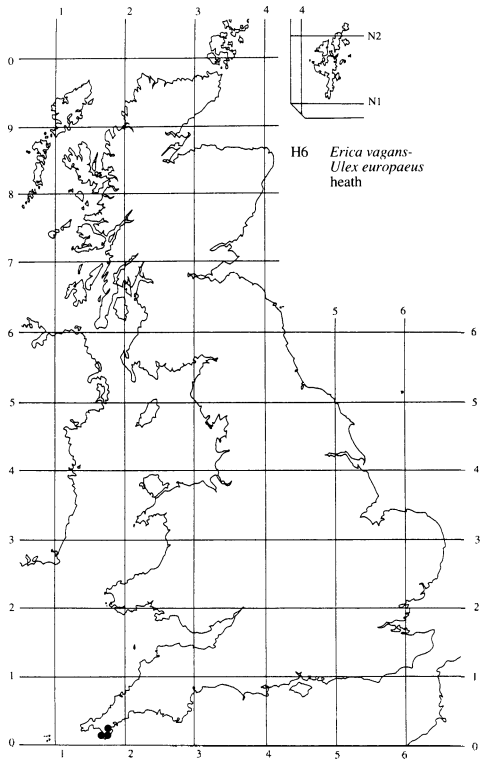

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