H5
Erica vagans-Schoenus nigricans heath

Synonymy

Erica vagans-Schoenus nigricans 'Tall Heath'   Coombe & Frost 1956*a*; *Erica vagans* heath   Gimingham 1972 *p.p.*; *Ulici gallii-Ericetum vagantis*   Bridgewater 1970 *p.p.*; *Ulici maritimi-Ericetum vagantis* (Géhu 1962) Géhu & Géhu 1973 *emend.* Bridgewater 1980; *Erica vagans-Schoenus nigricans* heath   Hopkins 1983 *p.p.*

Constant species

Anagallis tenella, Carex pulicaris, Erica tetralix, E. vagans, Festuca ovina, Molinia caerulea, Potentilla erecta, Schoenus nigricans, Serratula tinctoria, Succisa pratensis, Ulex gallii, Campylium stellatum.

Rare species

Agrostis curtisii, Erica vagans, Scilla verna.

Physiognomy

The *Erica vagans-Schoenus nigricans* heath is one of the two sub-shrub communities to which the nationally-rare Oceanic West European *Erica vagans* makes a constant and often prominent contribution, its long spikes of flowers adding a distinctive pale pink to the splash of colour provided by the ericoids in July through to September. Often, however, it is the consistent presence of *Schoenus nigricans* which marks out stands of this vegetation, its tall greyish semi-evergreen foliage standing a little proud of the rest of the cover (hence Coombe & Frost's (1956*a*) epithet 'Tall Heath'). In fact, *Schoenus* can be found as a rare associate in wetter tracts of various lowland heath types, but here it is an invariable member of the community and one of the most important structural components of the vegetation, occurring, often in abundance and generally in a strongly-tussocky form, with dense caespitose clusters of shoots growing on bulky rootstocks (Sparling 1962*a*, 1968, Wheeler 1975). *Molinia caerulea*, too, which is also constant and frequently of high cover, typically occurs as pronounced tussocks and *E. vagans*, together with the next most common sub-shrub, *E. tetralix*, often forms compact

bushes. Thus, although these four species generally dominate in intimate mixtures, forming a canopy 2–4 dm tall, there is often beneath this a well-defined system of runnels between the individual plants. These are flooded to a depth of a few centimetres for long periods during the winter and, more briefly, throughout the year after heavy rain, and so can provide a microhabitat different in character from the sides and tops of the *Schoenus* and *Molinia* tussocks, which are far removed from the influence of the ground waters.

Among other lowland heath sub-shrubs, only *Ulex gallii* occurs with any frequency throughout and, though occasionally co-dominant, it is typically subordinate in cover to the above, but conspicuous in late summer with its contrasting yellow flowers. *Calluna vulgaris*, however, is reduced to occasional and, with *E. cinerea*, which is scarce, is usually found as rather spindly plants rooted in the tussock sides. *Genista anglica* can also occur quite frequently: indeed, among the Lizard heaths, it is strongly preferential to this community, though is absent from apparently suitable sites on gabbro (Proctor 1971, Hopkins 1983). It, too, grows on the *Schoenus* and *Molinia* and its straggling shoots can become particularly abundant in the years after burning. *Salix repens* is occasional at low cover. In contrast to the other major kind of *E. vagans* vegetation, the *E. vagans-Ulex europaeus* heath, *U. europaeus* is uncommon here and usually confined to disturbed situations: among Hopkins's (1983) samples, it made a small contribution on the drier ground of old cultivation areas. His *Ulex europaeus* variant (equivalent to an intermediate 'Tall/ Mixed Heath' in Coombe & Frost 1956*a*) in which this gorse is much more prominent, with much strongly-tussocky *Molinia*, but reduced frequencies of a number of important species in the community, is best regarded as a type of *Molinia-Potentilla* mire in which *E. vagans* has a local role.

In undisturbed stands, not burned for some time and without any grazing, *Schoenus* and *E. vagans* tend to become more overwhelmingly dominant, and the vege-

tation choked with *Schoenus* and *Molinia* litter. In such situations, even those common associates, like *Potentilla erecta*, which are concentrated on the sides and tops of the tussocks, or which, like *Festuca ovina*, often occur there, can be crowded out. More striking still, the densely-shaded runnels can be virtually bare, such that the vegetation is very impoverished. Where litter and standing material have been destroyed by fire, on the other hand, or their accumulation kept in check by trampling and grazing, the associated flora is more extensive and richer. Among smaller vascular plants in the runnels, sedges are often important, with *C. pulicaris* constant, *C. panicea* and *C. flacca* frequent and, on the gabbro (Proctor 1971), *C. hostiana*, forming the kind of open sward that is also seen in many stands of the *Schoenetum*. And, as there, *Anagallis tenella* occurs commonly, forming quite extensive mats, particularly following fires. Even in the most well colonised and diverse runnels, however, there is not that striking richness among the vascular element typical of well-developed *Schoenetum* and many of the widely-tolerant small herbs frequent there, such as *Mentha aquatica*, *Equisetum palustre* and *Hydrocotyle vulgaris*, as well as more calcicolous plants, are absent here. Among taller herbs, too, there is a restricted flora, though this element is a little better developed and, as in the *Schoenetum*, includes some orchids. Thus, *Serratula tinctoria* and *Succisa pratensis* are constant, *Sanguisorba officinalis* frequent, and *Hypericum pulchrum*, *Stachys betonica*, *Pedicularis sylvatica*, *Dactylorhiza maculata* ssp. *ericetorum*, *D. incarnata* ssp. *incarnata* and *Gymnadenia conopsea* all occasional with, on gabbro again, *Platanthera bifolia*. Other low-frequency associates include *Polygala vulgaris*, *Juncus acutiflorus*, *J. maritimus* and *Galium uliginosum*. On the permanently moist ground characteristic of the *Eleocharis* sub-community, plants such as *E. multicaulis*, *Eriophorum angustifolium*, *Drosera rotundifolia* and *Pinguicula lusitanica* provide a floristic link with the *Schoenus-Narthecium* mire, although *Narthecium ossifragum* itself is rare here. In ungrazed heaths on wetter ground, particularly of this *Eleocharis* type, *Phragmites australis* can figure as scattered shoots or even as a quite dense overtopping canopy, giving a superficial impression of Phragmitetalia fen.

Bryophytes vary considerably in their contribution to the diversity and cover of this vegetation, though in the data of Hopkins (1983) they are a rather more consistent feature than in the stands originally described by Coombe & Frost (1956*a*), something which may reflect the impact of treatments because, as with the smaller vascular plants, the bryophytes are much reduced by litter accumulation and shade. In more open runnels, however, *Campylium stellatum* is very frequent and sometimes quite abundant with, fairly often, some *Ric-*

cardia multifida, *R. sinuata* and, over gabbro, *Scorpidium scorpioides*. In contrast with the *Schoenetum*, however, runnel species such as *Aneura pinguis*, *Drepanocladus revolvens*, *Cratoneuron commutatum* and *C. filicinum* are not usually found here, and the larger Mniaceae characteristic of the tussock sides in that community are likewise scarce, though *Fissidens adianthoides* can occasionally be found in such situations. On the other hand, the Sphagna typical of the tussock tops in the *Schoenus-Narthecium* community are also absent in this heath.

A distinctive feature of many runnels after wet weather is swollen gelatinous granules of blue-green algae, particularly *Scytonema ocellatum* with some *Stigonema ocellatum*, *Nostoc* sp. and *Zygogonium ericetorum* (Coombe & Frost 1956*a*).

Sub-communities

Typical sub-community: Typical 'Tall Heath' Coombe & Frost 1956*a*; Typical *Erica vagans-Schoenus nigricans* heath Hopkins 1983. This vegetation has all the general features of the community described above with no additional preferential species. The tussock/runnel structure is often well-defined, though stands vary considerably in species-richness which is strongly dependent upon time since burning and other treatments. Some floristic peculiarities can be seen where this kind of heath occurs over gabbro, as opposed to serpentine, with *Carex hostiana*, *Platanthera bifolia* and *Scorpidium scorpioides* appearing, *Genista anglica* dropping out (Proctor 1971, Hopkins 1983): such differences could form the basis of recognising two variants (see below).

***Eleocharis multicaulis* sub-community:** 'Tall Heath' variants Coombe & Frost 1956*a* *p.p.*; *Erica vagans-Schoenus nigricans* heath, *Eleocharis multicaulis* variant Hopkins 1983. *Schoenus* is generally an obvious dominant here, with *Molinia*, *E. vagans* and *E. tetralix* somewhat less abundant, *Calluna* and *E. cinerea* usually absent. Among smaller associates, *Carex panicea* is also typically missing. On the positive side, this vegetation is characterised by the preferential frequency of *Eleocharis multicaulis*, *Eriophorum angustifolium*, *Drosera rotundifolia*, *Pinguicula lusitanica* and *Dactylorhiza incarnata* ssp. *incarnata*, growing in runnels that are usually flooded to shallow depth through most of the year. Where there is no grazing, *Phragmites* is quite common and can be locally abundant.

Habitat

The *E. vagans-Schoenus* heath is confined to wet, base-rich but calcium-poor mineral soils and shallow peats on the Lizard in Cornwall. Interactions between the warm, oceanic climate of the area and its distinctive parent

materials have an important influence on the floristics of the community but the composition and physiognomy of particular stands are much affected by burning and sometimes also by grazing. Other past treatments, like the cutting of 'turf' have probably also influenced the appearance and distribution of the vegetation and, though the wet and impoverished character of the soils has previously afforded some protection against cultivation of the ground, the community is vulnerable to modern techniques of land improvement. Much of the remaining extent of this unusual vegetation type now has statutory or voluntary protection.

The climate of the extreme tip of Cornwall is warm, wet and windy (Coombe & Frost 1956a, Malloch 1970, Hopkins 1983). Mean annual maximum temperatures are a little cooler, at 25 °C, than those through most of the South-West Peninsula (Conolly & Dahl 1970), but the winters are the mildest on the British mainland, with February minima usually 4 °C above freezing (*Climatological Atlas* 1952), accumulated winter temperatures (December to March) of more than 55 °C (Page 1982) and, on average, less than 20 frosts annually, with these few being generally confined between mid-December and the beginning of March. The annual range of mean monthly temperatures is about 9 °C and the effective growing season is virtually year-round (Fairburn 1968).

However, despite the frequency of strong westerly winds (*Climatological Atlas* 1952), the rainfall of this part of Cornwall is not especially high, annual precipitation of around 900 mm (Meteorological Office 1977) being similar to levels recorded through much of lowland south-west Britain and very much less than that in more northerly oceanic areas. The annual distribution of rainfall also shows a clear winter peak and a minimum between April and July. Combined with the high summer insolation, this means that there is a potential water deficit in spring and early summer comparable with that in many more easterly and inland areas (Malloch 1970, Hopkins 1983). Along a west–east axis across southern Britain, therefore, the area has a markedly oceanic climate; along a south–north axis up the western seaboard, it exhibits certain Mediterranean tendencies (Coombe & Frost 1956a).

The general floristic character of the community reflects these climatic features. In its frequent combination of *E. tetralix* with *U. gallii*, this kind of vegetation continues the Oceanic West European trend already visible in the *U. gallii-Agrostis* heath, which has a wide distribution through south-west England. But here, there is the additional striking presence of *E. vagans*, a species virtually restricted in Britain to this area and one which adds a more specifically 'Lusitanian' feel to the community, representing a further stage in the progressive confinement of *Erica* spp. to the western seaboard of Europe, which continues in Ireland with *E. mediterranea*

and *E. mackiana* (Matthews 1955). Less typical of the community as a whole, and also occurring widely in cooler oceanic areas further north, but generally 'Lusitanian' in its European range, there is *Pinguicula lusitanica*. And the community provides a locus, too, for the Oceanic Southern *Anagallis tenella* and for *Serratula tinctoria* which, though Continental through Europe as a whole, has a strongly south-western distribution in Britain.

It is, however, the indirect effects of climate, working on the parent materials, that have the more obvious impact on the composition of the vegetation because, within this climatic zone, the *E. vagans-Schoenus* heath is rather strictly confined to soils that are, in the first place, wet and, second, moderately base-rich yet calcium-poor, features which derive in this area from the distinctive lithology of serpentine and gabbro, the former of major importance through the Lizard, the latter occurring as a smaller intrusion towards the east of the headland (Flett 1946). The resistance of these rocks to sub-aerial erosion means that the landscape of the Lizard is still dominated by the wave-cut platform, supposedly cut in Pliocene–Pleistocene times (Balchin 1964), over which gentler slopes predominate and which shows only a gradual rise on moving inland from the encircling cliffs. Much of this surface has a somewhat indistinct drainage pattern, with wide and shallow basins gathering water by percolation and surface run-off and feeding relatively unbranched streams that cut down sharply near the coast in deep 'cove-valleys' (Hopkins 1983). Over much of the ground, therefore, the soils shed excess winter rain but slowly and, where the serpentine and gabbro are free of a mantle of pervious drift, drainage is further impeded by the fact that these rocks weather to produce a large proportion of sticky clays (Butler 1953). It is on the stagnogleys of the Croft Pascoe Association (Staines 1984, Findlay *et al.* 1984), derived from serpentine and gabbro over slopes of less than 5° or so, that the *E. vagans-Schoenus* heath mainly occurs. Here, there is marked seasonal waterlogging with, on level ground, a few centimetres of water standing in the runnels long through the winter, then disappearing in the drier spring. In the *Eleocharis* sub-community, the vegetation extends a little way on to ground that is more or less permanently waterlogged around streams and more ill-defined drainage lines, and in such situations there can be a thicker humic top or a layer of peat in what is approaching a topogenous fen.

The other distinctive feature of these profiles lies in their chemistry. Serpentine, the more extensive parent material, is petrologically heterogeneous but made up largely of ferromagnesian silicates and fairly uniform in its decomposition products, giving rise to soils that have a superficial pH of between 5.5 and 7.5, but in which magnesium predominates over calcium; the profiles are

also rich in chromium and nickel, but poor in aluminium, potassium and phosphorus (Flett 1964, Coombe & Frost 1956*b*, Malloch 1970, Hopkins 1983). In fact, among British serpentine soils, those on the Lizard have a little more calcium than usual (Proctor & Woodell 1971), perhaps because of the presence of augite in the rocks (Coombe & Frost 1956*b*), perhaps because of some salt-spray deposition (Hopkins 1983) although this dies off rapidly inland and must be slight over most of the stands (Malloch 1970). It is, however, still insufficient to dominate the cation-exchange system. The gabbro soils, on the other hand, have a lower magnesium:calcium ratio, and also less chromium and nickel (Staines 1984), features which may play a part in the uneven distribution through the community of *Genista anglica* (mainly on serpentine), *Carex hostiana*, *Platanthera bifolia* and *Scorpidium scorpioides* (almost always on gabbro) (Proctor 1971, Hopkins 1983). Generally, however, the profiles are similar in providing an edaphic environment which is moderately base-rich, but not overwhelmingly calcareous, and also oligotrophic.

Some of the floristic characteristics of the community relate more obviously to the wetness of the soils. On the negative side, for example, a number of species which, on climatic grounds, might be expected to figure prominently here, are scarce. In comparison with the *U. gallii-Agrostis* heath, which extends through the South-West Peninsula but which is typical of more free-draining profiles, *Agrostis curtisii*, *Erica cinerea* and even the ubiquitous *Calluna*, are infrequent here and, when they are found, are typically growing epiphytically on the *Schoenus* or *Molinia* tussocks, where they are protected from any adverse effects of prolonged waterlogging (Ivimey-Cook 1959, Bannister 1965, Jones & Etherington 1970, Jones 1971*a, b*). On the Lizard, the edaphic preferences of the two heath types are sharply illustrated where the serpentine or gabbro become mantled with more pervious loess or Crousa Gravels, over which the *E. vagans-Schoenus* heath is replaced by the *U. gallii-Agrostis* type. This floristic difference, together with the corresponding vigour of *E. tetralix* and *Molinia* here, particularly in the Typical sub-community where the soils become aerated in spring and summer, confirms the general similarity of this kind of vegetation to the *Ericetum tetralicis* wet heath.

The presence of *Schoenus nigricans* provides one striking difference between the two communities, although it is not as surprising as all that. Certainly, though combinations of *Schoenus* and *Molinia* occur commonly elsewhere, sometimes also with *E. tetralix*, mixtures of these three species with *U. gallii*, even without the additional presence of *E. vagans*, are unusual: this is true not only of Britain but throughout western Europe (Coombe & Frost 1956*a*). But, on edaphic and climatic grounds, there is nothing especially odd about the vigour of *Schoenus* in the community. In general, it is a lowland plant, restricted to areas with a February minimum above freezing (Sparling 1968), so it can thrive in the relatively frost-free climate of the Lizard. And, though it is characteristic of wet and oligotrophic soils, these can vary greatly in their base-status and calcium carbonate content. Through much of mainland Britain, and particularly in the more continental east, it is characteristic of base-rich and calcareous soligenous mires, occurring pre-eminently in the *Schoenetum*. But, with the move to a more oceanic climate, it extends first into more base-poor soligenous vegetation, like the *Schoenus-Narthecium* mire of south-west Britain and flushed *Scirpus-Erica* wet heath of western Scotland, and then, in Ireland, on to the acidic ombrogenous peats of blanket mires. Within this sequence, the habitat of the *E. vagans-Schoenus* heath occupies an intermediate position between those of the *Schoenetum* and the *Schoenus-Narthecium* mire as far as base-status and calcium content are concerned. The calcium content is very much less than that of the *Schoenetum* soils, though the substitution of magnesium in the exchange complex means that there is some considerable overlap in the pH range of the two communities; in the *Schoenus-Narthecium* mire, on the other hand, pH is almost always lower than here because of the general cation-poverty of the substrates. The increased tolerance in *Schoenus* of more acidic and less calcareous environments in moving further west was attributed by Sparling (1962*b*, 1967*a, b*) to the greater oceanicity of the climate, perhaps working through dilution of the aluminium levels in the substrate. Quite apart from the relative dampness of the environment in the Lizard, the serpentine soils are also inherently poor in aluminium (Flett 1946).

Furthermore, the wet and oligotrophic character of these soils is also reflected in the herbaceous and cryptogam associates of the community. And, once again, given the edaphic conditions here, there is nothing especially unusual about the suite of species that marks out this community both from the other kinds of *Schoenus* vegetation in Britain and among the oceanic heaths of the south-west; in particular there is no floristic feature that is uniquely related to the predominance of serpentine among the soil parent materials. The group of species, *Anagallis tenella*, *Serratula tinctoria*, *Succisa pratensis*, *Carex panicea*, *C. pulicaris*, *C. flacca*, *Sanguisorba officinalis* and, occurring less frequently, *Stachys betonica* and *Hypericum pulchrum*, is of fairly diverse floristic affinities but they are all characterised by a tolerance of or, in some cases, a distinct preference for, soils of intermediate base-status and calcium content; and they can also be found together, in various combinations, in, for example, Molinietalia poor fens, surface-leached but moist calcicolous grasslands, and in calcifugous grasslands and heaths in which there is some

modest amelioration of base-poor conditions by flushing. Compared with the *Schoenetum*, there is a poor representation of more strictly calcicolous plants: among the sedges, *C. hostiana* occurs on the gabbro but, even among the bryophytes, which are in close contact with the ground waters in the runnels, it is species such as *Campylium stellatum*, *Riccardia multifida* and *Riccardia sinuata* which predominate. On the other hand, although the *Eleocharis* sub-community comes a little closer to the *Schoenus-Narthecium* mire than Typical *E. vagans-Schoenus* heath, even there, base-intolerant herbs and Sphagna are absent, maintaining the negative definition in the other direction. This group of species also provides a good distinguishing feature from other lowland heaths and, occurring together with more calcifugous plants like the ericoids and *Potentilla erecta*, produces a striking impression that is really only closely approached in flushed wet heath of the *Succisa-Carex panicea* sub-community of the *Ericetum tetralicis*, a vegetation type of wet gravels and sands of similar pH.

In the past, the wet and oligotrophic character of the soils at present occupied by the *E. vagans-Schoenus* heath probably afforded some protection against the primitive type of land improvement – paring, burning, scattering of fish-waste and seaweed, followed by a few seasons' cultivation – that seems to have occurred both inside and outside the enclosed fields on the Lizard, though it is possible that the tussocky character of the vegetation masks any remaining surface signs of such activity (Coombe & Frost 1956*a*, Hopkins 1983). It seems likely, however, that much of the ground was subject to the cutting of 'turf' which, particularly in the fourteenth and fifteenth centuries, was of great importance as a fuel for tin-smelting and which was also used domestically (Hopkins 1983). Exactly what this 'turf' was, whether always a distinct layer of peat or sometimes more of a thin paring of humus from the soil surface, is unknown (Coombe & Frost 1956*a*), but it looks as if the *E. vagans-Schoenus* heath is largely a secondary vegetation type which has developed on the wetter surfaces between the mounds of loess and Crousa Gravels after perhaps several extensive bouts of such stripping (Hopkins 1983, Staines 1984). In some cases, the development of more extensive runnels or pans within stands of the community could still mark out surface irregularities produced by such activities.

How important burning was in the past is unknown. Certainly, today, it is of major significance to the character of this vegetation though, except within the small proportion of enclosed heathland, such fires are now uncontrolled. With the accumulation of litter and dead sub-shrub branches, often substantial in the absence of grazing and gorse-gathering, and with the demise of 'turf'-cutting which created fire-breaks, and the increase in visitors, burning is, however, frequent. The effect of light, winter burns, especially where these

are well controlled within enclosed stands, is slight but, in spring and summer, when the soil surface and litter begin to dry out, fires can be ferocious and, where accidentally started, difficult to bring under control. Not that the effects of such burning need be detrimental: indeed, ultimately, they help maintain the community against the invasion of shrubs and trees (see below), and, by destroying the large quantities of *Molinia* and *Schoenus* litter that can accumulate and by setting back the development of a closed sub-shrub canopy, they create an opportunity for the short-term expansion of certain species, such as *Genista anglica*, *Anagallis tenella* and *Campylium stellatum* and, more generally, increase the species-richness of the vegetation. This is particularly true of stands where *Schoenus* and *Molinia* show a strongly-tussocky structure (something which may be related to fluctuation of the water-table: Hopkins 1983), where burning allows a fuller exploitation of the various microhabitats of the runnels, tussock sides and tussock tops. In such situations, the diversity of the community is strongly related to the interaction between time since the last burn and the degree of contrast between the wet and more base-rich runnels and dry and more base-poor tussocks.

Grazing which, since the 1930s and 1940s, has occurred only in the enclosed heaths of the Lizard, might be expected to produce similar effects to fire by preventing the accumulation of standing herbage and litter, but Hopkins (1983) found it difficult to assess its precise impact because of the fact that it is always accompanied by burning. Although he could detect no significant floristic difference between grazed and ungrazed stands, it is likely that trampling by stock enhances the development of the tussock/runnel structure, especially where the animals have access while the ground is moist.

The seasonal waterlogging of the ground means that, without drainage, which is anyway difficult over such gently-sloping land, the period of risk-free cultivation of the soils under the *E. vagans-Schoenus* heath is short. And, though the mild, moist climate promises potentially large yields of grass, there is often the continuing problem of poaching for much of the year. In addition to this, the inherent oligotrophic character of the soils necessitates the application of fertilisers (Findlay *et al.* 1984). Much of the cultivation on the Lizard has thus been confined to the more naturally eutrophic and better-drained soils beneath the *E. vagans-Ulex europaeus* heath and the loess-derived profiles under the *U. gallii-Agrostis* heath, although there has probably been some loss of the community over the more calcium-rich gabbro. Many remaining tracts fall within nature reserves or notified sites.

Zonation and succession

The *E. vagans-Schoenus* heath forms a major component of the mosaic of sub-shrub communities and other

vegetation types developed on the Lizard in relation to variations in soil moisture, base-status and trophic level and the amount of salt-spray deposition. The pattern of past and present treatments often influences the effect of these factors; and burning and, to a lesser extent, grazing still also play a major role in maintaining the community in its typical form.

One of the more gradual kinds of transitions is found where the soils retain the generally wet and base-rich character associated with the *E. vagans-Schoenus* heath, but seem to become somewhat more fertile with, in particular, increased availability of phosphate (Hopkins 1983), a feature which may reflect a switch in bedrock from serpentine to gabbro and somewhat less lengthy winter flooding, but which can also be associated with disturbance alongside walls, ditches and roadways. Then the community is replaced by the *Molinia-Potentilla* mire in which *Schoenus* can retain some representation, but where dominance shifts markedly to *Molinia*, with *E. vagans*, *E. tetralix* and *U. gallii* still present quite frequently but usually exceeded in abundance by *U. europaeus*, its bushes rooted in the often very large *Molinia* tussocks. Among the associates, such distinctive smaller herbs as *Anagallis tenella*, *Carex pulicaris* and *Festuca ovina* are usually overwhelmed by the accumulation of thick *Molinia* litter, and taller plants like *Serratula* and *Succisa* are replaced by *Angelica sylvestris* and *Eupatorium cannabinum*.

In such vegetation on the Lizard (which Hopkins (1983) included within the *E. vagans-Schoenus* heath as a *Ulex* variant), the climate is sufficiently mild for *Cladium* to gain a local hold in sites which are flooded only for very brief periods, as in the Kynance valleys, on Goonhilly Down and at Main Dale. Elsewhere, increased abundance and vigour of *Cladium* and the appearance of *Phragmites* on permanently-flooded soils along stream sides and in hollows marks a continuation of the zonation into sedge-dominated *Phragmites-Eupatorium* fen or *Cladietum marisci* swamp. In other places, the *E. vagans-Schoenus* heath grades more directly to fen vegetation through the *Eleocharis* sub-community, *Phragmites* becoming more abundant and vigorous in ungrazed transitions. Except where *Cladium* is overwhelmingly dominant, the *Molinia-Potentilla* mire and fens of such sequences seem to be more susceptible to shrub invasion than the *E. vagans-Schoenus* heath itself, perhaps because of their more eutrophic soils and, in the absence of burning, they are readily colonised by *Salix cinerea* to form stands of the *Salix-Galium* woodland (Hopkins 1983).

In other situations, the passage to the *Molinia-Potentilla* mire can denote a transition, over the lower flushed slopes of the shallow valleys that wind through the interior of the headland, to the *E. vagans-Ulex* heath, the community centred on the more free-draining base-rich brown earths of shedding ground on the serpentine and gabbro. In the *Molinia* sub-community of that kind of heath, typical of slightly gleyed profiles above the limit of seasonal inundation, *Schoenus* is reduced to low cover and *Molinia*, though abundant, is not strongly tussocky. In addition to *E. vagans*, *E. tetralix* and *U. gallii* remain frequent and *Serratula tinctoria* and *Stachys betonica* occur occasionally. But, again, *U. europaeus* becomes very common and prominent and, on the somewhat drier ground, there is an increase in *E. cinerea* and *Calluna*. Among the herbs, the appearance of *Sanguisorba officinalis* and *Viola riviniana* is the most obvious indication of the switch from one community to another. This vegetation may in turn give way to Typical *E. vagans-Ulex* heath over free-draining brown earths with local patches of *Ulex-Rubus* scrub or *Prunus* scrub where freedom from burning has permitted invasion of other woody plants.

By and large, it is through a zone of the *E. vagans-Ulex* heath that the *E. vagans-Schoenus* heath grades to the maritime *Calluna-Scilla* heath of the coastal cliff-top fringe. Locally, however, in very sheltered situations, the *E. vagans-Schoenus* heath can itself be found in cliff-top flushes, though it should be noted that such vegetation is different in composition from the *Schoenus*-dominated flushes found in exposed situations near the foot of cliffs on the Lizard: these are best placed in the *Festuca-Daucus* grassland.

More frequent than transitions to drier, base-rich soils, many of which, at least on the gabbro, are now cultivated and thus marked by an abrupt switch to improved grassland, are zonations to the base-poor and somewhat better-drained profiles developed from the loess and Crousa Gravels which are superimposed over the ultrabasic bedrocks. Characteristically, such soils are occupied by the *Ulex gallii-Agrostis* heath which thus forms irregular patches on the gentle interfluves of the peninsula, surrounded and broken up by stretches of the *E. vagans-Schoenus* heath. Over the margins of less well-defined areas of superficials, where the cover thins gradually or where loess or gravel has been mixed with the underlying base-rich parent material in bouts of past cultivation, the transition between the two heath types is correspondingly indistinct with *E. vagans*, *Serratula* and *Sanguisorba officinalis* running into the *U. gallii-Agrostis* heath in a marginal zone 2–10 m wide (Hopkins 1983). In other cases, steeper-edged banks of loess or gravel show an abrupt replacement of the one heath by the other, *E. vagans* and *Schoenus* both disappearing, together with most of their herbaceous associates, *E. cinerea*, *Calluna* and *Agrostis curtisii* increasing in frequency and cover to become co-dominant with the *E. tetralix*, *U. gallii* and *Molinia*.

This basic soil-related pattern has been affected by treatments in a variety of ways. Some activities, strongly controlled by the natural drainage quality or fertility of the ground, have had a more ordered impact which has

often confirmed the edaphic influence, as in the case of 'turf' stripping, largely confined to the humic stagnogleys of the serpentine and gabbro, or the primitive shifting cultivation of the past which seems to have been concentrated on the thinner deposits of loess and over the more nutrient-rich brown earths on the gabbro. Enclosure for grazing and the present pattern of burning, on the other hand, cut across the edaphic boundaries, so their effects can confuse the zonations described above. Fires, for example, particularly severe summer burns, can impose a structural uniformity within a tract of heathland, whose soil-related mosaic may take some years to grow out again. Within the communities of wetter soils here, *Molinia* is the plant likely to become temporarily dominant across such boundaries following fires, though on the poorer soils its vigour is reduced. Burning, with subsequent severe grazing, especially on more eutrophic soils or ones enriched with fertilisers, is likely to convert the *E. vagans-Schoenus* heath (and wetter stands of the *E. vagans-Ulex* and *U. gallii-Agrostis* heaths) into *Molinia-Potentilla* mire.

For the most part, however, burning, sometimes combined with grazing in the enclosures, has the effect of maintaining the different sub-shrub communities in a complex patchwork of vegetation in various stages of cyclical regeneration. Except on the most infertile soils, such treatments probably play some part in setting back the invasion of shrubs and trees though, over much of the headland, the scarcity of seed-parents and exposure to severe winds militate against rapid development of scrub and woodland. On the wetter soils, the natural eventual successor to the *E. vagans-Schoenus* heath is probably *Salix-Galium* woodland or *Salix-Betula-Phragmites* woodland; on seasonally-waterlogged profiles, some kind of *Betula-Molinia* woodland seems a likely development.

Distribution

The community is confined to the Lizard in Cornwall, where it makes up a major proportion of the open and enclosed heaths of the hinterland of the peninsula.

Affinities

The very striking character of the *E. vagans-Schoenus* heath, only vaguely hinted at in early studies (Tansley 1911, 1939), was first revealed in detail by Coombe & Frost (1956a) whose descriptive account has recently been expanded in a systematic phytosociological investigation of the vegetation of the Lizard by Hopkins (1983). The diagnosis here relies heavily on Hopkins's data and in essence the community differs only in the transfer of his *Ulex* variant into the *Molinia-Potentilla* mire.

In their discussion, Coombe & Frost (1956a) recognised the distinctively mixed nature of the communities,

though, at the time of their work, accounts of related heaths and mires were insufficiently detailed to permit more than a brief comparison of the vegetation types: now, these relationships are a little clearer, though this kind of heath remains difficult to place in existing phytosociological frameworks, a problem it shares with the other sub-shrub vegetation in which *E. vagans* plays a prominent role in Cornwall and north-west France (e.g. Dupont 1973, Vanden Berghen 1973, Hopkins 1983). In a more generalised scheme, like that of Böcher (1943), there is little difficulty in locating the British *E. vagans* heaths in an intermediate position in the sequence of communities running down the western oceanic seaboard of Europe, with affinities northwards to the *Ulex* heaths of the Ericion cinereae and southwards to the Ericion scopariae heaths. Böcher (1943) himself favoured recognising an '*Erica vagans* group' in the latter alliance, though he had very little data on which to base his diagnosis (Gadeceau 1903, Rübel 1930). Coombe & Frost (1956a) echoed this general view but, with their more detailed knowledge of the Lizard communities, considered that only the *E. vagans-Ulex* heath could be readily incorporated in the Ericion scopariae. They also stressed the floristic relationships that can be seen when British sub-shrub communities are examined on an east–west, rather than a north–south, axis. In such a light, the *E. vagans* heaths clearly belong among the *U. gallii* communities which replace the *U. minor* complex on moving westwards: this kind of perspective would locate them in the Ulicion gallii of des Abbayes & Corillion (1949). Alternatively, much more weight can be given to the presence of *E. vagans* itself as in the scheme of Géhu (1975), where this species and *E. ciliaris* are diagnostic of a Ulici-Ericion ciliaris, an alliance confined to south-west England and north-west France (with small outliers in Ireland: White & Doyle 1982).

At the present time, without a comprehensive examination of variation in heaths throughout western Europe, none of these solutions seems entirely satisfactory. One difficulty is that, within the range of British sub-shrub communities, the presence of *E. vagans* in both this and the *E. vagans-Ulex* heath is not accompanied by any other floristic features that mark out the vegetation types as distinctly southern European. Certainly, the geographical confinement of *E. vagans* to the Lizard is very striking, but the overall floristic affinities of the communities it occurs in are not directly related to any climatic peculiarities of the peninsula itself, rather to the generally oceanic conditions of the south-western part of Britain. Among the dry heaths, therefore, the communities are closest to the *U. gallii-Agrostis* and *Calluna-U. gallii* heaths.

However, the other difficulty in locating the *E. vagans* heaths together is that they are rather different from one

another. If the *E. vagans-Schoenus* heath is considered on its own, its closest relationships among other sub-shrub communities are much more obvious: they lie with the wet heaths of the Ericion tetralicis, particularly those types in which base-poverty is relieved by flushing, as in the *Succisa-Carex* sub-community of the *Ericetum tetralicis* and the *Carex* sub-community of the *Scirpus-Erica* wet heath, in the latter of which *Schoenus* is a very occasional local dominant.

Alternatively, as suggested by Coombe & Frost (1956*a*) and favoured by Hopkins (1983), the *E. vagans-Schoenus* heath can be related to other vegetation in which *Schoenus* plays a major role, more particularly to what the former authors knew as the *Schoeneto-Junce-tum* of Lemée (1937), but which has been more recently defined in Britain, largely as a result of the work of Wheeler (1975, 1980*c*). In Wheeler's *Schoeno-Juncetum*, sub-shrubs like *E. tetralix* and *Calluna* can make a locally prominent contribution, together with some

poor-fen and wet-heath plants, in an *ericetosum*, and Hopkins (1983) proposed incorporating the *E. vagans-Schoenus* heath as a new sub-community intermediate between this type of *Schoeno-Juncetum* and the *serratu-letosum* of Wheeler (1980*c*). In our scheme, in fact, Wheeler's (1980*c*) *ericetosum* is largely transferred to the *Schoenus-Narthecium* mire and the floristic affinities of the *E. vagans-Schoenus* heath to both this and our *Carex-Serratula* sub-community of a revised *Schoene-tum* have already been remarked upon. But the differences in both directions are also quite strong and the community could not readily be subsumed into either. It is better, then, to recognise the uniqueness of this kind of heath but to acknowledge that its peculiar character derives from various sources, not simply from the oceanic conditions, nor particularly from the predominance of serpentine among the substrates, but from a complex of climatic and edaphic features which overlap and interact in this particular way only on the Lizard.

Floristic table H5

	a	b	5
Erica vagans	V (3–8)	V (1–5)	V (1–8)
Schoenus nigricans	V (4–8)	V (5–8)	V (4–8)
Erica tetralix	V (1–6)	V (2–5)	V (1–6)
Serratula tinctoria	V (1–4)	V (2–5)	V (1–5)
Molinia caerulea	V (2–9)	IV (4–7)	V (2–9)
Anagallis tenella	IV (1–4)	V (1–3)	IV (1–4)
Campylium stellatum	IV (1–5)	V (2–5)	IV (1–5)
Succisa pratensis	IV (1–4)	V (2–4)	IV (1–4)
Carex pulicaris	IV (1–3)	IV (1–3)	IV (1–3)
Festuca ovina	V (1–5)	III (1–3)	IV (1–5)
Potentilla erecta	IV (1–4)	III (2–3)	IV (1–4)
Ulex gallii	IV (1–7)	III (1–6)	IV (1–7)
Genista anglica	III (1–3)	I (3)	II (1–3)
Carex panicea	III (2–4)		II (2–4)
Fissidens adianthoides	II (1–2)	I (1–2)	II (1–2)
Platanthera bifolia	II (1–3)	I (2)	I (1–3)
Calluna vulgaris	II (1–4)		I (1–4)
Dactylorhiza maculata ericetorum	II (1–3)		I (1–3)
Calypogeia fissa	II (1–3)		I (1–3)
Pedicularis sylvatica	II (1–3)		I (1–3)
Salix repens	II (2–4)		I (2–4)
Danthonia decumbens	II (1–3)		I (1–3)
Erica cinerea	I (2–7)		I (2–7)
Agrostis curtisii	I (1–4)		I (1–4)
Plantago maritima	I (1–3)		I (1–3)
Thymus praecox	I (1–2)		I (1–2)
Scutellaria minor	I (2–3)		I (2–3)
Linum catharticum	I (1–3)		I (1–3)

Floristic table H5 *(cont.)*

	a	b	5
Agrostis canina montana	I (1–3)		I (1–3)
Carex flacca	III (2–4)	IV (3–4)	III (2–4)
Eleocharis multicaulis	I (2)	V (1–4)	I (1–4)
Eriophorum angustifolium		V (1–5)	I (1–5)
Pinguicula lusitanica	I (1)	IV (1–3)	I (1–3)
Drosera rotundifolia	I (2)	IV (1–3)	I (1–3)
Phragmites australis	I (1–5)	III (2–3)	I (1–5)
Dactylorhiza incarnata incarnata		III (1–2)	I (1–2)
Riccardia multifida	III (1–3)	III (1–2)	III (1–3)
Riccardia sinuata	III (1–2)	III (1–3)	III (1–3)
Sanguisorba officinalis	III (1–4)	III (1–4)	III (1–4)
Carex hostiana	II (2–4)	III (2–3)	II (2–4)
Juncus acutiflorus	II (1–3)	III (1–2)	II (1–3)
Polygala vulgaris	II (1–3)	III (1–3)	II (1–3)
Scorpidium scorpioides	II (2–5)	II (2–3)	II (2–5)
Gymnadenia conopsea	II (1–2)	II (2–3)	II (1–3)
Hypericum pulchrum	II (1–2)	II (1)	II (1–2)
Stachys officinalis	I (1–2)	II (1)	I (1–2)
Galium uliginosum	I (1–2)	II (1)	I (1–2)
Ulex europaeus	I (4–5)	I (2)	I (2–5)
Angelica sylvestris	I (2)	I (2)	I (2)
Eupatorium cannabinum	I (4)	I (1)	I (1–4)
Eurhynchium praelongum	I (1–3)	I (1)	I (1–3)
Juncus maritimus	I (3–5)	I (4)	I (3–5)
Number of samples	51	9	60
Number of species/sample	19 (10–29)	20 (16–27)	19 (10–29)
Vegetation height (cm)	34 (14–90)	29 (17–45)	33 (14–90)
Vegetation cover (%)	98 (85–100)	91 (65–100)	97 (65–100)
Slope (°)	2 (0–5)	1 (0–4)	2 (0–5)
Soil pH	6.5 (5.4–7.2)	6.7 (6.5–7.1)	6.5 (5.4–7.2)

a   Typical sub-community

b   *Eleocharis multicaulis* sub-community

5   *Erica vagans-Schoenus nigricans* heath (total)

H5 *Erica vagans-Schoenus nigricans* heath