M23

Juncus effusus/acutiflorus-Galium palustre rush-pasture

Synonymy

Juncus acutiflorus-Acrocladium cuspidatum nodum McVean & Ratcliffe 1962 *p.p.*, Eddy *et al.* 1969; *Juncus acutiflorus* pasture Birse & Robertson 1967, 1973; *Juncus acutiflorus-Acrocladium cuspidatum* sociation Edgell 1969; Species-rich *Juncetum effusi* Eddy *et al.* 1969; *Juncus acutiflorus-Filipendula ulmaria* Association Birks 1973; *Juncus articulatus-Acrocladium cuspidatum* nodum Prentice & Prentice 1975; *Potentillo-Juncetum acutiflori* Birse & Robertson 1976, Birse 1980, 1984; *Juncus acutiflorus-Sphagnum palustre* nodum Adam *et al.* 1977 *p.p.*; *Galium palustre* nodum Daniels 1978 *p.p.*; Fen communities 27 & 28 Meade 1981; *Junco acutiflori-Molinietum* (O'Sullivan 1968) Ratcliffe & Hattey 1982 *p.p.*; Fen meadow Ratcliffe & Hattey 1982 *p.p.*

Constant species

Galium palustre, *Holcus lanatus*, *Juncus effusus/acutiflorus*, *Lotus uliginosus*.

Physiognomy

The *Juncus effusus/acutiflorus-Galium palustre* rush-pasture is a rather ill-defined assemblage of vegetation characterised by the abundance of either *Juncus effusus* or *J. acutiflorus*, sometimes both, in a ground of mesophytic herbs of wide occurrence in moister agricultural grasslands. Diversity among the dominants is not very great (nothing like so locally varied as in the *Juncus-Cirsium* fen-meadow, for example), but the structure of the vegetation can show considerable differences according to the treatment history. And, though the flora is rarely strikingly rich, the associates are quite diverse, both across the whole range of the community and, on a local scale, from site to site and even within large stands. Such variation makes the bounds of this vegetation type hard to fix, both against other rush-dominated communities, a problem that is greater towards the east of its distribution, and, increasingly to the west, against grasslands in which *Molinia caerulea* plays a prominent role.

Of the two rushes which usually dominate here, *J. effusus* is the commoner throughout, extending across the whole range of the community, though being distinctly more frequent and abundant in the more easterly sub-community through which this vegetation grades imperceptibly to the *Holco-Juncetum*. *J. acutiflorus* is much more distinctly western in its occurrence, rivalling or exceeding *J. effusus* in the other of the sub-communities, which is much more distinctive in its floristics and the usual type of this vegetation which has figured in previous accounts (e.g. McVean & Ratcliffe 1962, Birse & Robertson 1967, 1973, 1976, Edgell 1969, Birks 1973, Adam *et al.* 1977, Ratcliffe & Hattey 1982). Among other rushes, none occurs commonly, though some can be locally frequent and abundant. Sometimes, for example, *J. articulatus* supplements or replaces either of the two usual dominants, although there is no indication in the available data that this is a particularly western or coastal phenomenon, as hinted by McVean & Ratcliffe (1962). This species can hybridise with *J. acutiflorus* and intermediates are occasionally found here (McVean & Ratcliffe 1962, Prentice & Prentice 1975), but difficulties of identification among these taxa have probably led to *J. articulatus* being over-recorded in this kind of vegetation in some surveys (as suggested in Meade 1981, for example) and overall it is an uncommon plant in the community. *J. conglomeratus* is likewise rather infrequent, though it, too, can be mistakenly recorded for *J. effusus* var. *compactus*: it has been found at quite high covers at some sites but, generally speaking, is much more characteristic of heathy vegetation where rushes occur with much *Molinia caerulea*. *J. inflexus* and *J. subnodulosus*, species which are best represented on more base-rich soils to the east of Britain, are hardly ever found and their absence provides a good separation of this community from more calcicolous kinds of rush-dominated vegetation in the *Holco-Juncetum* and, more particularly, the *Juncus-Cirsium* fen-meadow.

Although rushes generally dominate, their abundance and stature and the representation of other elements in the vegetation are quite variable. Fairly often, the rushes

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have very high cover and they commonly attain half a metre in height, sometimes up to twice that, so their shading effect can be quite considerable, especially where the more densely-tussocky *J. effusus* is growing vigorously. In other cases, the rush cover is sparser or more discontinuous, when the associated flora amongst its shoots and between the clumps is denser. In ungrazed and unmown stands, this herbage can grow tall, often showing patchy local abundance among the subordinate species, but, where stock have access, a common occurrence here, the rushes may be closely grazed around and the stretches of intervening sward kept shortly cropped.

Most frequent among the associates is *Holcus lanatus* which is quite often itself so abundant as to give the lower tier of vegetation a rank grassy appearance where growth is less closely checked. But other grasses can be quite common, too, with *Agrostis canina* ssp. *canina*, *A. stolonifera*, *Anthoxanthum odoratum* and *Poa trivialis* occurring throughout with varying degrees of frequency. The first two in particular can show locally high cover and in more open damper places form quite extensive mats, sometimes with a little *Glyceria fluitans*. In drier stands, *Festuca rubra* and *Agrostis capillaris* sometimes become frequent, forming with *Anthoxanthum* the bulk of a sward which can extend out from amongst the rush clumps to form extensive stretches of Nardo-Galion grassland. Then, where there has been some improvement of the surrounding pasture, *Cynosurus cristatus* and *Lolium perenne* can seed in and become well established. Finally, among the grasses, there is *Molinia caerulea*, a species of no more than very local significance in the eastern *J. effusus* sub-community but, towards the west, becoming increasingly common and abundant and making the vegetation of the *J. acutiflorus* sub-community virtually continuous with that of the *Molinia-Potentilla* grassland, a community with which it is often associated around the margins of damper heaths. The similarities and differences between these vegetation types are well seen in the floristic tables produced from Pembrokeshire heaths (Meade 1981) and Welsh wetlands (Ratcliffe & Hattey 1982): typical stands of each can look different enough but, in some cases, the diagnosis of intermediates has to depend on the relative proportions of Junci and *Molinia*.

Intermixed with the grasses is a variety of other herbs which, when present in numbers, can give this vegetation quite a colourful appearance. Some of the commoner species among them are able to grow tall where grazing is not intense and by mid-summer can put up their flowering stems above the level of the rush canopy. *Cirsium palustre* is the commonest of these but *Rumex acetosa*, *Angelica sylvestris* and *Epilobium palustre* also occur quite frequently and, sprawling among them, there is often some *Galium palustre* and *Lotus uliginosus*. Then, among the smaller associates, frequent species are *Mentha aquatica*, *Ranunculus flammula*, *R. repens*, *R. acris* (these buttercups often disposed in relation to increasing dryness of the ground: Harper & Sagar 1953), *Cardamine pratensis*, *Hydrocotyle vulgaris*, *Viola palustris* and *Stellaria alsine*. *Potentilla erecta* also occurs occasionally, though it is quite strongly preferential for the *J. acutiflorus* sub-community.

Quite frequently, too, there are some sedges in the sward, though the larger species, such as *Carex acutiformis* and *C. disticha*, which are commonly co-dominant in the *Juncus-Cirsium* fen-meadow, and *C. elata* and *C. paniculata*, which occur there locally, are typically absent here. But such smaller sedges as *C. nigra*, *C. echinata* and *C. demissa* make an occasional appearance and can emphasise floristic similarities with the Caricion nigrae poor-fens, among which *J. effusus* and *J. acutiflorus* can also show dominance. In other stands, *C. panicea* is frequent, giving a somewhat basiphilous look to the vegetation, at least in comparison with the calcifuge grasslands and heaths which often surround the community. Where base-enrichment is more pronounced, as in some of the stands described from Moor House (Eddy *et al.* 1969), *C. dioica* and *C. pulicaris* can also be found, though these are never of more than local significance.

Other plants of wide national distribution which can occur in the community include *Trifolium repens*, *Cerastium fontanum*, *Plantago lanceolata* and *Prunella vulgaris*, species which tend to increase in transitions to improved pastures around, or, where grazing is absent, *Filipendula ulmaria*, the local abundance of which can bring the vegetation close to Filipendulion fen in its appearance. Then, in damper hollows, there can be some *Potentilla palustris*, *Equisetum fluviatile* and *Caltha palustris*, while poached areas can have a specialised flora of their own in which *Juncus bulbosus* can be locally prominent.

One further striking occasional in this kind of vegetation and a plant of some phytogeographical significance, is *Carum verticillatum*, which is sometimes found in the *J. effusus* sub-community, but more often in the *J. acutiflorus* type, the range of which takes in the distribution of this local Oceanic West European umbellifer. It is, however, not confined here, occurring also in the *Molinia-Potentilla* grassland and in vegetation which is probably best referred to the *Cirsio-Molinietum*, though very much on its far-western fringes (B.D. Wheeler pers. comm.). Other species which, with *Carum*, were regarded by Braun-Blanquet as characteristic of this kind of Atlantic rush-dominated vegetation, such as *Wahlenbergia hederacea* and *Scutellaria minor*, occur occasionally but are likewise not restricted to the community. *Senecio aquaticus*, a plant regarded as characteristic of Irish vegetation of this same general type (Braun-Blanquet & Tüxen 1952, Ivimey-Cook & Proctor 1966*b*, White & Doyle 1982) is no more than scarce.

Bryophytes are variable in their cover and very sparse among denser herbage but, where the vegetation is a little more open, they can be abundant over the moist surface of the soil, on litter and over the stools of the vascular plants. *Calliergon cuspidatum* is the most frequent species throughout but *Brachythecium rutabulum* and *Rhytidiadelphus squarrosus* can also occur and, less commonly, *Brachythecium rivulare*, *Pseudoscleropodium purum*, *Plagiomnium undulatum*, *Lophocolea bidentata s.l.* and *Pellia epiphylla*. Small patches of *Polytrichum commune* and some of the less demanding Sphagna can sometimes be found but the absence of extensive carpets of these species provides a good diagnostic criterion against the Caricion nigrae poor fens.

Sub-communities

***Juncus acutiflorus* sub-community:** *Juncus acutiflorus-Acrocladium cuspidatum* nodum McVean & Ratcliffe 1962 *p.p.*, Eddy *et al.* 1969; *Juncus acutiflorus* pasture Birse & Robertson 1967, 1973; *Juncus acutiflorus-Acrocladium cuspidatum* sociation Edgell 1969; *Juncus acutiflorus-Filipendula ulmaria* Association Birks 1973; *Juncus articulatus-Acrocladium cuspidatum* nodum Prentice & Prentice 1975; *Potentillo-Juncetum acutiflori* Birse & Robertson 1976, Birse 1980, 1984; *Juncus acutiflorus-Sphagnum palustre* nodum Adam *et al.* 1977 *p.p.*; *Galium palustre* nodum Daniels 1978 *p.p.*; Fen communities 27 & 28 Meade 1981; *Junco acutiflori-Molinietum* (O'Sullivan 1968) Ratcliffe & Hattey 1982 *p.p.*; Fen meadow Ratcliffe & Hattey 1982 *p.p.* In this more sharply-defined of the two sub-communities, *J. effusus* remains very common and its dense tussocks can be quite abundant, but it is typically accompanied and usually exceeded by *J. acutiflorus*, not a rush of strongly tufted growth but often forming extensive and thick clumps of shoots from its far-creeping rhizomes. *J. articulatus* (or putative hybrids with *J. acutiflorus*) can be locally prominent and *J. conglomeratus* is occasionally found. Growing among the rushes, the commonest grasses here are *Holcus lanatus* and, preferentially frequent, *Molinia*, and either or both of these can bulk fairly large in a rank second tier to the vegetation in ungrazed stands. But it is the rushes which characteristically retain dominance and a great abundance of *Molinia*, with the kinds of associates generally typical of this community, marks a shift to the *Molinia-Potentilla* grassland. Other grasses to be found here are *Anthoxanthum* and, rather less commonly, *Agrostis canina* ssp. *canina*, *A. stolonifera*, *Festuca rubra* and *Poa trivialis*. Then, such community herbs as *Cirsium palustre*, *Rumex acetosa* and *Angelica* remain frequent and, trailing among them, there is often some *Galium palustre* and *Lotus uliginosus*. *Filipendula ulmaria* is rather more common here, too, than in the *J. effusus* sub-community and, where there is an abundance of these herbs, together with occasional *Lythrum salicaria* and *Iris pseudacorus*, the appearance of the vegetation is very different from the pastured stands included here. Such transitions to Filipendulion fen can be seen throughout the range of the community, particularly where freedom from grazing is combined with some nutrient enrichment, but this kind of physiognomy is particularly evident in stands described from Skye by Birks (1973, as a *Juncus-Filipendula* Association), where the additional occurrence of plants such as *Crepis paludosa*, *Cirsium helenioides* and *Trollius europeaus* gives a distinctly northern feel.

More usually, the lower tier of the vegetation has frequent records for *Mentha aquatica*, *Cardamine pratensis*, *Ranunculus flammula* and *R. repens* with, preferentially common here, *R. acris*, *Potentilla erecta*, *Achillea ptarmica*, *Equisetum palustre* and *Carex panicea*. In ranker stands, such plants may be reduced to sparse individuals but, where there is some grazing, they can make a more obvious contribution to the shorter sward between the rushes and be locally enriched by Nardo-Galion or Cynosurion herbs according to soil conditions and treatment. In other cases, puddled hollows can have some *Juncus bulbosus*, *Myosotis laxa* ssp. *caespitosa* and *Potentilla anserina*, or the presence of species such as *Carex nigra*, *C. echinata*, *Narthecium ossifragum* and sparse tufts of Sphagna may create the impression of a transition to poor fen. Throughout this diverse range of vegetation included here, *Carum verticillatum* can occasionally be found within its local centres of distribution in Devon, west Wales and western Scotland.

***Juncus effusus* sub-community:** Species-rich *Juncetum effusi* Eddy *et al.* 1969; *Junco acutiflori-Molinietum* (O'Sullivan 1968) Ratcliffe & Hattey 1982 *p.p.*; Fen meadow Ratcliffe & Hattey 1982 *p.p.* This sub-community is less well-defined than the above and essentially represents a transition between the *J. acutiflorus* sub-community and the *Holco-Juncetum*, the rush-pasture of circumneutral gley soils throughout lowland Britain. Thus, *J. acutiflorus* is generally uncommon here and *J. effusus* the usual dominant, sometimes forming a dense mass of huge spreading tussocks which crowd out many of the associates but quite often occurring as discrete clumps between which are stretches of herbage that, again, can vary between very rank to shortly-cropped. *J. articulatus* can sometimes be found (indeed it is perhaps a little more frequent here than in the other sub-community) and *J. conglomeratus* also occurs in some stands, but *J. inflexus*, a common alternative dominant in the *Holco-Juncetum*, is typically absent. Although *Molinia* is characteristically infrequent, other grasses are quite important in the sward with *Holcus* *lanatus* often being accompanied by *Agrostis canina* ssp. *canina*, *A. stolonifera*, *Poa trivialis* and, weakly preferential, *Deschampsia cespitosa*. *Anthoxanthum* and *Festuca rubra* are a little less common but, where improved pasture forms a surround to stands, a common occurrence, *Cynosurus* and *Lolium perenne* can figure at low covers.

Such plants, together with *Ranunculus repens*, *R. acris*, *Cardamine pratensis* and *Lotus uliginosus*, emphasise the close relationship of this vegetation to the *Holco-Juncetum*, but good distinguishing features here are the high frequencies of *Galium palustre*, *Cirsium palustre*, *Ranunculus flammula*, *Mentha aquatica* and the occasional presence of *Stellaria alsine*, *Epilobium palustre*, *Angelica sylvestris*, *Hydrocotyle vulgaris*, *Viola palustris* and *Carex nigra*. Also, plants such as *Rumex crispus*, *R. obtusifolius*, *Cirsium arvense* and *C. vulgare*, which often get a hold in run-down stands of the *Holco-Juncetum*, and emphasise its closer relationship with the Elymo-Rumicion, are not usually found here.

Habitat

The *Juncus-Galium* rush-pasture occurs over a variety of moist, moderately acid to neutral, peaty and mineral soils in the cool and rainy lowlands of western Britain. It is a community of gently-sloping ground, found around the margins of soligenous flushes and water-tracks and as a zone around topogenous mires and among wet heaths, but it is especially characteristic of and widespread in stretches of ill-drained and relatively unimproved or reverted pasture. And, throughout, it is grazing (occasionally mowing) which ultimately maintains this vegetation against progression to woodland, and which controls much of its floristic and structural character. Draining and other kinds of soil improvement have reduced the extent of the community, particularly at lower altitudes where intensive pastoral agriculture has become prevalent.

Among rush-dominated vegetation of pastures and meadows, this community is found at the opposite climatic and edaphic extreme from the *Juncus-Cirsium* fen-meadow. It has an essentially oceanic distribution, being largely confined to those parts of Britain with cool summers and mild winters. Almost all samples lie beyond the 26 °C mean annual maximum isotherm, which makes a crude separation between the western and northern parts of the country and the south-east (Conolly & Dahl 1970), but few penetrate into areas with a February minimum more than half a degree C or so below freezing (*Climatological Atlas* 1952), which limits the occurrence of the community over much of the Highlands and north-east Scotland, in the Southern Uplands and the Pennines and higher ground in Wales. In more southerly parts of Britain, this kind of vegetation can be found at altitudes up to 400 m or more, but in general, and increasingly to the north, it is a lowland community with most samples occurring below 200 m. Throughout this zone, the climate is humid, with most sites experiencing over 1200 mm rain annually (*Climatological Atlas* 1952) and more than 160 wet days yr^{-1} (Ratcliffe 1968), and often cloudy skies: such conditions reach a peak in places like Skye, where there can be over 3000 mm rain with more than 220 wet days yr^{-1} (Birks 1973).

The floristic response to such conditions in this vegetation is fairly modest and imprecise. Certainly, within Europe as a whole, species such as *J. acutiflorus*, *Carum verticillatum*, *Wahlenbergia hederacea* and *Scutellaria minor* all show Oceanic West European distributions (Matthews 1955) and characterise a distinct trend in the composition of Molinietalia communities. But *J. acutiflorus*, though it shows a clear preference for more westerly vegetation types and, among rush-dominated pastures and meadows is strongly diagnostic of this type, has a wide geographical range in Britain and is of fairly catholic occurrence in relation to our climate. *Wahlenbergia* and *Scutellaria* are much more confined but both, particularly the latter, extend outside the distribution of the *Juncus-Cirsium* rush-pasture, most notably in the warmer and drier parts of central southern and south-east England, and neither is well represented in central Scotland, where the community is widespread. Even within the area of overlap, these species are not common in the community, nor are they confined to it. Geographically, it is *Carum* which shows the best coincidence of occurrence, though this plant is strikingly confined to particular stretches of western Britain (Perring & Walters 1962) and, again, can be found there in other vegetation types than this (B.D. Wheeler, pers. comm.). All these features emphasise the difficulty of characterising a substantial phytogeographic boundary between this kind of vegetation and the rush-pastures and meadows further to the east. The contrast between the *Juncus-Cirsium* fen-meadow and the *J. acutiflorus* sub-community here is clear enough, and this latter vegetation type is the more oceanic of the western kinds of rush-pasture being concentrated at lower altitudes (mean 137 m) down the Atlantic seaboard of Wales and Scotland. But separating the *Juncus-Galium* rush-pasture from the *Holco-Juncetum* is much more difficult. Essentially, the *J. effusus* sub-community of the *Juncus-Cirsium* rush-pasture is a transition to this vegetation, being concentrated in an ill-defined zone to the east of the *J. acutiflorus* type, running through Devon and Cornwall, Wales and into northern Britain and can be found at substantially greater altitudes (mean 195 m). In this region, the prominence of the Oceanic West European element in the flora is weakening somewhat, though change is often visible mainly in terms of a shift in dominance between the two rushes, and this and some other floristic contrasts can be affected by other factors.

A further complication in the definition of the *Juncus-Galium* rush-pasture is that, with the increasing oceanicity that helps sharpen up the differences with the Calthion communities, the boundary with the *Molinia*-dominated vegetation of the Junco-Molinion type breaks down. In western Britain, *J. acutiflorus* and *Molinia* each transgress far into vegetation dominated by the other, and are found associated with a similar range of species, among them *Carum*, *Wahlenbergia* and *Scutellaria minor*, as well as many more general Molinietalia and Molinio-Arrhenatheretea herbs. Such vexatious problems of separating the *J. acutiflorus* sub-community from various kinds of *Molinia-Potentilla* grassland are a real reflection of a floristic convergence influenced by the oceanic climate of the western part of the country.

Edaphic conditions provide some help in understanding the particular environmental preferences of the *Juncus-Galium* rush-pasture among this range of communities. Within the oceanic lowlands, it can be found on a variety of moderately acid to neutral soils that are kept moist to wet for most of the year, but its distribution is strongly centred on profiles with a measure of drainage impedence, such as have developed on very gentle slopes over argillaceous bedrocks and superficials. In central and north Wales and south-west Scotland, for example, Silurian and Ordovician shales provide important substrates, while Carboniferous and Devonian shales support stands of the community in central and south-east Scotland, south Wales and the South-West Peninsula. In the last area, too, and also in Dumfries & Galloway, this kind of vegetation can be found on profiles derived from granites and, throughout the glaciated areas of western Britain, deposits of heavier-textured drift have often weathered to suitable soils.

The particular kinds of profiles developed in such situations are usually stagnogleys, where high rainfall or water shed from surrounding slopes induces surface-water gleying over impermeable substrates on gentle slopes; or ground-water gleys where, in impeded hollows, there is some shallow fluctuation of the water-table. Over stretches of more subdued scenery, such as have been derived from extensive outcrops of readily-weathering shales or widely mantled by till, such profiles can be the predominant element in the soil cover; in other cases, they mark out areas of more local drainage impedence in rougher terrain. Both kinds of gley can accumulate a humose topsoil and grade to true peats, on to which the community can extend a little way. Thus, it is common over stagnohumic gleys, widespread in areas of higher rainfall, though not usually where these are strongly flushed or at altitudes where the climate is too inequable. And it occurs over humic gley soils and on shallow peats such as develop in waterlogged hollows and in transitions to streamside alluvium.

The generally moist conditions here are reflected in the associated flora of the community by the high frequencies of species which are of wide occurrence in wetter habitats, such as *Galium palustre*, *Ranunculus flammula*, *Mentha aquatica*, *Agrostis stolonifera*, *Cardamine pratensis* and *Ranunculus repens*, as well as plants that are rather more strongly preferential to Molinietalia communities, like *Cirsium palustre*, *Lotus uliginosus*, *Angelica sylvestris* and, of course, the two rushes. Quite a number of these can be found with some regularity in certain kinds of *Molinia-Potentilla* mire, but the switch from rush- to *Molinia*-dominance in that vegetation seems to mark a tendency to better aeration of the soils and, perhaps, a brisker nutrient turnover. Thus, although the *Juncus-Galium* rush-pasture and *Molinia-Potentilla* mire show some overlap in the kinds of profiles on which they can occur, often being found contiguously on shallow peats, for example, the latter vegetation type seems to be centred on more free-draining, moist acid soils, such as gently-flushed peats and stagnohumic gleys. Under the *Juncus-Galium* rush-pasture, though soils may dry out somewhat above in summer, seasonal stagnation and only moderately mesotrophic conditions seem to be the rule.

One other difference between the edaphic environments of the communities is that the soils here are not quite so acid as under the *Molinia-Potentilla* grassland. Again, there is some overlap in base-richness but, by and large, the superficial reaction under the *Juncus-Galium* rush-pasture is in the range pH 4–6. Certainly, the profiles are sufficiently acid and calcium-poor as to inhibit the occurrence of *J. subnodulosus* and part of the floristic and geographical contrast between this community and the *Juncus-Cirsium* fen-meadow is to do with soil reaction: where the two vegetation types occur in the same region, as on Anglesey, they clearly mark out differing profiles and parent materials. But more calcifuge plants are not numerous or frequent here. *Potentilla erecta* becomes common in the *J. acutiflorus* sub-community and is very much a marker of this kind of vegetation through lowland Scotland (Birse & Robertson 1967, 1973, 1976, Birse 1980, 1984); and, with plants like *Anthoxanthum odoratum* and *Festuca rubra*, it can provide a strong measure of continuity with the Nardo-Galion swards which often adjoin the *Juncus-Galium* rush-pasture in western Britain (e.g. King 1962, King & Nicholson 1964). *Carum*, too, slightly preferential to the same sub-community, is a marker of less base-rich Molinietalia vegetation (Oberdorfer 1979). Then, in damper stands, species such as *Agrostis canina* ssp. *canina*, *Viola palustris*, *Carex nigra*, *C. echinata* and *C. demissa* can give the impression of a floristic transition

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to small-sedge poor-fen vegetation of the Caricion nigrae. Despite the more frequent occurrence of *P. erecta* and *Carum* in the *J. acutiflorus* sub-community the soil reaction there does not appear to be any more acidic than in the *J. effusus* sub-community: indeed, Birks (1973) suggested that, of the two dominants, it was *J. effusus* that indicated a tendency to more pronounced surface acidity that comes with leaching of drier soils under this vegetation. Such puzzles await resolution, but what can be said for the moment is that, even where such calcifuge tendencies are better developed, they are not very strongly expressed and an assessment of the character of the community often depends on comparison with its vegetational context. Among suites of blanket mires, base-poor flushes and acid grasslands, for example, such as provide a background at Moor House (Eddy *et al.* 1969) and on Hoy (Prentice & Prentice 1975), the *Juncus-Galium* rush-pasture can seem mildly basiphilous and sometimes indicate the influence of slightly more calcareous ground waters in such situations as these.

The final very important environmental factor which has an influence on the community is the treatment it receives, which is ultimately responsible for the maintenance of the vegetation, and which exerts a powerful control on its composition and structure, sometimes confusing the effects of climate and soil. For the most part, the community is treated as pasture or, rather, it occurs within grazing land around the upland fringes, constituting a varying proportion of the available herbage, according to natural relief and drainage and the extent of land improvement. Many lowland stands have been subject to draining, fertiliser application and reseeding, the soils being able to yield potentially heavy grass crops in the wet climate, but towards and beyond the limit of enclosure in western Britain, and, more locally, in areas of traditional, less intensive agriculture, or where common rights have prevailed, such improvement has been uneconomic or hindered and it is here that the most extensive stands are to be found. Often, however, smaller tracts of the community can be found in more intractable areas within generally improved landscapes, as around stretches of the open water or unreclaimed mires and along stream and river banks and, where there has been a history of agricultural decline, such stands have expanded with the reversion of the surrounding pastures.

Both cattle and sheep are turned on to this vegetation and, though each kind of stock produces rather different effects, the general influence of judicious grazing is to keep the rushes in check and reduce the intervening vegetation to a more close-cropped sward. In fact, where the community forms only a proportion of the available herbage, other more productive communities will be preferentially grazed, leaving the *Juncus-Galium* rush-pasture with a fairly rank understorey of herbs, but many of its characteristic dicotyledons are resistant to grazing and will survive heavy cropping as non-flowering rosettes or nibbled shoots. On moister soils, highly susceptible to poaching, especially where cattle are grazed, it may be much more difficult to hinder the dominance of the rushes, since the exposure of moist, bare ground creates ideal conditions for the germination of their seeds, huge quantities of which can remain dormant for long periods in the soil (Milton 1936, 1948, Moore & Burr 1948, Salisbury 1964). Indeed, it is possible that many stands of the community have originated or spread because of this kind of pastoral mismanagement (McVean & Ratcliffe 1962). In drier situations, however, the rushes may be reduced to smaller discrete patches and the intervening stretches of sward take on some of the character of a Nardo-Galion grassland or, where there is an element of eutrophication of the soils by dunging, or by washing or drifting in of fertiliser, of a Cynosurion sward.

Grazing usually also holds in check any marked contribution from taller herbs like *Filipendula* though, in less accessible sites, and particularly where there is some silting, as on river banks, such plants may become more obvious as in the Skye stands described by Birks (1973), and they can maintain their abundance under a mowing regime, provided it is not combined with grazing. In fact, though stands may be included within a hay crop from agricultural enclosures, mowing alone is not a very common treatment of this community, except where it is found on road verges cut to maintain visibility.

Zonation and succession

The *Juncus-Cirsium* rush-pasture occurs in zonations and mosaics with a variety of grasslands, mires and heaths, the disposition of the vegetation types usually reflecting variations in soil conditions and treatments. The community can subsist in non-intensive agricultural landscapes but improvement has destroyed many stands, or altered or truncated zonations. With neglect, improved swards can revert to this kind of vegetation and the community, in turn, progress to woodland.

Around the upland fringes of western Britain, the *Juncus-Galium* rush-pasture is still an important and extensive component of less-improved grazing land, both within and beyond the limits of enclosure. Its contribution to the vegetation cover in such predominantly pastoral landscapes is dependent on the drainage pattern, controlled by such natural factors as geology and relief, so where there has been no improvement of drainage the disposition and size of stands remain effective markers of the extent of impedence over gentle slopes with impervious substrates. And the commonest type of zonation is then to calcifuge grasslands of one sort or another, with increasing freedom of water move-

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ment in the profile, a change often indicated by increase in slope, in other cases by a switch in parent materials, or both. Alternations of shales with pervious sandstones present one kind of underlying geological pattern, fairly common in the palaeozoic deposits of western Britain, but frequently it is the distribution of ill-draining drift, lodged on plateaus, moderate slopes and choking small stream-beds, that controls the occurrence of the community.

In edaphic terms, these zonations are usually marked by a change from some sort of gleyed profile under the *Juncus-Galium* rush-pasture, to a brown podzolic soil or podzol, carrying a Nardo-Galion grassland. With increasingly free drainage, and greater tendency to surface eluviation, the rushes and Molinietalia associates drop out, leaving herbs such as *Anthoxanthum*, *Festuca rubra*, *Agrostis capillaris* and *Potentilla erecta*, as mainstays of some kind of *Festuca-Agrostis-Galium* grassland. Junctions can be sharp, where underlying edaphic conditions change suddenly, but often they are fairly gentle, as where drift influence alters gradually or where the penetration of stock creates a transitional mosaic zone between clumps of rushes. The surveys of King (1962; see also King & Nicholson 1964) include some of these intermediate swards from southern Scotland and, in the data from Moor House (Eddy *et al.* 1969), transitions to grasslands with much *Nardus* can be seen, a quite widespread feature at such higher altitudes. At this site, too, and also around Cader Idris (Edgell 1969), some of the surrounding swards are flushed with the more base-rich water which gleys the soils under the *Juncus-Galium* rush-pasture, and here the zonation can be to *Festuca-Agrostis-Thymus* grassland, into which Nardo-Galion herbs and such plants as *Carex panicea*, *Cirsium palustre* and *Agrostis canina* ssp. *canina* can extend.

Although the *Juncus-Cirsium* rush-pasture is only slightly mesophytic, transitions such as these probably involve a switch to soils which are somewhat more oligotrophic than the gleys. Within enclosed agricultural land, however, the surrounding swards have often received some fertilising, even if only from the stock which, in this kind of mosaic, give most of their attention to the drier grasslands, or from artificials such as basic slag. Then, a Cynosurion element may become prominent in the transition, with, say the *Holcus-Trifolium* sub-community of the *Festuca-Agrostis-Galium* grassland surrounding the rush-pasture, or, where there has been more assiduous improvement with some top-sowing, the *Anthoxanthum* sub-community of the *Lolio-Cynosuretum*. Cynosurion species may drift into the rush-pasture, blurring the boundaries, and the next stage of improvement is for draining of the gleys to facilitate the extinction of the rushes and their Molinietalia associates and the reclamation of the entire sward. This has been a very widespread practice, particularly over less intractable ground at lower altitudes, and though blocking of drains can allow relatively rapid reversion to the *Juncus-Galium* rush-pasture, many stands have been permanently destroyed.

Beyond the limits of enclosure, where the community can be found at moderate altitudes, the stagnohumic gleys on which it characteristically occurs often form intergrade soils between brown podzolic profiles and peats proper (Avery 1980). In some situations, the *Juncus-Galium* rush-pasture can thus be seen as part of a more extensive transition right through from Nardo-Galion swards to blanket mire with the thickening of the organic horizon from mor humus, through humose top-soil to ombrogenous peat. In such places, the community may be preferentially grazed along with stretches of *Festuca-Agrostis-Galium* or *Nardus-Galium* grasslands as the most productive and palatable vegetation types, so the switch to the peat vegetation is often marked by the appearance of ericoids, first in the *Scirpus-Erica* wet heath, then in Erico-Sphagnion mire. In these kinds of zonations, as at Moor House (Eddy *et al.* 1969) and on Cader Idris (Edgell 1969) the *Juncus-Galium* rush-pasture often occurs in quite well-defined stream-side stands running through the tracts of peat. Then, it can be seen as a mesotrophic equivalent to rush-dominated types of *Carex echinata-Sphagnum* mire. Where such streams are surrounded by gently-flushed stretches of peat, and particularly where the vegetation has been burned over and grazed, *Molinia-Potentilla* grassland can form an extensive fringe to the community.

In the lowland landscape, too, the *Juncus-Galium* rush-pasture can be found with wet heath and mires on peats, where soligenous conditions develop in ill-draining valley bottoms with gleying of their surrounds. Indeed, within stretches of more improved agricultural landscapes, such areas, sometimes preserved as common-lands, as on Gower and in Pembrokeshire (Meade 1981), can include most of the transitions of this kind. In these localities, the wet heath can be represented by the *Ericetum tetralicis*, with the *Succisa-Carex* community of which the *Juncus-Galium* rush-pasture has much in common, and this can grade in waterlogged hollows to the *Narthecio-Sphagnetum* valley bog with *Hyperico-Potametum* soakways. Again, *Molinia*-dominated vegetation can supervene in such transitions where gentle slopes have some modest flushing or where burning and grazing have favoured its spread. In the south-west of Britain and south Wales, this may be far-flung stands of the *Cirsio-Molinietum* where there is some base-enrichment in the ground waters but, usually, it is some kind of *Molinia-Potentilla* mire. Where this adjoins the *Juncus-Galium* rush-pasture, transitions between the two can be very gentle or form complex mosaics of dominance by rushes and *Molinia* (e.g. Meade 1981, Ratcliffe & Hattey 1982: site type V).

Topogenous hollows in the lowlands can also show

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zonations from the community to vegetation on peat, where the latter accumulates under the influence of a more or less permanently high water-table. In such situations, the *Juncus-Galium* rush-pasture can form a fringe around Phragmitetalia fen, into which the Junci can extend some way, but where continuity is seen mainly through tall dicotyledons like *Cirsium palustre*, *Angelica sylvestris* and *Filipendula ulmaria*, and other herbs such as *Galium palustre*, *Ranunculus flammula*, *Mentha aquatica*, *Cardamine pratensis*, *Hydrocotyle vulgaris* and *Epilobium palustre*, with a switch in dominance to helophytes, notably *Phragmites australis* or, quite commonly around open-water transitions in the western parts of Britain, *Carex rostrata*. Reed-dominated vegetation is often of the *Phragmites-Eupatorium* fen, the outward spread of *Phragmites* often being curtailed by grazing ahead of its edaphic limit (site types VII & VIII, Ratcliffe & Hattey 1982); while an increase in *C. rostrata*, together with *Potentilla palustris*, *Menyanthes trifoliata* and *Equisetum fluviatile*, all of them occasional in the *Juncus-Galium* rush-pasture, usually marks a transition to the *Potentillo-Caricetum* (site type IV, Ratcliffe & Hattey 1982). Where stock, usually cattle in these situations, come down to water at such fen stands within enclosed pastures, the *Juncus-Galium* fringe is typically a much-puddled zone.

Transitions from the community to *Phragmites-Eupatorium* fen can also be seen on the unimproved margins of sluggish streams and rivers, where the *Juncus-Galium* rush-pasture can persist on alluvial gleys over the terraces. Here, too, the *Filipendula-Angelica* tall-herb fen is often to be found on soils which are too dry to support dense *Phragmites* but periodically enriched by allochthonous mineral matter deposited in floods. Grazing, again, may have some influence on the transition from the *Juncus-Galium* rush-pasture to this Filipendulion community. Fragments of these kinds of zonations can often be seen alongside field-margin ditches and along damp hedge-banks.

In all these situations, it is usually grazing, much less often mowing, which maintains the *Juncus-Cirsium* rush-pasture; and imprudent pasturing, with its frequent poaching, probably enhances the hold of the community on these ill-draining soils. Where grazing is withheld, however, and there is no cutting or burning of the vegetation, seral progression can be rapid with direct invasion of woody plants, particularly of *Salix cinerea* and *Betula pubescens*, whose light fruits can be wind-borne for considerable distances, and sometimes also of *Alnus*, if seed-parents are close. Where a persistent phase of *Filipendula*- or *Molinia*-dominance does not supervene, such colonists can quickly come to prevail in stands of *Salix-Galium* woodland, a particularly widespread and common community of gleyed mineral soils in the western lowlands of Britain, or of *Betula-Molinia* woodland. With these two vegetation types, the *Juncus-Galium* fen-meadow can show considerable floristic overlap, sometimes surviving little changed under more open canopies. It is possible that at lower altitudes such woodlands eventually progress further by the invasion of *Quercus robur*.

Distribution

The community is widespread through the west of Britain from Devon and Cornwall to Skye and Caithness. In Scotland, where the *J. acutiflorus* sub-community prevails, this kind of vegetation is exceedingly common at low to moderate altitudes and much more frequent in the west-central lowlands than our records indicate. It remains common in Wales, though increasingly here there is a switch to the *J. effusus* sub-community, the usual type of *Juncus-Galium* rush-pasture in the South-West Peninsula. In that region, it becomes more local, though it remains abundant in some areas, like the fringes of the granite moors and more intractable parts of the Devonshire Culm Measures.

Affinities

Almost without exception, the rush-pasture vegetation previously described from western Britain has been of the type included here as the *J. acutiflorus* sub-community (McVean & Ratcliffe 1962, Edgell 1969, Eddy *et al.* 1969, Birks 1973, Birse & Robertson 1976, Adam *et al.* 1977, Birse 1980, 1984). Certainly, this is the more sharply characterised of the two kinds, representing an opposite floristic extreme from the *Juncus-Cirsium* fen-meadow but, particularly towards the south of its range, this general type of vegetation shows an ill-defined transition to the *Holco-Juncetum*, through a switch in dominants and a waning of Nardo-Galion elements. It is these intermediate stands which comprise the *J. effusus* sub-community: an alternative treatment, less satisfactory in our view, would be to include such vegetation in the *Holco-Juncetum* as an additional sub-community, leaving the *J. acutiflorus* sub-community to comprise the core of the *Juncus-Cirsium* rush-pasture.

Such difficulties of definition hint at the need for a reassessment of the relationship among Molinietalia vegetation through the whole of Europe now that we have a clearer picture of the range of these kinds of communities in Britain. Much effort has already been expended in debating the phytosociological status of more Atlantic *J. acutiflorus* vegetation such as that included here. One view (Birse & Robertson 1976, Oberdorfer 1977, Birse 1980, 1984) would incorporate it into a Juncion acutiflori alliance, along with equivalent Irish rush-pasture, the *Senecioni-Juncetum*, emphasising the boundary with the Calthion on the basis of such oceanic plants as *J. acutiflorus* itself, *Carum*, *Wahlenbergia* and *Scutellaria minor*. Against the flora of mainland European Calthion communities, which itself includes

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some Continental species of fairly strong fidelity, such plants present a sharp phytogeographical contrast. However, when the intervening range of British vegetation of this general type is included, it becomes much more difficult to draw a boundary between these alliances: the extremes are still distinct enough, the intermediates grade with a frustrating continuity. One solution to this problem is to expand the Calthion to include this western rush-dominated vegetation, as O'Sullivan (1976, 1982) and White & Doyle (1982) did. Another is to retain the two alliances, while recognising that, towards the Atlantic seaboard of Europe, the sharp affinities of their species groupings become less precise, and are often heavily overlain by a generalised Molinietalia element encouraged throughout by broadly similar agricultural treatments.

A second problem of definition is that the clearer the differences between this western rush-pasture and the Calthion communities become, the harder it is to separate the former from *Molinia*-dominated vegetation, which is likewise very widespread in the more oceanic parts of Britain and which tends to show a floristic convergence under the influence of the climate. Thus, although it has been customary to separate the *Molinia-Potentilla* grassland from the *Juncus-Galium* rush-pasture by placing the former in the Junco conglomerati-Molinion alliance, the communities do come very close, with some overlap between *J. acutiflorus* and *Molinia*, and species such as *Carum*, *Wahlenbergia* and *Scutellaria minor* occurring in both. This could be recognised by subsuming both types within a single Juncion acutiflori, and setting the major disjunction among western Molinietalia communities at the Pyrenees, beyond which this alliance gives way to an Anagallido-Juncion acutiflori. But the fact that this alliance is characterised by *Carum*, *Wahlenbergia*, *S. minor*, *Anagallis tenella* and *Lobelia urens*, all of them species whose British ranges fall roughly within our Juncion acutiflori vegetation, brings a new confusion. Clearly, the time is ripe for a further thorough revision of these communities.

Floristic table M23

	a	b	23
Juncus effusus	IV (1–6)	V (2–10)	V (1–10)
Holcus lanatus	IV (1–8)	IV (1–7)	IV (1–8)
Galium palustre	IV (1–4)	IV (1–5)	IV (1–5)
Lotus uliginosus	IV (1–6)	IV (1–5)	IV (1–6)
Juncus acutiflorus	V (2–9)	I (1–5)	II (1–9)
Molinia caerulea	III (1–7)	II (1–5)	II (1–7)
Ranunculus acris	III (1–6)	II (1–5)	II (1–6)
Potentilla erecta	III (1–5)	I (1–4)	II (1–5)
Filipendula ulmaria	II (2–7)	I (2–6)	II (2–7)
Achillea ptarmica	II (1–6)	I (1–5)	I (1–6)
Carex panicea	II (1–4)	I (1–4)	I (1–4)
Equisetum palustre	II (1–4)	I (1–8)	I (1–8)
Carum verticillatum	II (1–4)	I (1–5)	I (1–5)
Aulacomnium palustre	I (1–6)		I (1–6)
Lythrum salicaria	I (1–5)		I (1–5)
Luzula multiflora	I (1–4)		I (1–4)
Taraxacum officinale agg.	I (1)		I (1)
Iris pseudacorus	I (8)		I (8)
Juncus bulbosus	I (2–4)		I (2–4)
Dactylorhiza maculata	I (1–4)		I (1–4)
Narthecium ossifragum	I (2–4)		I (2–4)
Calypogeia fissa	I (2–3)		I (2–3)
Potentilla anserina	I (2–6)		I (2–6)
Lathyrus pratensis	I (3–5)		I (3–5)
Stellaria graminea	I (1–2)		I (1–2)
Myosotis laxa caespitosa	I (1–3)		I (1–3)

Stellaria alsine	I (1–3)	II (1–5)	II (1–5)
Juncus articulatus	I (5–7)	II (1–5)	II (1–7)
Deschampsia cespitosa	I (1–4)	II (1–6)	I (1–6)
Epilobium obscurum		I (1–3)	I (1–3)
Myosotis secunda		I (1–6)	I (1–6)
Eurhynchium praelongum		I (2–6)	I (2–6)
Athyrium filix-femina		I (1–3)	I (1–3)
Luzula campestris		I (2–3)	I (2–3)
Calliergon cordifolium		I (2–8)	I (2–8)
Cirsium palustre	III (1–5)	III (1–5)	III (1–5)
Ranunculus flammula	III (1–5)	II (1–6)	III (1–6)
Agrostis canina canina	II (1–6)	III (2–7)	III (1–7)
Anthoxanthum odoratum	III (1–6)	II (1–6)	II (1–6)
Mentha aquatica	III (1–6)	II (1–7)	II (1–7)
Rumex acetosa	II (1–5)	III (1–5)	II (1–5)
Agrostis stolonifera	II (1–7)	III (1–9)	II (1–9)
Cardamine pratensis	II (1–3)	III (1–7)	II (1–7)
Ranunculus repens	II (2–5)	II (1–5)	II (2–5)
Poa trivialis	II (2–5)	II (1–7)	II (1–7)
Calliergon cuspidatum	II (1–5)	II (1–7)	II (1–7)
Angelica sylvestris	II (1–5)	II (1–6)	II (1–6)
Epilobium palustre	II (1–3)	II (1–3)	II (1–3)
Hydrocotyle vulgaris	II (1–5)	II (1–6)	II (1–6)
Viola palustris	II (1–6)	II (1–5)	II (1–6)
Festuca rubra	II (2–7)	I (1–5)	I (1–7)
Carex nigra	I (2–5)	II (1–5)	I (1–5)
Scutellaria minor	I (1–4)	I (1–5)	I (1–5)
Agrostis capillaris	I (2–6)	I (1–4)	I (1–6)
Rhytidiadelphus squarrosus	I (1–4)	I (1–4)	I (1–4)
Juncus conglomeratus	I (1–4)	I (3–5)	I (3–5)
Brachythecium rutabulum	I (1–6)	I (2–7)	I (1–7)
Lychnis flos-cuculi	I (1–5)	I (2–5)	I (1–5)
Glyceria fluitans	I (1–4)	I (1–6)	I (1–6)
Trifolium repens	I (1–4)	I (1–5)	I (1–5)
Cerastium fontanum	I (1–2)	I (1–4)	I (1–4)
Potentilla palustris	I (2–5)	I (2–5)	I (2–5)
Brachythecium rivulare	I (1–4)	I (1–4)	I (1–4)
Equisetum fluviatile	I (1–3)	I (1–4)	I (1–4)
Plantago lanceolata	I (1–4)	I (1–4)	I (1–4)
Succisa pratensis	I (1–5)	I (1–4)	I (1–5)
Cynosurus cristatus	I (1–4)	I (2–6)	I (1–6)
Prunella vulgaris	I (2–3)	I (1–4)	I (1–4)
Caltha palustris	I (2–5)	I (2–5)	I (2–5)
Senecio aquaticus	I (1–3)	I (1–6)	I (1–6)
Polytrichum commune	I (1–2)	I (1–8)	I (1–8)
Lophocolea bidentata s.l.	I (1–3)	I (1–4)	I (1–4)
Valeriana officinalis	I (3–4)	I (2–4)	I (2–4)
Poa pratensis	I (1–2)	I (2–6)	I (1–6)
Cardamine flexuosa	I (1)	I (1–3)	I (1–3)
Carex ovalis	I (2–4)	I (1–4)	I (1–4)

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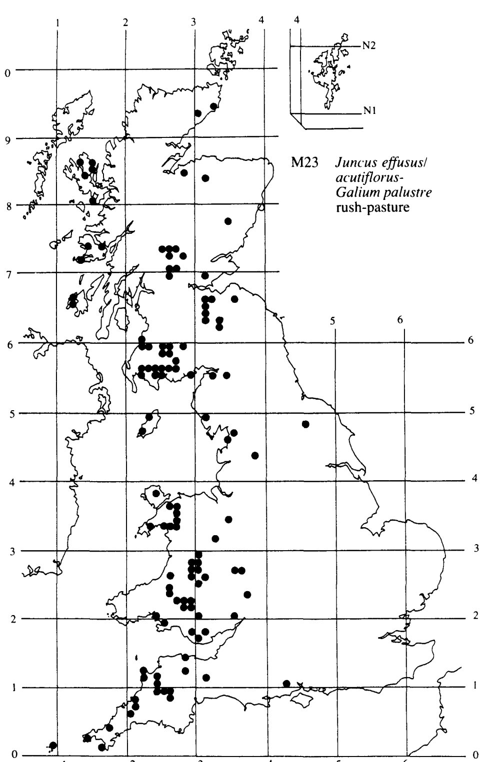
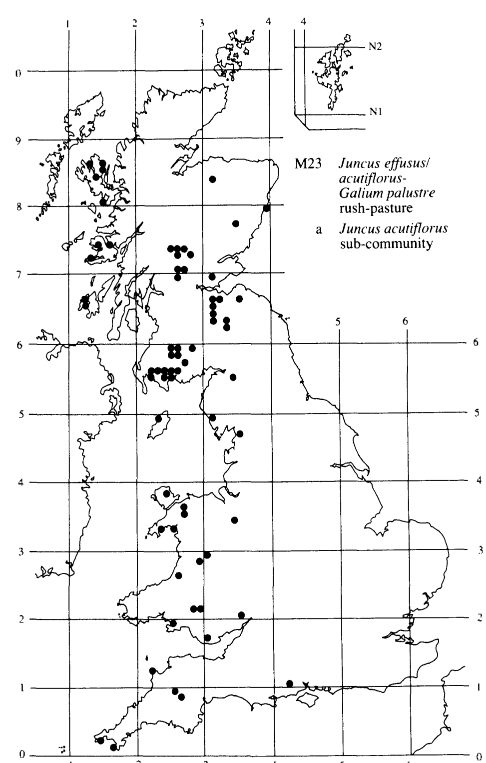
Floristic table M23 *(cont.)*

	a	b	23
Carex echinata	I (1)	I (2–4)	I (1–4)
Carex demissa	I (1–4)	I (1–3)	I (1–4)
Veronica scutellata	I (1–3)	I (1–3)	I (1–3)
Pellia epiphylla	I (3–4)	I (2–4)	I (2–4)
Polygonum hydropiper	I (1–4)	I (1–6)	I (1–6)
Number of samples	38	62	100
Number of species/sample	21 (6–39)	17 (8–28)	19 (6–39)
Vegetation height (cm)	47 (30–100)	56 (10–130)	52 (10–130)
Herb cover (%)	96 (60–100)	98 (80–100)	98 (60–100)
Bryophyte cover (%)	15 (0–80)	26 (0–80)	21 (0–80)
Altitude (m)	137 (20–390)	195 (10–430)	163 (10–430)
Slope (°)	1 (0–10)	1 (0–30)	1 (0–30)
Soil pH	4.9 (3.7–5.6)	4.9 (3.5–6.2)	4.9 (3.5–6.2)

a *Juncus acutiflorus* sub-community
b *Juncus effusus* sub-community
23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture (total)





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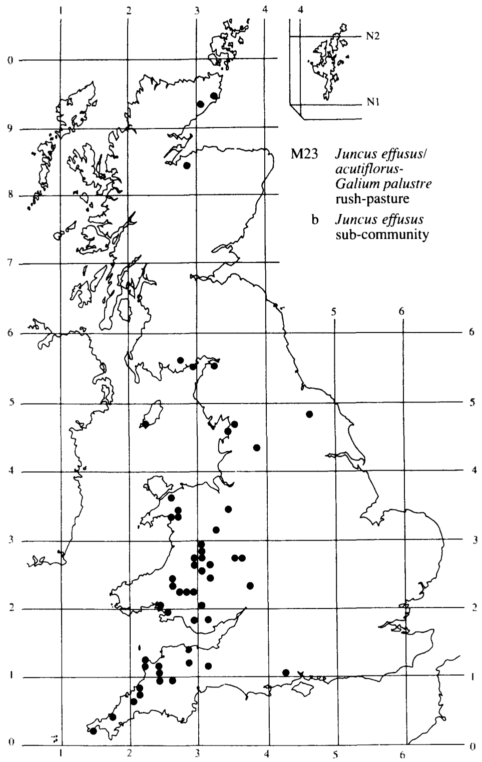

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