M9
Carex rostrata-Calliergon cuspidatum/giganteum mire

Synonymy
Carex rostrata 'reedswamp' Holdgate 1955*b p.p.*; Lower fens Holdgate 1955*b p.p.*; Mixed fen Holdgate 1955*b*; *Carex rostrata*-brown moss provisional nodum McVean & Ratcliffe 1962, Ferreira 1978; *Carex rostrata-Acrocladium* sociation Spence 1964 *p.p.*; *Carex nigra-Acrocladium* sociation Spence 1964 *p.p.*; *Potentilla-Acrocladium* sociation Spence 1964 *p.p.*; *Filipendula-Acrocladium* sociation Spence 1964 *p.p.*; *Carex rostrata-Scorpidium scorpioides* Association Birks 1973; *Potentilla palustris-Acrocladium* nodum & related fens Proctor 1974 *p.p.*; General fen Adam *et al.* 1975 *p.p.*; *Acrocladio-Caricetum diandrae* (Koch 1926) Wheeler 1975 *p.p.*; *Peucedano-Phragmitetum caricetosum* Wheeler 1978 *p.p.*; *Acrocladium cuspidatum-Carex diandra* mire Ratcliffe & Hattey 1982; *Caricetum diandrae* Dierssen 1982; *Caricetum rostratae* Dierssen 1982 *p.p.*

Constant species
Carex rostrata, *Eriophorum angustifolium*, *Galium palustre*, *Menyanthes trifoliata*, *Potentilla palustris*, *Calliergon cuspidatum*.

Rare species
Carex appropinquata, *C. diandra*, *Cicuta virosa*, *Dactylorhiza traunsteineri*, *Liparis loeselii*, *Potamogeton coloratus*, *Pyrola rotundifolia*, *Sium latifolium*, *Utricularia intermedia*, *Cinclidium stygium*.

Physiognomy
The *Carex rostrata-Calliergon cuspidatum* mire is a community of diverse composition and physiognomy, even within individual stands, but it is generally characterised by a fairly rich assemblage of vascular plants, among which sedges predominate, over a luxuriant carpet of bulky mosses, in which Sphagna are but locally represented. The commonest sedge overall is *Carex rostrata* and this is quite often abundant, sometimes a sole dominant, particularly in the *Campylium-Scorpidium* sub-community. Very frequently, however, it is accompanied here by the nationally rare Continental Northern sedge *C. diandra*, which has its main locus in Britain in this community and which can likewise be very prominent, especially in the *Carex diandra-Calliergon giganteum* sub-community. In some stands, one or both of these species are accompanied by a third tall, rhizomatous sedge which can be locally abundant, *C. lasiocarpa*. When these plants are growing vigorously, they can make up a patchy canopy 60 cm or more high. In some localities, there are also prominent tussocks of *C. paniculata* or *C. appropinquata*, though these sedges are scarce in the community as a whole. Other possible local dominants of low frequency throughout are *Juncus subnodulosus* and *Schoenus nigricans* and, in a few places, the *Carex-Calliergon* mire occurs in some very striking mosaics with the *Peucedano-Phragmitetum* when a sparse or patchy cover of *Phragmites australis* or *Cladium mariscus* can occur (in what Wheeler (1978, 1980*a*) called *Peucedano-Phragmitetum caricetosum*).

Intermixed with these species or forming a fringe around their more extensive patches is a variety of associates of low to medium height. Some, like *Potentilla palustris* and *Menyanthes trifoliata*, are very common throughout the community and can attain high cover locally. These species probably play an important part in the establishment of the floating rafts in which form this vegetation is often found and, when they are abundant, they accentuate the similarity between the community and the closely-related *Potentillo-Caricetum rostratae*. Also very common are *Eriophorum angustifolium*, *Equisetum fluviatile*, *E. palustre*, *Succisa pratensis*, *Pedicularis palustris*, *Cirsium palustre* and *Ranunculus flammula* and, distributed somewhat more unevenly through the two sub-communities, *Mentha aquatica*, *Caltha palustris*, *Valeriana dioica*, *Angelica sylvestris*, *Epilobium palustre* and *Lychnis flos-cuculi*. For the most part, all these plants occur as scattered individuals but, when they are present in rich assortments, they give the vegetation a quite distinctive stamp. Other sedges apart

from the bulkier species listed earlier can also make a contribution. *C. panicea* and *C. nigra* are both very frequent and the latter especially can be conspicuous in its tussock form (var. *tornata*, not the non-rhizomatous var. *juncea* (= *C. juncella*, which is Scandinavian: c.f. Holdgate 1955*b*)). In the *Campylium-Scorpidium* sub-community, there is further enrichment of the sedge component with records for a variety of species among which *C. limosa* and *C. echinata* are the most common. Grasses are few in number but *Molinia caerulea* is quite frequent and, in drier stands, it can be abundant, when the vegetation begins to approach the *Cirsio-Molinietum* in its composition. *Agrostis stolonifera* is also fairly common, though *A. canina* ssp. *canina* is very scarce in comparison with the Caricion nigrae poor fens. Apart from the occasional *Juncus subnodulosus*, rushes are characteristically uncommon, though there is sometimes a little *J. articulatus* or *J. acutiflorus*.

Three other structural elements may attain some measure of prominence among the vascular cover. First, there is often some sprawling *Galium palustre* and, less commonly, *G. uliginosum*. Second, wetter areas, which may be sufficiently well defined as to form small complexes of pools, can have some submerged aquatic plants, notably *Utricularia* ssp., and emergents like *Ranunculus lingua* and the rare *Sium latifolium* and *Cicuta virosa*. And, third, there may be some small saplings of *Salix cinerea* (and, in northern Britain, *S. pentandra*) and *Betula pubescens*, when the vegetation may be transitional to the *Salix-Carex rostrata* woodland.

Bryophytes almost always form a conspicuous component of the vegetation, often attaining more than 50% cover in a luxuriant carpet. The most frequent species throughout are larger *Calliergon* ssp.: *C. cuspidatum* is a constant of the community and *C. giganteum* and *C. cordifolium* are frequent, though distinctly preferential to the *Carex diandra-Calliergon giganteum* sub-community. There is also quite often one or more of the larger Mniaceae, *Plagiomnium rostratum*, *P. affine*, *P. elatum*, *P. undulatum*, *P. ellipticum* or *Rhizomnium pseudopunctatum*. Members of these two groups of mosses can be quite common in the *Potentillo-Caricetum rostratae*, but a further group of more or less calcicolous species helps define the community against both this fen and the Caricion nigrae mires. *Campylium stellatum* is the most frequent of these and it is often accompanied in the *Campylium-Scorpidium* sub-community by *Scorpidium scorpioides* and *Drepanocladus revolvens*; more occasional through the community as a whole are *Bryum pseudotriquetrum*, *Cratoneuron commutatum*, *C. filicinum* and *Ctenidium molluscum*. Other bryophytes recorded at low frequencies in this kind of mire are *Hylocomium splendens* and *Climacium dendroides*. In contrast to the Caricion nigrae communities, Sphagna, apart from the most base-tolerant of the genus, *S. contortum*, are distinctly uncommon, though there can be occasional patches of *S. subnitens*, *S. auriculatum*, *S. recurvum* and *S. warnstorfii*.

Sub-communities

***Campylium stellatum-Scorpidium scorpioides* sub-community:** *Carex rostrata* 'reedswamp' Holdgate 1955*b p.p.*; Lower fens Holdgate 1955*b p.p.*; *Carex rostrata*-brown moss provisional nodum McVean & Ratcliffe 1962, Ferreira 1978; *Carex rostrata-Scorpidium scorpioides* Association Birks 1973; *Acrocladio-Caricetum diandrae schoenetosum*, *sphagnetosum p.p.* and *juncetosum p.p.* (Koch 1926) Wheeler 1975. Although *Carex diandra* is quite common in this sub-community and can be locally abundant, the usual dominant is *C. rostrata*, sometimes accompanied by *C. lasiocarpa*. At some sites, *Schoenus nigricans* is a prominent associate in this taller stratum, as in the stands included in Wheeler's (1975, 1980*b*) *Acrocladio-Caricetum schoenetosum*, but its overall frequency is low. Smaller sedges are much more numerous and varied than in the other sub-community, though they are generally represented by scattered individuals: the community species *C. panicea* and *C. nigra* retain their high frequency here but, in addition, *C. limosa* and *C. echinata* are strongly preferential and there are occasional records for *C. lepidocarpa*, *C. dioica*, *C. serotina*, *C. demissa* and *C. hostiana*, though these latter species are never so structurally important here as in the *Pinguiculo-Caricetum dioicae*.

The representation of herbaceous associates is variable but generally not very rich and their total cover is typically quite low, giving a rather open look to the vascular component. *Menyanthes trifoliata* and *Potentilla palustris* can be patchily prominent but, for the most part, the community species occur as scattered plants. There are also but few preferentials among this element in this sub-community, though more aquatic plants of wet hollows and pools are a little more prominent with *Utricularia* ssp., *Potamogeton polygonifolius* and *Juncus bulbosus/kochii* giving the impression of a local development of Littorelletea vegetation. *Eleocharis quinqueflora* and *Pinguicula vulgaris* occur is some stands, *Viola palustris*, *Narthecium ossifragum* and *Drosera rotundifolia* in others and, sometimes, such assemblages can be closely juxtaposed in complex mosaics. The nationally rare *Pyrola rotundifolia* has been recorded in this kind of vegetation.

Characteristically, however, it is not these associates which comprise the prominent ground to sedge-dominance but the bryophytes. Apart from *Calliergon cuspidatum*, the *Calliergon* spp. and Mniaceae are somewhat less frequent and conspicuous than in the other sub-

community, though they can occur locally. But typically very extensive is a patchwork of the 'brown mosses' *Campylium stellatum*, *Scorpidium scorpioides* and *Drepanocladus revolvens* (sometimes determined to the more calcicolous var. *intermedius*: but see Smith 1978). There are also occasional clumps of Sphagna, notably the base-tolerant *S. contortum* but also, less commonly, *S. subnitens*, *S. auriculatum*, *S. recurvum* and *S. warnstorfii*. *Aneura pinguis* is also preferential at low frequency.

***Carex diandra-Calliergon giganteum* sub-community:** Mixed fen Holdgate 1955*b p.p.*; *Carex rostrata-Acrocladium*, *Carex nigra-Acrocladium*, *Potentilla-Acrocladium* and *Filipendula-Acrocladium* sociations Spence 1964 *p.p.*; *Potentilla palustris-Acrocladium* nodum & related fens Proctor 1974 *p.p.*; Miscellaneous *Carex* fens Proctor 1974 *p.p.*; General fen Adam *et al.* 1975 *p.p.*; *Acrocladio-Caricetum diandrae typicum*, *cicutetosum*, *crepetosum* and *juncetosum subnodulosi* Wheeler 1980*b*; *Peucedano-Phragmitetum caricetosum* Wheeler 1978 *p.p.*; *Acrocladium cuspidatum-Carex diandra* mire Ratcliffe & Hattey 1982. The pattern of dominance among the vascular plants is more variable here than in the *Campylium-Scorpidium* sub-community. Both *Carex rostrata* and *C. diandra* are very frequent and either or both may dominate, with or without *C. lasiocarpa*. Very locally, in eastern England, *Juncus subnodulosus* is abundant in this upper stratum of the vegetation (in what Wheeler (1980*b*) termed a *juncetosum*), and in parts of Broadland this sub-community occurs in intimate mosaics with the *Peucedano-Phragmitetum* when *Cladium* or *Phragmites* can be patchily represented.

Herbaceous associates, particularly taller dicotyledons, are also more numerous in this sub-community: together, they can constitute a quite lush and species-rich cover and some of them can attain local dominance along with the sedges, as in the series of fens defined by Spence (1964), Proctor (1974) and Adam *et al.* (1975). As well as *Potentilla palustris* and *Menyanthes*, *Filipendula ulmaria* can be prominent (especially along the sides of streams where there is some silting) and there are also frequent records for *Valeriana dioica*, *Epilobium palustre*, *Angelica sylvestris* and *Lychnis flos-cuculi*, occasionally for *Valeriana officinalis* and, more locally in wetter places, for *Ranunculus lingua*, *Cicuta virosa* and *Sium latifolium* (as in the *cicutetosum* of Wheeler 1980*b*). Among the smaller herbs, too, there are some good preferentials with *Caltha palustris*, *Cardamine pratensis* and *Mentha aquatica* all common. *Crepis paludosa* has been recorded from some northern stands (as in Wheeler's (1980*b*) *crepetosum*) and, in Broadland, *Dactylorhiza traunsteineri* and the very rare *Liparis loeselii* occur in this vegetation (e.g. Wheeler 1978, 1980*a*, *b*). Occasional pools can have *Utricularia* ssp., *Potamogeton polygonifolius*, *P. coloratus* and *Hottonia palustris*.

As in the *Campylium-Scorpidium* sub-community, bryophytes are often extensive and it is here that *Calliergon giganteum* and *C. cordifolium*, *Plagiomnium rostratum* and *P. affine* show their maximum development, sometimes occurring in a variegated carpet, in other stands showing local replacement in a more well-defined mosaic (e.g. Proctor 1974). *Campylium stellatum* occurs occasionally but *Scorpidium*, *Drepanocladus revolvens* and Sphagna are very scarce.

Habitat

The *Carex-Calliergon* mire is characteristic of soft, spongy peats kept permanently moist by at least moderately base-rich and calcareous waters. It is commonest in the wetter parts of topogenous mires, in natural hollows or old peat-workings, but it can also occur in places with a strong soligenous influence, in small spring-head basins, along the margins of lagg streams around raised mires and in flushes on blanket mires. It is typically too wet to be grazed but in some areas it occurs within mowing-marsh that is still cropped.

The local distribution of this kind of mire is in part a reflection of the scarcity of the rather particular environmental conditions that it favours. To the north-west of Britain, it is generally found as part of the vegetation in basins receiving drainage waters from limestones or other highly calcareous rocks or superficials, as at Sunbiggin Tarn in Cumbria (Holdgate 1955*b*), Malham Tarn in North Yorkshire (Sinker 1960, Proctor 1974, Adam *et al.* 1975) and the Anglesey fens (Wheeler 1975, 1980*b*), all on Carboniferous Limestone, and at Newham Fen in Northumberland and the Whitlaw Mosses in southern Scotland (Ratcliffe 1977, Wheeler 1980*b*) developed in glacial drift. Here it occurs in open-water transitions or in more infilled basin mires, often with some marginal seepage from the surrounds, but in this region, too, it can also mark out smaller areas influenced by soligenous calcareous waters, within blanket mires (as on Skye: Birks 1973) or, at altitudes up to about 800 m, in slope flushes feeding little peat-filled hollows (McVean & Ratcliffe 1962). In the south-eastern lowlands of Britain, the *Carex-Calliergon* mire can again be found in basin mires, as on some of the north Norfolk commons (Wheeler 1980*b*), but it also occurs in wetter areas within some of the Broadland fens, though these stands do not appear to experience an orthodox flood-plain mire regime and may always occupy disused peat-workings (Wheeler 1978, Giller & Wheeler 1986*a*: see below). The distribution of these sites is such that this vegetation provides a locus for a number of Continental Northern species in Britain: *Carex diandra*, *C. lasiocarpa*, *Cicuta virosa*, *Crepis paludosa*, *Hottonia palustris*.

In all the various site types, the waters and substrates with which the community is associated are typically

fairly base-rich, with a pH always above 5 and usually above 6, and with dissolved calcium levels in the range 15–50 mg l^{-1} (Spence 1964, Proctor 1974, Wheeler 1983), conditions which are reflected in the shift away from the more calcifugous floristic elements prominent in the Caricion nigrae to the more calcicolous. In the community as a whole, the change is best seen among the bryophytes where, apart from the base-tolerant *Sphagnum contortum*, Sphagna are of rather patchy occurrence, *Calliergon cuspidatum*, *C. giganteum* and *C. cordifolium* replace *C. stramineum*, and the calcicolous 'brown mosses' become very prominent. But there are also occasionally records, too, for such typical Caricion davallianae herbs as *Eleocharis quinqueflora*, *Pinguicula vulgaris*, *Carex dioica* and *C. lepidocarpa*.

However, it is a very distinctive feature of some stands that pH varies quite widely within a small compass (e.g. Proctor 1974). This affects not only the sharpness with which the *Carex-Calliergon* mire is differentiated from the vegetational context in which it occurs but probably also plays some part in the development of the fine patterning often to be seen among the bryophytes and herbs, and is perhaps involved in the floristic differentiation of the two sub-communities. Such variations are sometimes related to complex patterns of seepage in sites with soligenous influence or, in topogenous fens, they may reflect the extent to which the vegetation is maintained in close contact with the ground waters. There may also be some autogenic differentiation of more acidic nuclei, around the patches of Sphagna best seen in the *Campylium-Scorpidium* sub-community, or other bryophytes like *Rhizomnium pseudopunctatum* (e.g. Proctor 1974: see also Clapham 1940).

Though not so impoverished as the habitats of the Caricion nigrae poor fens, those of the *Carex-Calliergon* mire are probably always relatively poor in available phosphorus and nitrogen (Proctor 1974, Giller & Wheeler 1986*a*, *b*). However, there may be some difference in the trophic state of the environments of the two sub-communities. The *Campylium-Scorpidium* sub-community is largely confined to the sub-montane north-west of Britain and often occurs there in situations which seem oligotrophic, like small flushes. The *Carex diandra-Calliergon giganteum* type is more consistently associated with topogenous mires where there may be some deposition of allochthonous material and, in the south-eastern lowlands, perhaps some influence from fertiliser run-off: its strong contingent of mesophytic tall herbs certainly bring it close in its floristics to some of the richer Phragmitetalia fens and Molinietalia fen-meadows.

The other important environmental feature associated with the development of the *Carex-Calliergon* mire is the maintenance of a more or less consistently high water-table in soft and often deep peats. Some sites where the community occurs, notably basins in the wetter north-western uplands, do experience considerable fluctuations in water-level, from a few centimetres above the surface to up to 40 cm below (Holdgate 1955*b*, Spence 1964), but such changes are usually not seasonally maintained and probably do not leave the fen mat desiccated for long periods of time. Even where the *Carex-Calliergon* mire occurs within flood-plain mires, as in Broadland, the water-level fluctuations are somewhat irregular in the vicinity of the stands (Giller & Wheeler 1986*a*). Moreover, the vegetation often develops as a floating or semi-floating raft which can rise and fall with any change in water-level, as the typically unconsolidated deposits beneath expand and contract: this tends to reduce the amplitude of the variations relative to the surface and maintain a fairly consistent hydrological and redox environment. In the Ant valley fens in Broadland, Giller & Wheeler (1986*a*, *b*) found that it was this, rather than any consistent differences in cation concentration in the substrates or treatment of the vegetation, which distinguished the situations where the *Carex-Calliergon* mire developed, among a mosaic of Phragmitetalia swamps and fens, from the surrounding firm peat. Again, it may be possible that the floristic differences between the two sub-communities are related to fine variations in the height of the water-table. In comparable vegetation in The Netherlands, Segal (1966) noted that a *Scorpidium* phase was associated with wetter conditions, an *Acrocladium* (*Calliergon*) *cuspidatum* phase with drier conditions, local patches of more base-tolerant Sphagna developing in either. In some situations, this may represent a seral development with an upraising of the surface of the fen mat: certainly the establishment of an extensive bryophyte carpet seems to play an important role here in the colonisation by the community dicotyledons (Segal 1966, Giller & Wheeler 1986*a*).

In Broadland, the stretches of soft, unconsolidated peat in which the community develops are invariably associated with fairly shallow peat-cuttings, sometimes extensive turf-ponds 60–80 cm deep, excavated in the nineteenth century and now almost completely colonised (Wheeler 1978, Giller 1982, Giller & Wheeler 1986*a*). At some other sites, too, such as Malham Tarn (Proctor 1974), the *Carex-Calliergon* mire may mark out artificial hollows in which rather particular environmental conditions pertain, a feature of very considerable importance for the conservation of the community where terrestrialisation is proceeding apace. Giller & Wheeler (1986*a*) suggested that, in Broadland, maintenance of the striking species-rich mosaics in which the *Carex-Calliergon* mire occurs and which provide a locus for some notable rarities, would probably necessitate the excavation of new turf-ponds.

The generally wet and insubstantial nature of the

ground here usually preclude grazing of those stands which are open to stock. In the Ant valley fens, the stretches of the *Peucedano-Phragmitetum* in which the community is found are still summer-mown for sedge (*Cladium*) every three or four years but, though this helps maintain the richness of the mosaics (Wheeler & Giller 1982*a*), it does not explain why the *Carex-Calliergon* component of the vegetation cover should be so very localised within the generally more species-poor tracts of fen which cover most of the turf-ponds (Giller & Wheeler 1986*a*).

Zonation and succession

The community is typically found among suites of swamps and mires whose distribution is related to the water regime of the environment and the base-status and calcium content of the waters and substrates. In some places, such zonations obviously reflect successions with increasing terrestrialisation but, in more oligotrophic situations, seral progression may be slow and, in isolated sites, woody seed-parents may be very remote. Under certain conditions, it is also possible that succession tends not to the establishment of mire forest but ultimately to ombrogenous bog.

The simplest sequences in which the *Carex-Calliergon* mire occurs are found in open-water transitions around lakes and pools with more base-rich waters, as in limestone and drift basins towards the upland northwest. Here, the community is often fronted by stands of the *Caricetum rostratae* or *Equisetetum fluviatile* swamps (or, in parts of Scotland, the *Caricetum vesicariae*) extending out into deeper open water (Holdgate 1955*b*, Spence 1964). More locally, in this kind of site, the *Cladietum marisci* may be represented in the zonation: it is especially well-developed in the Anglesey fens (Wheeler 1980*a*, *b*), though in the cooler conditions at higher latitudes and altitudes becomes increasingly sparse (e.g. Holdgate 1955*b*). Very commonly, the *Carex-Calliergon* mire forms a mosaic behind the swamp zone with the *Potentillo-Caricetum*, also often developed as a floating raft, within which there may also be a local occurrence of the *Carex-Sphagnum squarrosum* mire: through all of these, *Carex rostrata*, *Eriophorum angustifolium*, *Potentilla palustris* and *Menyanthes* may form a continuous backdrop to the differentiation of diagnostic suites of bryophytes and herbs in the various fens. Where there is any development of woody vegetation in such sequences, it is generally of the *Salix-Carex* type, characterised by rather diverse canopies of willows, in which *Salix pentandra* generally figures prominently, over a field layer that retains a strong floristic continuity with the surrounding fen. A more or less complete sequence of this general type is well seen at Malham Tarn (Proctor 1974, Adam *et al.* 1975).

At this site, too, it is possible to see some complications of this basic pattern. First, since base- and calcium-enrichment are strongly dependent on springs which debouch water from calcareous bedrocks (Carboniferous Limestone in this case), the *Carex-Calliergon* mire occurs closely juxtaposed to calcifugous mire vegetation more remote from soligenous influence or elevated above the ground water-table on ombrogenous peats. Directly comparable abrupt floristic contrasts can be seen where the community occurs locally around more base-rich flushes in stretches of blanket mire or wet heath in Scotland, where the basins are often insufficiently extensive for swamps to be represented, but where montane mires, like the *Carex-Sphagnum warnstorfii* community, and spring vegetation, like the *Carici-Saxifragetum aizoidis*, may also be represented (McVean & Ratcliffe 1962, Birks 1973).

Second, where calcareous conditions are maintained over shallower peats running away around the fringe of the basin, the *Carex-Calliergon* mire gives way at Malham, and around soligenous base-rich flushes on upland slopes, to the *Pinguiculo-Caricetum dioicae*, a community with which it shows quite strong floristic affinities but where species like *Carex rostrata*, *C. diandra*, *Potentilla palustris* and *Menyanthes* fade in importance and where there is a stronger representation of Caricion davallianae plants.

Third, on fairly moist and firm peats or peaty alluvium where there is a greater measure of nutrient enrichment, the *Carex-Calliergon* mire can pass to Molinietalia vegetation in which tall herbs become consistently prominent, together with plants like *Molinia caerulea* and/or *Juncus subnodulosus*. At Malham, such vegetation is represented by the rather particular *Molinia caerulea-Crepis paludosa* community, as well as the more widely distributed *Filipendula ulmaria-Angelica sylvestris* community (Proctor 1974, Adam *et al.* 1975). Similar transitions can be seen at Sunbiggin Tarn (Holdgate 1955*b*) and around some Scottish lochs (Spence 1964) and, where the *Carex-Calliergon* mire occurs very locally in fens in eastern England, it is generally in a context of Junco-Molinion fen-meadows (Wheeler 1980*b*, *c*).

The very distinctive occurrences of the community in Broadland preserve the general features of the swamp/fen transitions outlined above but the vegetation types represented are somewhat different, the mosaics very intricate and their origin, as noted above, rather special. In this area, the *Carex-Calliergon* mire occurs in intimate contact with various types of the *Peucedano-Phragmitetum* (notably the *Cicuta* sub-community) and was grouped within that association by Wheeler (1978, 1980*a*) as a distinct *caricetosum*. These mosaics, together with tracts of the *Cladietum marisci* and some species-rich types of *Phragmitetum*, occupy the turf-ponds and

are surrounded by stretches of the *Peucedano-Phragmitetum*, *Schoenus* and *Myrica* sub-communities on the firmer, uncut peats. *Cladium* is generally the present fen-dominant (and is regularly mown) and seems to have figured prominently in the relatively short successional life of this quite striking vegetation in the disused cuttings (Giller & Wheeler 1986*a*).

Throughout its range, at least at lower altitudes and in less remote sites, the *Carex-Calliergon* mire is probably a successional stage to the development of Salicion cinereae mire forest, to the north the *Salix-Carex* woodland, to the south-east the *Salix-Betula-Phragmites* woodland. The maintenance of a generally high water-table or irregular fluctuations in water-level may hinder invasion by woody plants and, in Broadland, mowing for sedge can repeatedly set back colonisation but, where the fen mat begins to emerge permanently more than a few centimetres above the water level, progression to woodland is probably potentially quite rapid. There is also the possibility that the *Carex-Calliergon* mire is seral to the development of poor-fen and ombrogenous mire, through the local formation of *Sphagnum* nuclei, a progression to the *Carex-Sphagnum squarrosum* mire and selective invasion by *Betula pubescens*. Such a sere seems to be in operation in the Ant valley fens, where the *Sphagnum* sub-community of the *Salix-Betula-Phragmites* woodland forms striking islands in the fen, and it perhaps heralds the development of *Betula-Molinia* woodland and some kind of *Sphagnum*-dominated bog.

Distribution

The community has a widespread but rather local distribution, being limited by the fairly sparse occurrence of suitable natural situations and, in the lowland south-east, by wetland drainage and the cessation of shallow peat-digging. The *Campylium-Scorpidium* sub-community is largely north-western in its range, with scattered outliers in the south, and predominantly in smaller soligenous sites; the *Carex diandra-Calliergon giganteum* sub-community occurs throughout the range, mostly in topogenous mires.

Affinities

The *Carex-Calliergon* mire brings together a variety of previously-described vegetation types whose extremes are represented by the *Carex rostrata*-brown moss mires of McVean & Ratcliffe (1962), Birks (1973) and Ferreira (1978) and the communities dominated by mixtures of *C. rostrata*, *C. diandra* and *C. lasiocarpa* with a range of tall-fen herbs characterised by Holdgate (1955*b*), Spence (1964), Proctor (1974) and Adam *et al.* (1975) and subsumed by Wheeler (1975, 1980b) into his *Acrocladio-Caricetum diandrae*. Despite the considerable diversity in the pattern of dominance and in the composition of the bryophyte carpet, the community holds together well as the most calcicolous of the mires in which *C. rostrata* is well represented and provides the major British locus for *C. diandra*. It compares closely with *C. diandra*-dominated mires from other parts of north-west Europe such as Norway (Dierssen 1982), France (Wattez & Géhu 1972), Germany (Oberdorfer 1977, Ellenberg 1978), Belgium (Le Brun *et al.* 1949), The Netherlands (Segal 1966, Westhoff & Den Held 1969), Switzerland (Koch 1926) and Poland (Matuszkiewicz 1981) where the vegetation types have generally been related to the *Caricetum diandrae* (Jon. 1932) Oberdorfer 1957 or the *Scorpidio-Caricetum diandrae* Koch 1926. As in parts of Britain, such communities on the Continent are often associated with peat-cuttings (e.g. Duvigneaud 1949, Segal 1966). They have sometimes been placed in a Caricion lasiocarpae, more usually in the Caricion davallianae and, as here, provide a locus for such alliance indicators as *Liparis loeselii*, *Dactylorhiza traunsteineri*, *Sphagnum contortum* and *Cinclidium stygium*.

The *Carex-Calliergon* mire has close relationships with various other kinds of mire. It is fairly well marked off from the poor fens of the Caricion nigrae but grades floristically to other Caricion davallianae communities (through the smaller calciolous sedges and dicotyledons and some of the bryophytes), to Phragmitetalia fens (where tall herbs are prominent with bulky sedges and helophytes) and to Molinietalia fen-meadows (where tall herbs are associated with *Molinia* and *Juncus subnodulosus*).

Floristic table M9

	a	b	9
Carex rostrata	V (1–9)	V (1–6)	V (1–9)
Eriophorum angustifolium	V (1–4)	V (1–4)	V (1–4)
Menyanthes trifoliata	IV (1–7)	V (1–7)	V (1–7)
Potentilla palustris	IV (1–4)	IV (1–4)	IV (1–4)
Calliergon cuspidatum	IV (1–4)	IV (1–7)	IV (1–7)

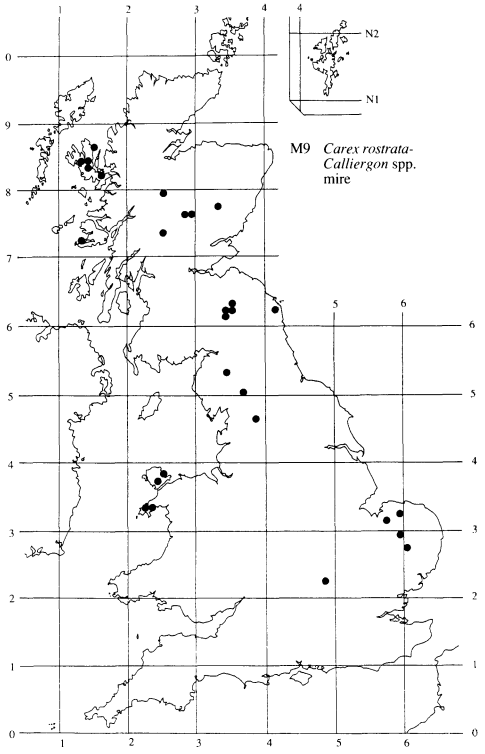
Floristic table M9 *(cont.)*

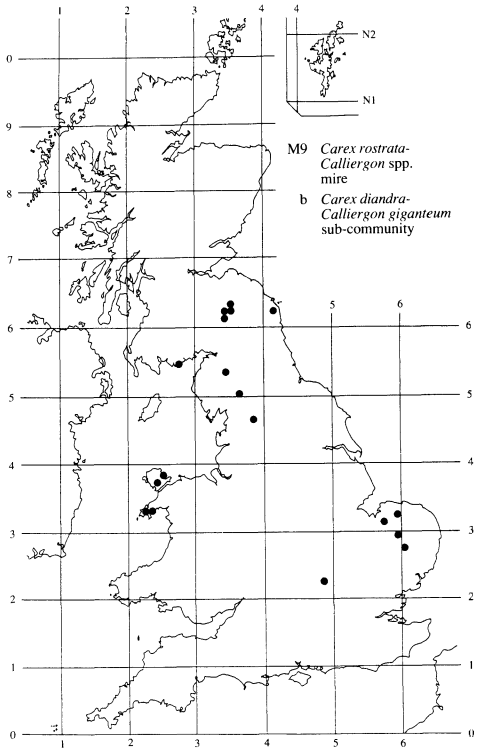
	a	b	9
Galium palustre	III (1–3)	IV (1–4)	IV (1–4)
Campylium stellatum	V (1–5)	II (1–4)	III (1–5)
Scorpidium scorpioides	IV (1–6)	I (4)	II (1–6)
Drepanocladus revolvens	IV (1–4)	I (1–4)	II (1–4)
Carex limosa	III (1–4)	I (1–3)	II (1–4)
Utricularia spp.	III (1–3)	I (1)	II (1–3)
Sphagnum contortum	III (1–4)	I (1)	II (1–4)
Carex echinata	III (1–3)		II (1–3)
Viola palustris	II (1–3)	I (1–3)	I (1–3)
Carex lepidocarpa	II (1–4)	I (1–3)	I (1–4)
Potamogeton polygonifolius	II (1–2)	I (1–3)	I (1–3)
Sphagnum subnitens	II (1–3)	I (1)	I (1–3)
Eleocharis quinqueflora	II (2–3)	I (1)	I (1–3)
Potentilla erecta	II (1–2)	I (1–4)	I (1–4)
Aulacomnium palustre	II (1–3)	I (1–3)	I (1–3)
Triglochin palustris	II (1–2)	I (1)	I (1–2)
Aneura pinguis	II (1–3)	I (1–3)	I (1–3)
Carex dioica	II (1–4)		I (1–4)
Sphagnum auriculatum inundatum	II (2–3)		I (2–3)
Carex demissa	II (3–4)		I (3–4)
Pinguicula vulgaris	II (2–3)		I (2–3)
Carex serotina	I (3–4)		I (3–4)
Sphagnum recurvum	I (2–4)		I (2–4)
Juncus bulbosus/kochii	I (2)		I (2)
Carex hostiana	I (3–5)		I (3–5)
Sphagnum warnstorfii	I (1–4)		I (1–4)
Narthecium ossifragum	I (1–2)		I (1–2)
Pyrola rotundifolia	I (1–3)		I (1–3)
Dactylorhiza majalis purpurella	I (1–3)		I (1–3)
Drosera rotundifolia	I (1–3)		I (1–3)
Caltha palustris	II (1–3)	V (1–3)	III (1–3)
Cardamine pratensis	II (1–3)	V (1–3)	III (1–3)
Carex diandra	II (4–7)	IV (1–7)	III (1–7)
Calliergon giganteum	II (1–4)	IV (1–4)	III (1–4)
Valeriana dioica	II (1–4)	IV (1–4)	III (1–4)
Mentha aquatica	II (1–4)	IV (1–3)	III (1–4)
Epilobium palustre	I (1–3)	IV (1–4)	II (1–4)
Angelica sylvestris	II (1–3)	III (1–3)	II (1–3)
Lychnis flos-cuculi	II (1–3)	III (1–3)	II (1–3)
Filipendula ulmaria	I (1–3)	III (1–3)	II (1–3)
Galium uliginosum	I (1–3)	III (1–3)	II (1–3)
Calliergon cordifolium	I (1)	II (1–4)	II (1–4)
Ranunculus lingua	I (1–3)	II (1–3)	I (1–3)
Plagiomnium rostratum	I (1)	II (1–3)	I (1–3)
Plagiomnium affine	I (1)	II (1–3)	I (1–3)
Holcus lanatus	I (1)	II (1–3)	I (1–3)
Valeriana officinalis	I (1–3)	II (1–3)	I (1–3)

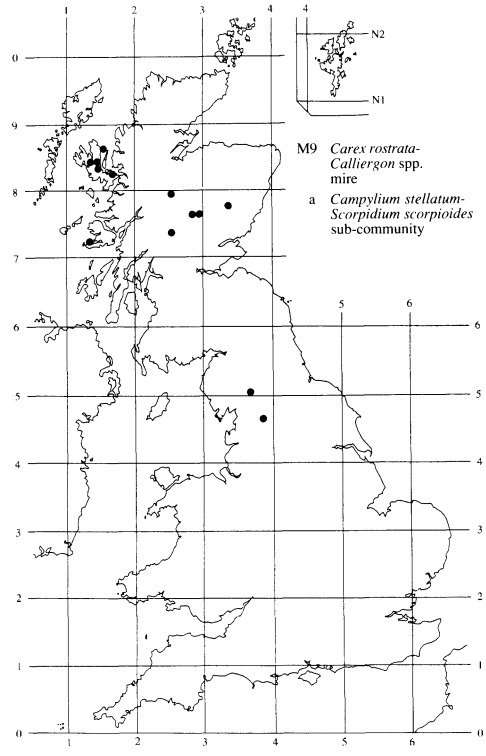
Ranunculus acris	I (1)	II (1–3)	I (1–3)
Dactylorhiza fuchsii	I (1)	II (1–3)	I (1–3)
Juncus acutiflorus	I (1–3)	II (1–3)	I (1–3)
Juncus subnodulosus		II (1–7)	I (1–7)
Scutellaria galericulata		I (1–3)	I (1–3)
Geum rivale		I (1–2)	I (1–2)
Lotus uliginosus		I (1–3)	I (1–3)
Lythrum salicaria		I (1)	I (1)
Equisetum fluviatile	III (1–4)	III (1–4)	III (1–4)
Equisetum palustre	III (1–4)	III (1–3)	III (1–4)
Carex nigra	III (1–4)	III (1–3)	III (1–4)
Carex panicea	III (1–5)	III (1–3)	III (1–5)
Succisa pratensis	III (2–3)	III (1–3)	III (1–3)
Molinia caerulea	III (1–5)	II (1–4)	III (1–5)
Pedicularis palustris	III (1–4)	II (1–4)	III (1–4)
Cirsium palustre	II (1–3)	III (1–3)	III (1–3)
Agrostis stolonifera	II (1–3)	III (1–3)	III (1–3)
Ranunculus flammula	II (1–4)	II (1–3)	II (1–4)
Carex lasiocarpa	II (4–5)	II (1–7)	II (1–7)
Juncus articulatus	II (1–4)	II (1–3)	II (1–4)
Phragmites australis	II (1–4)	II (1–4)	II (1–4)
Bryum pseudotriquetrum	II (1–3)	II (1–3)	II (1–3)
Salix cinerea sapling	II (1–3)	II (1–5)	II (1–5)
Climacium dendroides	I (1–3)	II (1–4)	I (1–4)
Hylocomium splendens	I (1–3)	II (1–4)	I (1–4)
Hydrocotyle vulgaris	I (1–3)	I (1–3)	I (1–3)
Eupatorium cannabinum	I (1–3)	I (1–3)	I (1–3)
Rhizomnium pseudopunctatum	I (1–4)	I (1–3)	I (1–4)
Salix repens	I (1–3)	I (1–4)	I (1–4)
Cratoneuron commutatum	I (1–2)	I (1–3)	I (1–3)
Carex paniculata	I (1–4)	I (1–4)	I (1–4)
Cratoneuron filicinum	I (1–3)	I (1–3)	I (1–3)
Betula pubescens sapling	I (1–3)	I (1–3)	I (1–3)
Carex appropinquata	I (1–5)	I (1–6)	I (1–6)
Ctenidium molluscum	I (1–4)	I (1)	I (1–4)
Plagiomnium elatum	I (1–3)	I (1–3)	I (1–3)
Carex flacca	I (1)	I (1)	I (1)
Vicia cracca	I (2)	I (1–3)	I (1–3)
Plagiomnium undulatum	I (1)	I (1–3)	I (1–3)
Schoenus nigricans	I (3)	I (4)	I (3–4)
Crepis paludosa	I (1)	I (1–3)	I (1–3)
Dactylorhiza incarnata	I (1)	I (1–3)	I (1–3)
Cladium mariscus	I (4–5)	I (1–4)	I (1–5)
Parnassia palustris	I (1–3)	I (1)	I (1–3)
Number of samples	16	24	40
Number of species/sample	23 (16–33)	27 (12–35)	25 (12–35)

a *Campylium stellatum-Scorpidium scorpioides* sub-community
b *Carex diandra-Calliergon giganteum* sub-community
9 *Carex rostrata-Calliergon* spp. mire (total)

https://doi.org/10.1017/9780521391658.013 Published online by Cambridge University Press







https://doi.org/10.1017/9780521391658.013 Published online by Cambridge University Press