BOTANICAL COMPOSITION AND CONSERVATION VALUE OF *CYNOSURUS CRISTATUS–CALTHA PALUSTRIS* GRASSLAND AT WEST SEDGEMOOR

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SUMMARY

A botanical survey of West Sedgemoor, on the Somerset Levels and Moors, was carried out for the RSPB and English Nature between June and August 1996. Results indicate that at that time the site supported 249ha of wet meadow grassland referable or closely related to MG8, the *Cynosurus cristatus–Caltha palustris* grassland of the National Vegetation Classification (NVC), which appears to represent at least one-quarter of the total area of this vegetation type in England and Wales. However, the botanical composition of MG8 at West Sedgemoor deviates considerably from that of the published tables. Some stands are floristically close to the *Agrostis stolonifera–Carex* spp. community recently described from Southlake and King's Sedgemoor, but there are extensive areas that are more easily accommodated within the newly delimited '*Carex* spp. unit' of MG8. Details of the floristic composition of the vegetation are presented, and the distribution of the various types of MG8 at West Sedgemoor is discussed in relation to agricultural and hydrological management of the site.

KEYWORDS: Somerset Levels and Moors, National Vegetation Classification, Calthion Alliance, Flood-Pasture, Wet grassland

INTRODUCTION

A National Vegetation Classification (NVC) survey of West Sedgemoor, conducted in 1996 (Prosser and Wallace 1996), identified approximately 380ha of wet meadow vegetation as belonging to the *Calthion palustris* alliance, within the *Molinio–Arrhenatheretea* (Tüxen 1937). Of this, 249ha were assigned to various forms of *Cynosurus cristatus–Caltha palustris* grassland (NVC community code-number MG8; Rodwell 1992). To put this in context, it is worth noting that Jefferson and Robertson (1996) estimated <500ha of MG8 grassland remaining in England and Wales, while Blackstock *et al.* (1999), in their review of surveys conducted in England and Wales between 1978 and 1996, identified 234ha of 'mainstream' MG8, plus an additional 145ha of intermediate vegetation that showed clear affinities with MG8. Assuming a survey

coverage of 25–50% of potential sites, they estimated that the total area of MG8 in England and Wales probably lies in the range 500–1000ha.

Jefferson and Robertson (1996) included the Somerset Levels in their list of National Nature Reserves having 'a significant unimproved lowland grassland component', although West Sedgemoor was not identified individually in their table of Nature Conservation Review sites having grassland as a principal interest. However it is clear that this site, with 249ha of MG8 and related *Calthion* vegetation, possibly holds more than one-quarter of the current area of *Cynosurus cristatus–Caltha palustris* grassland in England and Wales, making it of national importance for the conservation of this vegetation type.

The treatment of the MG8 flood pasture vegetation was inadequately covered in the NVC mesotrophic grassland descriptions (Rodwell 1992) and in the light of recent surveys (e.g. Cox and Leach 1996; Prosser and Wallace 1996) Rodwell *et al.* (2000) considered that a revision of MG8 and MG8-related vegetation in the NVC was necessary. Gowing *et al.* (2002) recognised three new expressions of MG8. Two of these are probably distinct at least at sub-community level – an '*Agrostis stolonifera* unit' (not found on West Sedgemoor), characteristic of mineral soils, and a '*Carex* spp. unit', the form of the grassland typically occurring on the peaty soils of the Somerset Levels. Their third unit (*Agrostis–Carex* grassland) appears to have affinities with the '*Agrostis stolonifera–Carex* spp. grassland' described by Cox and Leach (1996), and is probably best viewed as falling within the more broadly defined '*Carex nigra–Agrostis stolonifera–Senecio aquaticus* unit' within the *Calthion* (Rodwell *et al.* 2000). These three vegetation units appear to be separated, to varying degrees, along a hydrological gradient, with the '*Agrostis–Carex* unit' occupying those sites most prone to spring and summer flooding. More detailed analyses of the general hydrological regimes of the different units are given in Gowing *et al.* (2002).

COMPARISON OF THE BOTANICAL COMPOSITION OF THE UNITS OF THE *CALTHION PALUSTRIS* AT WEST SEDGEMOOR IN 1996

The *Calthion* vegetation in this paper refers to the narrower continental definition of the alliance which, in the British context, encompasses the NVC communities MG8 and M22. MG9 and MG10, also placed within the *Calthion* alliance in the NVC, are of rather different character and are not considered here.

The 'noda' defined during the 1996 NVC survey of West Sedgemoor have been compared with the newly defined units of the *Calthion palustris* (Cox and Leach 1996; Gowing *et al.* 2002) with the aid of the computer program SIN (Prosser 1990). The results show that in 1996 West Sedgemoor supported 150ha of the '*Carex* spp.' expression of MG8 (including two 'sub-units' – see below), 25ha of the '*Carex–Agrostis–Senecio*' grassland, and a further 74ha of vegetation apparently intermediate in character between the two.

Table 1 presents summary floristic data for the four units of MG8-related vegetation at West Sedgemoor, along with the NVC data for MG8 (taken from Rodwell 1992) and the '*Agrostis–Carex grassland*' described by Gowing *et al.* (2002), the latter forming part of the *Carex spp–Agrostis stolonifera–Senecio aquaticus* grassland of Rodwell *et al.* (2000). The distinguishing features of the various units/sub-units on West Sedgemoor are described in the following sections.

Carex Spp. Unit

This unit is characterised by constant *Cynosurus cristatus, Holcus lanatus, Ranunculus acris* and *Anthoxanthum odoratum*, and with *Filipendula ulmaria, Agrostis stolonifera,* and *Cardamine pratensis* all over-represented in comparison with the MG8 table in the NVC

	1 MG8 NVC	2 Carex (var I)		3 Carex (var ii)		4 transitional		5 Cx-Ag -Sn		6 Agrostis-Carex Gowing
Cynosurus cristatus	V	IV	(1- 25)	V	(1- 18)	IV	(1- 20)	I	(1)	II
Ranunculus acris	V	IV	(1- 12)	IV	(1- 8)	III	(1- 8)	I	(1)	II
Anthoxanthum odoratum	IV	V	(1- 22)	V	(1- 20)	V	(1- 20)	II	(1- 6)	III
Holcus lanatus	V	V	(1- 12)	V	(1- 20)	IV	(1- 12)	I	(1- 4)	I
Filipendula ulmaria	II	V	(1- 45)	IV	(1- 40)	IV	(1- 20)	II	(1- 4)	I
Agrostis stolonifera	II	IV	(1- 40)	V	(2- 50)	V	(1- 80)	V	(3- 55)	V
Cardamine pratensis	II	IV	(1- 2)	IV	(1- 2)	V	(1- 3)	IV	(1- 5)	V
Plantago lanceolata	III	V	(1- 20)	IV	(1- 18)	III	(1- 15)	I	(1- 5)	I
Cirsium dissectum		V	(1- 45)	II	(1- 8)	III	(1- 18)	II	(1- 6)	I
Carex panicea	III	V	(1- 30)	I	(1)	II	(1- 15)	II	(1- 8)	I
Agrostis canina		IV	(1- 55)	I	(1- 18)	I	(1- 5)			I
Thalictrum flavum		IV	(1- 65)	II	(1- 18)	II	(1- 12)	II	(1- 8)	I
Leontodon hispidus	II	IV	(1- 40)	I	(1- 22)	I	(1- 4)			I
Centaurea nigra	I	III	(1- 20)	II	(1- 18)	I	(1- 3)	I	(1)	I
Festuca rubra	V	III	(1- 30)	I	(1- 18)	I	(1)	I	(2)	I
Rhinanthus minor	II	III	(1- 15)	II	(1- 15)	I	(1- 4)	I	(1)	I
Lolium perenne	II	I	(1- 4)	V	(1- 30)	II	(1- 20)			II
Trifolium pratense	III	II	(1- 12)	IV	(1- 2)	I	(1- 5)			I
Trifolium repens	V	II	(1- 8)	IV	(1- 10)	III	(1- 6)	I	(1)	III
Leontodon autumnalis	IV	II	(1- 4)	IV	(1- 12)	III	(1- 6)	III	(1- 6)	II
Taraxacum sect. vulgaria	II	I	(1- 2)	IV	(1- 4)	I	(1)			II
Cerastium fontanum	IV	I	(1- 1)	III	(1- 2)					I
Vicia cracca		II	(1- 5)	III	(1- 18)	I	(1- 3)	I	(1)	I
Danthonia decumbens		I	(1- 12)	I	(1- 2)					
Festuca pratensis	II	III	(1- 15)	IV	(1- 25)	V	(1- 20)	III	(1- 15)	I
Rumex acetosa	IV	III	(1- 5)	V	(1- 6)	IV	(1- 5)	I	(1)	II
Ranunculus repens	III	III	(1- 28)	V	(1- 28)	V	(1- 40)	III	(1- 20)	V
Poa trivialis	IV	II	(1- 10)	IV	(1- 30)	V	(1- 50)	II	(1- 12)	IV
Caltha palustris	V	III	(1- 28)	II	(1- 10)	V	(1- 35)	IV	(1- 22)	I
Persicaria amphibia		II	(1- 4)	IV	(1- 10)	V	(1- 15)	V	(1- 60)	V
Senecio aquaticus	I	III	(1- 8)	II	(1- 2)	IV	(1- 10)	IV	(1- 15)	III
Eleocharis palustris	II	I	(1)	I	(1- 10)	II	(1- 35)	V	(1- 45)	II
Glyceria fluitans		I		II	(1- 15)	II	(1- 20)	III	(1- 55)	III
Myosotis laxa caespitosa	I	I	(1- 10)	I	(1- 2)	II	(1- 6)	III	(1- 220	I
Galium palustre		II	(1- 10)	I	(1)	II	(1- 5)	III	(1- 8)	I
Carex nigra		III	(1- 45)	I	(1- 10)	III	(1- 25)	III	(3- 60)	III
Ranunculus flammula		IV	(1- 8)	I	(1- 4)	III	(1- 5)	IV	(1- 10)	II
Calliergon cuspidatum	II	III	(1- 40)	I	(1- 6)	I	(1- 25)	II	(1- 30)	III
Carex disticha	II	II	(1- 25)	I	(3- 28)	II	(1- 80)	II	(1- 95)	II
Hydrocotyle vulgaris		III	(1- 35)			I	(1- 18)	II	(1- 30)	
Lychnis flos-cuculi	II	II	(1- 2)	II	(1- 2)	II	(1)			I
Juncus conglomeratus		II	(1- 8)	I	(1)	I	(1- 3)	I	(1)	
Carex viridula ssp oedocarp	I	II	(1- 20)			I	(6)	I	(1- 2)	
Deschampsia cespitosa		II	(1- 12)	I	(1- 18)	II	(1- 18)	I	(1- 10)	II
Phleum pratense		II	(1- 12)	III	(1- 20)	III	(1- 15)	II	(1- 2)	II
Prunella vulgaris		II	(1- 12)	II	(1- 5)	I	(1)			
Juncus effusus	I	II	(1- 20)	I	(1- 8)	II	(1- 18)	II	(1- 10)	I
Dactylorhiza praetermissa		II	(1- 2)	I	(1)	I	(1)			
Festuca arundinacea		II	(1- 22)	I	(2)	I	(1- 5)			
Carex riparia		I	(1- 18)	I	(1- 20)	I	(1- 70)	I	(20- 45)	I
Brachythecium rutabulum		I	(1- 10)	I	(1- 80)	I	(1- 20)	I	(2- 5)	I
Triglochin palustre		I	(1- 2)	I	(1)	I	(1- 2)	I	(1- 2)	
Bromus racemosus		I	(1- 3)	II	(1- 15)	I	(1- 2)			I
Bromus commutatus		I	(1- 10)	I	(1- 3)	I	(1- 2)	I	(1)	
Mentha aquatica		I	(1- 2)					I	(1- 20)	
Carex hirta		I	(1- 5)	I	(4- 18)	I	(1- 15)	II	(1- 10)	I
Juncus articulatus	II	I	(1- 8)			I	(1- 2)	II	(1- 40)	II
Iris pseudacorus		I	(1)			I	(1)	I	(1- 4)	I
Potentilla anserina		I	(1- 8)	I	(1- 12)			I	(2- 3)	I
Phalaris arundinacea		I	(1)	I	(1- 5)	I	(1- 8)	II	(1- 20)	I

Table 1 Synoptic table for units of the calthion at West Sedgemoor in 1996: continues over

	MG8 NVC	Carex (var I)		Carex (var ii)		transitional		Cx-Ag -Sn		Agrostis-Carex Gowing
Alopecurus pratensis		I	(1)	II	(1- 15)	I	(1- 18)			III
Eurhynchium praelongum	I	I	(2)	I	(1- 13)	I	(4- 10)			I
Alopecurus geniculatus				I	(1- 3)	I	(1- 25)	I	(1- 15)	III
Glyceria maxima				I	(1- 3)	I	(2- 20)	I	(6- 10)	I
Glyceria declinata	I					II	(1- 20)	II	(2- 15)	
Oenanthe fistulosa						I	(1- 2)	II	(1- 2)	II
Rumex crispus						I	(1- 2)	I	(1- 2)	I
Number of samples	15	101		56		77		30		347
Mean species/sample	26	23.4		21.9		21.4		17.4		

Table 1 (cont) Synoptic table for units of the calthion at West Sedgemoor in 1996. This tabulates the constancy data for West Sedgemoor *Calthion* noda (columns 2–5) against the NVC MG8 and newly defined *Carex–Agrostis–Senecio aquaticus* grassland communities. Column 1: NVC constancy classes for MG8 (Rodwell 1992); Column 2: MG8 *Carex unit, Leontodon hispidus–Agrostis canina* sub-unit; Column 3: MG8 *Carex unit, Lolium perenne–Trifolium pratense* sub-unit; Column 4: Stands transitional between 3 and 5; Column 5: *Carex–Agrostis– Senecio aquaticus* vegetation; Column 6: *Agrostis–Carex* grassland (Gowing *et al.* 2002). For the West Sedgemoor noda each species is represented by a constancy class, minimum, and maximum cover value (using visual estimates of % cover in a 2 x 2m quadrat). Constancy classes follow the normal NVC convention and refer to the frequency of occurrence of a species in the stands sampled: thus Constancy I = 1–20%, II = 21–40%, III = 41–60%, IV = 61–80% and V = 81–100%. Species present at <5% across all noda have been excluded to aid clarity.

(Rodwell 1992). Two variants of this unit are distinguishable on West Sedgemoor. First, a '*Leontodon hispidus–Agrostis canina* sub-unit', which occurs as a low-growing sedge lawn and has *Cirsium dissectum, Thalictrum flavum, Carex panicea, Leontodon hispidus, Agrostis canina, Rhinanthus minor, Hydrocotyle vulgaris,* and *Festuca rubra* as preferential species. Second, a '*Lolium perenne–Trifolium pratense* sub-unit', a bulkier sward having the appearance of a flower-rich hay meadow in mid-June. Less prone to flooding and possibly subject to past fertilizer applications, this latter sub-unit is distinguished by having *Lolium perenne, Trifolium pratense, Rumex acetosa, Trifolium repens, Taraxacum officinalis, Leontodon autumnalis, Centaurea nigra,* and *Alopecurus pratensis* as preferentials. Of the two sub-units, the '*Lolium-Trifolium* sub-unit' is closer in its overall floristic composition to MG8 as defined in the NVC.

Carex–Agrostis Stolonifera–Senecio Aquaticus Unit

This unit has a generally more species-poor vegetation than the '*Carex* spp. unit' and at West Sedgemoor the stands are characterised by the high frequency, and cover, of *Eleocharis palustris*, with *Glyceria fluitans, Galium palustre,* and *Myosotis laxa* also preferential. Some stands are further characterised by dense cover of *Carex disticha*.

As defined here, the West Sedgemoor stands of this unit differ from the '*Agrostis-Carex* spp. grassland' at Southlake (Cox and Leach 1995) in the lower frequency of small Carices, *Ranunculus acris, Alopecurus geniculatus,* and *Oenanthe fistulosa*, and higher frequency of *Poa trivialis, Caltha palustris, Eleocharis palustris, Myosotis laxa,* and *Galium palustre.* The West Sedgemoor stands appear to be fully encompassed by the more broadly defined '*Agrostis-Carex* unit' of Gowing *et al.* (2002), which was derived from over 300 samples, mainly from peat sites in Somerset.

Transitional Stands

As implied, these stands appear to be intermediate in their floristic composition between the bulkier, grass-dominated stands, of the '*Lolium perenne–Trifolium pratense* sub-unit' of the

'*Carex* spp.' unit and the '*Carex–Agrostis–Senecio* unit'. They seem to occupy damper situations than the '*Carex* spp.' stands, have more abundant *Caltha*, which is very evident in the spring, but by mid-June support a bulky, often rather species-poor, sward. There is a suggestion that fields supporting this kind of intermediate vegetation may have been in receipt of higher fertilizer applications in the past.

DISTRIBUTION AND MANAGEMENT

West Sedgemoor is a ditch-drained system on peat where fields are traditionally cut for hay and then aftermath-grazed. Notified as a SSSI in 1982/83, much of the area was entered into the Somerset Levels and Moors Environmentally Sensitive Area with a prescribed management regime involving hay cutting between 1 July and 15 August, followed by aftermath grazing. An additional supplement was introduced in 1992 for hydrological management aimed at maintaining higher spring/summer water tables. In 1995 the RSPB owned 520ha, of which 45–60% were cut each year for hay, with aftermath grazing not exceeding 1.1 livestock units days/ha. Of this, 290ha were hydrologically managed to achieve a range of winter and spring flooding regimes (Evans *et al.* 1995).

A snapshot of the distribution of flood-water across the moor was obtained from flood maps produced by the RSPB in March 1995. In 1996 the various vegetation units appeared to occupy areas of different flooding frequency: thus, while mid-March flooding was recorded at 26% of quadrat locations in the MG8 '*Carex* spp. unit' 67% of samples in the '*Carex spp–Agrostis–Senecio* unit' were found to have been flooded at that time. As expected, the intermediate or 'transitional' unit also had an intermediate level of flooding, with 49% of quadrat locations flooded in mid-March 1995 (Prosser and Wallace 1996, fig. 8).

The area of greatest flooding, south of the middle drain, supported the '*Leontodon–Agrostis* sub-unit', though the extent of flooding here favoured development of other mire and swamp associations, such that many fields supported <50% MG8 vegetation, which tended to be concentrated around the drier 'rims' of the fields. In contrast, areas of extensive flooding towards the west of the moor supported stands of the '*Carex–Agrostis–Senecio* unit' and 'transitional' vegetation.

The '*Lolium–Trifolium* sub-unit' of the '*Carex* spp. unit' appeared to be largely restricted to the periphery of the basin, often beyond the limits of spring flooding.

North of the Middle Drain, in the centre of the site – where MG8 is the principal vegetation unit of a large block of fields – the '*Leontodon–Agrostis* sub-unit' predominated in the areas closest to the Middle Drain. Scattered fields experiencing full flooding supported stands of the 'transitional' unit, which also became more prominent to the east of this area and along the North Drove. The prevalence of so much vegetation intermediate in its composition between the *Lolium*-rich expression of the '*Carex* spp. unit' and the '*Carex–Agrostis–Senecio* unit' in areas subject to partial late spring flooding suggested a shift in species composition resulting from hydrological changes on a part of the site where agricultural intensification might have been greater in the 1970s.

Monitoring between 1993 and 2001 indicated that the higher than average rainfall throughout the late 1990s resulted in shifts from the '*Carex* spp. unit' to the '*Carex–Agrostis–Senecio* unit', with these changes being most evident in fields north of the Middle Drain which had supported a more grass-dominated sward in 1993 (Gowing *et al.* 2002). It was recognised by 1995 that late flooding was detrimental to the survival of MG8 vegetation (Evans *et al.* 1995) and Raised Water Level Areas combined with the higher than average annual rainfall since 1994 may account for the development of such extensive areas of intermediate or 'transitional' vegetation to the north of the middle drain.

Botanical monitoring is ongoing, with 16 fields surveyed in detail between 1993 and 1995 being resurveyed in 2001. Changes in the composition of the vegetation suggest a general increase in species tolerant of wet soil conditions and a decline in those species more normally associated with only moist soils. The RSPB is producing hydrological models to help understand the causes of these changes and the significance of the higher than average rainfall in recent years which happened to coincide with changes in ditch management as part of the raised water-level management scheme. Given the national importance of the MG8 at West Sedgemoor, continued monitoring is desirable to keep track of future changes in the vegetation, in particular to ascertain whether the 'drier' elements of the flora characteristic of the '*Carex* spp. unit' of MG8 are able to reassert themselves in the event of lower rainfall and less prolonged spring flooding.

The RSPB is introducing a novel management programme in an attempt to maintain the high summer water tables required by many breeding waders whilst avoiding surface flooding during the hay meadow growing season, considered to be detrimental to the quality of MG8 grassland. A milling mole plough is being used to create a sub-irrigation system which should reduce peat wastage whilst maintaining high summer water tables (RSPB 2003). It is clear that further botanical monitoring will be required to assess the effectiveness of this system.

ACKNOWLEDGEMENTS

This work was carried out by the authors under contract to RSPB and English Nature, and we thank the farmers for allowing us access to their land. We also wish to thank Simon Leach for finally persuading us to present our findings to a wider audience, and for his comments on the manuscript.

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Hilary Wallace and Mike Prosser are freelance botanists who have been carrying out vegetation surveys using the National Vegetation Classification since 1986, before it was even published! They have also been involved in grassland monitoring programmes in Somerset for the RSPB, English Nature and Silsoe College, Bedfordshire since the early 1990s and more recently on other grassland sites in lowland England with Cranfield University under DEFRA-funded projects. Outside the hay meadow season their work focuses on issues relating to the plant community development of coniferous plantations in Scotland, lowland heathlands and saltmarshes in Wales.

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