Calcareous, groundwater-fed fens in England: Distribution, Ecology and Conservation

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Introduction

Calcareous, groundwater-fed fens are some of the most botanically diverse habitats in England, supporting several rare and threatened species, often within a very small area (individual stands range from a few square metres up to a few hectares). These habitats are also important for other wildlife, particularly invertebrates (JNCC, 2007).

These wetlands typically occur in valleyhead and hillslope situations and are mainly irrigated by groundwater discharge from springs and seepages, with the water table close to the surface all year. The underlying bedrock is usually the source of the irrigating water, although some sites are irrigated by groundwater derived from calcareous superficial deposits.

Distinctive types of vegetation associated with calcareous groundwater outflow in England are represented by several National Vegetation Classification (NVC) plant communities (Rodwell, 1991).

The relationship between vegetation and environmental variables, including water supply, from sites throughout England and Wales has been investigated in the Wetland Framework (Wheeler, Shaw & Tanner 2009) .

Key features of the main plant communities of calcareous, base-rich fens are summarised below. Several of these plant communities are recognised as habitats of International importance and are classified as EU Habitats Directive Annex 1 habitats.





Left to right:
'Brown mosses' including *Scorpidium cossonii*
Gymnadenia conopsea with *Drosera longifolia*
Dactylorhiza incarnata
Liparis loselii
Dactylorhiza traunsteinerioides
Nomenclature follows Stace, 2010 and Smith, 2004.

Vegetation types and habitat characteristics

Based on Rodwell 1991; Wheeler, Shaw & Tanner 2009; Wheeler 1988

Main NVC plant communities

M10 *Carex dioica - Pinguicula vulgaris* mire*
Widespread in the uplands, particularly in North-Western England, where it often occurs in mosaics with unimproved grassland and heathland; a few isolated patches in lowland England.
Low-growing vegetation with an open sward, typically dominated by small sedges, with *Schoenus nigricans* at some sites. Extensive bryophyte component and wide range of associated herbs including many with a particularly northern distribution eg. *Carex dioica* and *Primula farinosa*.
Overlaps with M13, but generally more species-poor, often more open and lower growing. Tends to occur in locations of slightly lower fertility and base-status than M13. Some more acidic versions occur. Some examples occur within acidic peaty habitats, and soakways. M10 can be transitional to several different vegetation types.
Shaw & Wheeler (1991) found an increase in base-richness was associated with an increase in the number of rare species recorded, but there were fewer rare species in the most fertile stands.

Left: Carex dioica

Below: Primula farinosa

Plant diversity (121 stands)	Total species	Mean (range) species 4m^{-2}
All species	264	32 (10 – 55)
Principal mire species	136	23.5 (10 –37)
Rare mire species	32	2.1 (0 – 8)

Water Supply
•Occurs on soligenous slopes, fed by groundwater from semi-confined or un-confined bedrock or drift aquifers, either directly – as seepages; or by downslope flow of groundwater over an (often superficial) aquitard – as flushes. Some examples have marl or tufa precipitation.
•Mean pH 6.7 ; range 4.9 – 7.7

Schoenus nigricans with Dactylorhiza traunsteinerioides

M13 *Schoenus nigricans - Juncus subnodulosus* mire*
Generally occurs in lowland England, mainly in East Anglia, with hotspots in Oxfordshire and North Yorkshire. Similar to M10, but usually structurally more complex. *Schoenus nigricans* and *Juncus subnodulosus* usually dominate, with a rich range of associated species. The *Schoenus - Juncus* sward is generally of moderate height, but in most sites there are low-growing surfaces amongst the dominants and there can be small runnels or pools. These lower-growing patches are typically the most botanically diverse areas and include an extensive bryophyte component. M13 supports several rare species.

Plant diversity (117 stands)	Total species	Mean (range) species 4m^{-2}
All species	367	30.9 (7 – 65)
Principal mire species	154	22.2 (3 – 53)
Rare mire species	39	2.3 (0 – 13)

Epipactis palustris

Water Supply
•Strongly soligenous, often with visible springs. Typically fed by lateral or vertical groundwater discharge from a semi-confined or unconfined aquifer. Calcite precipitation often visible.
• Irrigating waters are typically base-rich/high pH (mean pH 7.0 ; range 5.7 – 8.3).

Related NVC plant communities

M11 *Carex demissa - Saxifraga aizoides* mire*
Upland vegetation closely related to M10. Usually found in open, stony runnels beneath spring lines on mountain sides. Often occurs in association with M10.
M9/M22* *Carex rostrata - Calliergon cuspidatum* mire transitional to **M22 *Juncus subnodulosus - Cirsium palustre*** fen meadow.
Distinctive vegetation often with *Carex diandra*, *C. lepidocarpa* and *C. rostrata* as well as *Juncus subnodulosus* over extensive 'brown' moss lawns.
Occurs in more stagnant situations than M10 and M13.

Fen Meadow:
M10 and M13 often inter-grade with fen meadow communities, M22 and M24.
M22 *Juncus subnodulosus - Cirsium palustre* fen meadow (pictured left)
M22 often occurs in base-rich fens and it is a very variable plant community: stands can be strikingly species-rich or species-poor. It is the most widespread community of base-rich fens in England, and generally occurs in more fertile conditions than M10 and M13.

M24 *Molinia caerulea - Cirsium dissectum* fen meadow** (pictured left)
M13 and M24 often occur together as complex mosaics of tussocks and hollows. M24 frequently develops from M13 as a consequence of drying (resulting from drainage, or natural seral processes), or it replaces M13 spatially along a water table gradient.
M22 and M24 are associated with areas of permanent and intermittent groundwater seepage.

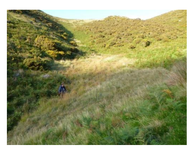
M37 *Cratoneuron commutatum - Festuca rubra* spring & M38 *Cratoneuron commutatum - Carex nigra* spring * (pictured left)
Low-growing spring-head vegetation dominated by the golden brown moss *Cratoneuron commutatum* (now split into P*alustriella commutata* and *P. falcata* –inset picture). Very variable range of associated species. In the most calcareous locations occurs with M10, M11 and M13; but can also occur on its own. Often, but not always, associated with precipitation of tufa, sometimes forming impressive mounds .

EC Habitats Directive Annex 1 habitats:

*H7230 Alkaline Fen
** Most examples of M24 are classed as H6410 Molinia Meadows, but are regarded as H7230 Alkaline Fen where M24 overlaps into M13
*** H7220 Petrifying Springs

Natural England National Habitat Inventories

• In 2012 Natural England commissioned a project to create a GIS Inventory capturing the location and extent of vegetation qualifying as Annex 1 habitat 'Alkaline Fen' in England.
• This was a desk-based project collating information from a wide variety of sources.
• Approximately 3000 records (points and polygons) were captured from existing datasets. For many sites the most recent available survey data were pre-1990.
• Records will be added and updated as new survey datasets become available.
• The GIS Inventory will allow NE to plan survey, monitoring and management of these habitats.
Figure 1 shows the known general distribution of the NVC plant communities M10 and M13 in relation to bedrock grouped into hydrogeological types .



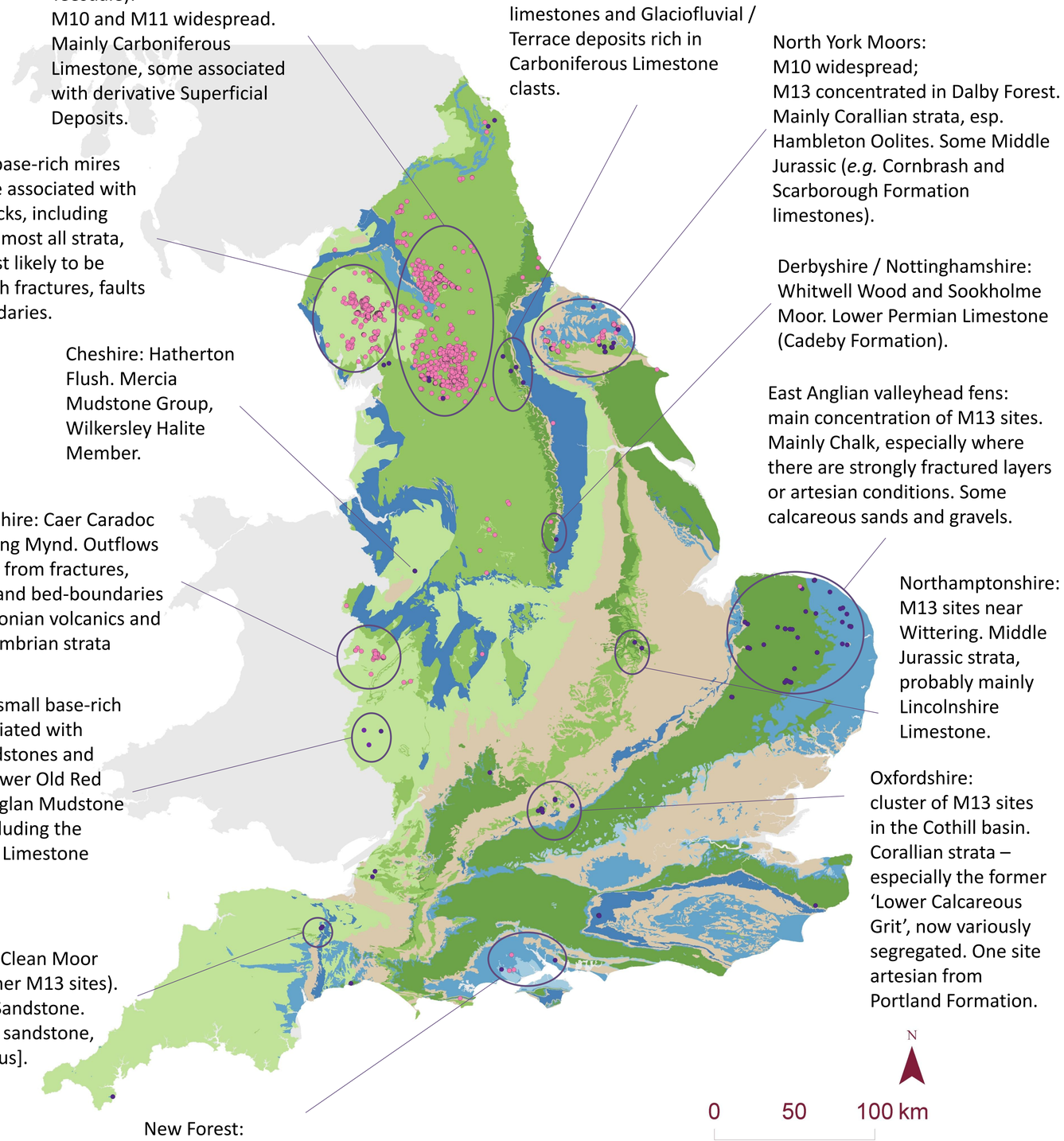

Left: 'Alkaline Fen' in Shropshire (L) & in the French Alps (R)

Right: tufa formation in North York Moors (L) and in Switzerland (R)


Conservation issues

• Size - often small, many stands are only a few square metres in extent
• Sites in the lowlands are often isolated, and vulnerable to changes in management
• Management – mowing and grazing is important in maintaining low growing vegetation
• Groundwater abstraction – can cause dehydration and loss of characteristic and rare species, particularly bryophytes
• Nutrient enrichment – from surface water, groundwater and atmospheric pollution; lowland sites are particularly vulnerable because surrounding land use is generally more intensive; increase in fertility is usually associated with decrease in species-richness and loss of rare species (Shaw & Wheeler, 1991; Fen Management Handbook, 2010).

Figure 1. Distribution of stands of M10 and M13 in England in relation to bedrock



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www.jncc.gov.uk (Annex 1 habitats, Annex 2 species; BAP habitats and BAP species; NVC)
www.naturalengland.org.uk and www.natureonthemap.naturalengland.org.uk (Habitat inventories; protected sites)

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