Norfolk Vanguard Offshore Wind Farm

Appendix 22.7

Botanical Survey Report

Environmental Statement

Volume 3 - Appendices

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Environmental Impact Assessment
Environmental Statement

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For and on behalf of Norfolk Vanguard Limited

Approved by: Ruari Lean, Rebecca Sherwood

Signed: [redacted]

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Norfolk Vanguard
Botanical survey

Report prepared by Norfolk Wildlife Services Ltd.
on behalf of Royal HaskoningDHV, October 2017

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2. Executive Summary

2.1. Following consultation on The Extended Phase 1 Habitat Survey (Royal HaskoningDHV, 2017a), a detailed survey of the River Wensum and its floodplain were recommended to be carried out to understand any potential effects of horizontal directional drilling on the designated and notifiable features of River Wensum Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI).

2.2. The survey had four aims:

1. To identify the National Vegetation Classification (NVC) communities within the River Wensum SAC and SSSI.
2. To note if the following plants are growing within the River Wensum or grazing marsh ditches:
    - pond water-crowfoot *Ranunculus peltatus;*
    - stream water-crowfoot *Ranunculus penicillatus ssp. pseudofluitans;*
    - river water-crowfoot *Ranunculus fluitans.*
3. To identify the NVC communities within the semi-improved grassland found adjacent to the River Wensum.
4. To look for presence of calcareous groundwater springs/seepage within the semi-improved grassland.

2.3. Methodologies were developed using guidance documents from Rodwell (2006) and Doarks and Leach (1990).

2.4. The semi-improved grassland adjacent to the River Wensum consisted of two main NVC communities, which were often transitional to each other:

- MG6 – *Lolium perenne-Cynosusus cristatus* grassland
- MG10 – *Holco-Juncetum effusi* rush pasture

2.5. The River Wensum consisted of two main NVC communities:

- A8a - *Nuphar lutea* community, “species-poor” sub community (aquatic zone)
- S5 - *Glycerietum maximae* swamp, *Alisma plantago-aquatica-Sparganium erectum* sub community (marginal edge)

2.6. Communities associated with the ditches varied depending on location and land management. They were classified according to Doarks and Leach (1990) as being:

- Aquatic End Group A5b – *Lemna minor-Lemna trisulca*-filamentous algae
- Aquatic End Group A6 - *Callitriche stagnalis*/*platycarpa*
- Aquatic End Group A7b - *Potamogenton pectinatus-Myriophyllum spicatum*
- Emergent End Group E1 – *Carex riparia/acutiformis-Phragmities australis*
- Emergent End Group E2 – *Glyceria Maxima-Berula erecta*
- Emergent End Group E3 - *Juncus effusus*

2.7. None of the following species, associated with the River Wensum SAC habitat were recorded during the botanical survey within the River Wensum or its floodplain: *R. peltatus, R. penicillatus ssp. pseudofluitans or R. fluitans*

2.8. There was no evidence of calcareous ground water spring or seepage activity with the study area.

3. Introduction

3.1. Project background

3.1.1. Norfolk Vanguard is a proposed offshore wind farm being developed by Vattenfall Wind Power Limited (or an affiliate company), with a capacity of 1800MW, enough to power 1.3 million UK households. The offshore wind farm comprises two distinct areas, Norfolk Vanguard East (NV East) and Norfolk Vanguard West (NV West) and will be connected to the shore by offshore export cables installed within the provisional offshore cable corridor. The project will also require onshore infrastructure in order to connect the offshore wind farm to the National Grid at the existing National Grid substation at Necton, which in summary will comprise the following:

- Landfall;
- Cable relay station (if required);
- Underground cables;
- Onshore substation; and
- Extension to the existing Necton National Grid substation.

3.1.2. The location of the onshore electrical infrastructure is shown on Figure 1, Appendix A: of the Extended Phase 1 Habitat Survey Report (Royal HaskoningDHV, 2017a). Collectively the onshore electrical infrastructure is herein referred to as the 'onshore project area'.

3.1.3. During the development of the project, the onshore Scoping Area that was initially defined has been refined, to include three landfall options, associated cable relay search zones, as well as an onshore substation search zone in proximity to the Necton National Grid substation. A 200m wide cable corridor has been identified within which the buried cable will be located, and Horizontal Directional Drilling (HDD) zones and mobilisation zones have been identified along the cable corridor.

3.1.4. The surveys described within this report were designed and based on the onshore project area which was in use when the project Extended Phase 1 Habitat Survey was undertaken (February 2017). As the project design is further refined, these search zones will decrease in size, and the final options for the siting of infrastructure (i.e. one cable relay station, one landfall, one onshore substation) will be taken forward for the final Development Consent Order (DCO) application in June 2018.

3.2. Aim of report

3.2.1. As Norfolk Vanguard is a Nationally Significant Infrastructure Project (NSIP) an Environmental Impact Assessment (EIA) is required as part of a DCO application under the Planning Act 2008.

3.2.2. Norfolk Wildlife Services were appointed in late April 2017 to undertake additional ecological surveys to support this application as set out within the Survey Scope (Royal HaskoningDHV, 2017b).

3.2.3. The Extended Phase 1 Habitat Survey (Royal HaskoningDHV, 2017a) identified the potential for legally protected species located within the project area plus a 50m buffer surrounding the project area, and provided recommendations for further surveys required to characterise the ecological baseline for the project area.

3.3. Survey objective

3.3.1. The botanical survey had four objectives:

1. To identify the NVC communities within the River Wensum SAC and SSSI;

2. To note if the following plants are growing within the River Wensum or grazing marsh ditches:
    - pond water-crowfoot *R. peltatus;*
    - stream water-crowfoot *R. penicillatus ssp. pseudofluitans;*
    - river water-crowfoot *R. fluitans.*
3. To identify the NVC communities within the semi-improved grassland found adjacent to the River Wensum.
4. To look for presence of calcareous groundwater springs/seepage within the semi-improved grassland.

3.4. Survey scope

3.4.1. Development of survey scope

3.4.1.1. A Scoping Report for the EIA (Royal HaskoningDHV, 2016) was submitted to the Secretary of State on 3 October 2016 and the response in the form of a Scoping Opinion (PINS, 2016) published on 11 November 2016. That Scoping Opinion included the consultation responses of Natural England and Norfolk County Council.

3.4.1.2. An Extended Phase 1 Habitat Survey of the onshore project area was undertaken during February 2017 (Royal HaskoningDHV, 2017a). The Extended Phase 1 Habitat Survey identified the potential for legally protected species located within the project area plus a 50m buffer surrounding the project area, and provided recommendations for further surveys required to characterise the ecological baseline for the project area. These recommendations were issued to stakeholders on 17 March 2017 for comment, as part of the project Evidence Plan Process. Feedback was received from Norfolk County Council and Natural England on the 23 March 2017 and 3 April 2017 respectively that the methodologies were appropriate and acceptable.

3.4.1.3. A Survey Scope detailing the surveys required in order to deliver the Extended Phase 1 Habitat Survey Report recommendations (Royal HaskoningDHV, 2017b) was produced in March 2017. The Survey Scope (set out in Section 3.4.2) was used to tender for delivery of ecological surveys required for the project. Norfolk Wildlife Services based the methodology on this Survey Scope in consultation with the client.

3.4.2. Survey Scope

Survey area

3.4.2.1. Following consultation with Natural England conducted as part of the Evidence Plan Process, the need for a detailed assessment of the habitat associated with the River Wensum was recommended to ensure that the potential effects of proposed horizontal directional drilling under the River Wensum upon the quantifying features of the River Wensum SAC and the notified features of the River Wensum SSSI were fully understood. As a consequence a botanical survey will be undertaken to characterise the habitats of the semi-improved grassland found adjacent to the River Wensum during the field survey. This botanical survey will also involve a systematic search of the site in order to check the wet grassland habitats for the presence of springs and seepages, in order to characterise the water environment within the River Wensum floodplain.

3.4.2.2. The locations of the habitats scoped into the botanical survey are shown on Figure 1 (Appendix 1 of this report).

Methodology

3.4.2.3. The botanical survey will follow the methodology set out in *National Vegetation Classification: Users' handbook* (Rodwell, 2006). The survey will cover all semi- improved and wet grassland areas adjacent to the River Wensum within the survey area (as shown on Figure 1). Quadrat sampling will be used within delineated sub-communities, and those species found within each quadrat identified. An NVC communities map will be drawn up following the results of the survey, and the precise location of all notable species recorded.

The following aquatic plant species, for which the habitat is given its SAC status, will be given particular attention:

- pond water-crowfoot *Ranunculus peltatus*
- stream water-crowfoot *R. penicillatus ssp. pseudofluitans*
- river water-crowfoot *R. fluitans*.

3.4.2.4. The optimal surveying window for the botanical survey is between April and June.

3.4.2.5. The survey should be undertaken by experienced NVC surveyors, preferably members of the CIEEM. No species licences are required for this survey.

3.5. Scoping of survey locations

3.5.1. Natural England recommended the need for a detailed assessment of the habitat associated with the River Wensum to ensure that the potential effects of proposed horizontal directional drilling under the River Wensum upon the qualifying features of the River Wensum SAC and the notified features of the River Wensum SSSI were fully understood.

3.6. Conservation Status of the River Wensum SAC

3.6.1. The whole length of the River Wensum is a designated Site of Special Scientific Interest (1993) and Special Area of Conservation (2005). The site is listed under Annex I for habitat 3260 "Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation".

3.6.2. The River Wensum represents sub-type 1 in lowland eastern England. Although the river is extensively regulated by weirs, *Ranunculus* vegetation occurs sporadically throughout much of the river's length. Stream water-crowfoot *R. penicillatus*ssp. *pseudofluitans* is the dominant *Ranunculus* species but thread-leaved water-crowfoot *R. trichophyllus* and fan-leaved water-crowfoot *R. circinatus* also occur.

3.7. Presence of springs and seepages

3.7.1. Soligenous water movement through the soil discharging from rocks can be at a point (spring) or over a wide area (seepage). A pre-requisite for this type of groundwater discharge is an underlying or adjacent aquifer, such as the Cretaceaous chalk aquifer underlying the soils of the River Wensum.

3.7.2. Evidence of spring activity is usually characterised by surface wetness and/or a change in vegetation community within a site.

4. Methodology

4.1. Section 4.1 sets out the proposed survey protocol as agreed between Royal HaskoningDHV and Norfolk Wildlife Services prior to any field work commencing, and Section 4.2 sets out how the surveys were delivered in relation to the protocol and identifies any deviations or modifications that took place during the delivery phase.

4.1. Survey protocol

4.1.1. This Section details the proposed survey protocol as agreed between Royal HaskoningDHV and Norfolk Wildlife Services prior to any field work commencing.

Relevant guidance

4.1.2. The following guidance documents were used to inform development of the survey methodology:

- Rodwell, J.S. (2006) National Vegetation Classification: Users' handbook. JNCC
- Doarks, C., & Leach, S. J. (1990). A classification of grazing marsh dyke vegetation in Broadland. Nature Conservancy Council.

Methodology

4.1.3. Three different methodologies will be undertaken for different aspects of the Norfolk Vanguard botanical survey.

- An NVC survey of grassland within the wider floodplain (Rodwell 2006) including identification of any springs and seepages.
- For the Norfolk Vanguard River Wensum SAC/SSSI Survey, an adapted NVC river survey on a point-sampling basis, supplemented by visual examination.
- A vegetation survey of the ditches using the methodology of Doarks and Leach (1990).

4.1.4. The three methodologies are described below.

Grassland NVC survey

4.1.5. Sampling of the site will be undertaken in accordance with the approach set out in Rodwell (2006). An initial walkover will be conducted to identify the broad vegetation communities present within the site. Following this, sampling quadrats will be randomly selected within each broad vegetation community. A full species list will be noted for each quadrat, with species abundances quantified in accordance with the Domin scale and vegetation height will be recorded.

Table 1 : Domin cover values

Domin	Cover (%)
10	91-100
9	76-90
8	54-75
7	34-50
6	26-33
5	11-25
4	4-10
3	<4% (many individuals)
2	<4% (several individuals)

1	<4% (few individuals)

4.1.6. Any potential calcareous groundwater seepage/spring activity within the site will be noted.

4.1.7. A NVC community type will be attributed to the sampling locations. A map showing the NVC communities will be drawn up following the results of the survey, and the precise location of all notable species recorded.

4.1.8. Quadrat sampling will be used within delineated sub-communities, and those species found within each quadrat identified.

Analysis to NVC Communities

4.1.9. The NVC community type for each sampling location will be on Rodwell (2006) and surveyor experience from comparable sites with those identified communities. Floristic tables will be generated for each community type that summarises the abundance and constancy values of constituent species among the samples. Constancy values will be allocated as per the following table:

Table 2 : Constancy tables as defined in Rodwell (2006)

Constancy	Frequency (5%)	Description
I	1-20 (i.e. 1 stand in 5)	scarce
II	21-40	occasional
III	41-60	frequent
IV	61-80	constant
V	81-100	constant

4.1.10. Keys of British Plant Communities Volume 3: Grasslands and Montane Communities, British Plant Communities Volume 4: Aquatic communities, swamps and tall herb fen and British Plant Communities Volume 1: Woodlands and scrub will be used to assign NVC community types.

River Wensum SAC/SSSI Survey

4.1.11. The total length of the River Wensum survey reach (a distance of 360m) will be split into 10 equal parts, so sampling will occur approximately every 35m.

4.1.12. A canoe will be anchored in the approximate centre of the river at the identified sampling locations (Figure 2). Photographs will be taken and grid references noted at each sampling location.

4.1.13. A rope with a 3 headed grapnel will be thrown 5m south west and north east of each anchored sampling location. The grapnel will be allowed to sink to the river bed before being slowly pulled along the river bed and into the canoe.

4.1.14. At each sampling location any plants collected on the grapnel will be noted by the field surveyor and scored according to a percentage scale (0-100%).

4.1.15. A bathascope will be used at and between sampling locations to look through the water column at vegetation towards the river bed. A visual assessment will be made through the water column regarding species, abundances and vegetation height. Shallower vegetation will be incorporated within the sampling regime.

4.1.16. Particular attention will be paid to identify those species listed within the specification document.

4.1.17. The following aquatic plant species, associated with the River Wensum SAC habitat, will be given particular attention:

- pond water-crowfoot *R. peltatus .*
- stream water-crowfoot *R. penicillatus ssp. pseudofluitans .*
- river water-crowfoot *R. fluitans*.

4.1.18. An NVC community will be attributed to each of the sampling locations, based on a combination of the grapnel sampling and bathascope assessment.

4.1.19. An NVC community will be attributed to the marginal vegetation.

Ditch Survey

4.1.20. Four distinct ditch systems were identified within the River Wensum floodplain survey area and were labelled Ditch 1-4 (see Figure 3).

4.1.21. Within each ditch system, 20m sections will be chosen per ditch that appears to contain homogenous or representative vegetation for both aquatic and emergent communities. Photographs will be taken and grid references noted at each sampling location.

4.1.22. All species within the aquatic zone will be noted with abundances (quantified within DAFOR) and general notes about the ditch recorded. Local cover values will also be noted, where relevant. Emergent species are defined as those within the aquatic zone, which for most of the summer have the majority of their biomass above the water surface.

Table 3 : DAFOR and local cover values

DAFOR	Cover (%)	Local cover vales
Dominant (D)	70-100	A-LD
Abundant (A)	30-70	F-LD, FLA
Frequent (F)	10-30	O-LD, OLA
Occasional (O)	3-10	R-LD, R-LA, O-LF
Rare (R)	<3	R-LF, R-LO

4.1.23. The following aquatic plant species, associated with The River Wensum SAC habitat, will be given particular attention:

- pond water-crowfoot *R. peltatus*
- stream water-crowfoot *R. penicillatus ssp. pseudofluitans*
- river water-crowfoot *R. fluitans*

Analysis to Endgroups

4.1.24. Aquatic and emergent species for each sampling location will be attributed an End Group. Species and abundances will be hand sorted through the key in Doarks and Leach (1990) to identify an aquatic and emergent End Group for each sampling location. These groups are set out in the Tables below.

Table 4 : Aquatic vegetation communities, as defined in Doarks and Leach (1990)

Community	Binomial Names	Common names
A1	*Scirpus fluitans-Potamogeton natans*	Floating club rush-broad leaved pondweed

A2	*Potamogeton natans-Hottonia palustris-Myriophyllum verticillatum*	Broad leaved pondweed-Water violet-Whorled water milfoil
A3a	*Potamogeton natans*	Broad leaved pondweed
A3b	*Stratiotes aloides-Hydrocharis morsus-ranae*	Water soldier-Frogbit
A4	*Ceratophyllum demersum*	Rigid hornwort
A5a	*Elodea Canadensis-Ceratophyllum demersum*	Canadian pondweed-Rigid hornwort
A5b	*Lemna minor-Lemna trisulca*-Filamentous algae	Common duckweed-Ivy leaved duckweed-Filamentous algae
A6	*Callitriche stagnalis/platycarpa*	Common/Various leaved water starwort
A7a	Filamentous algae-*Enteromorpha*	Filamentous algae-Gutweed
A7b	Potamogeton pectinatus – Myriophyllum spicatum	Fennel pondweed-Spiked water milfoil

Table 5 : Emergent vegetation communities, as defined in Doarks and Leach (1990)

Community	**Binomial Names**	**Common names**
E1	*Carex riparia/acutiformis-Phragmities australis*	Greater/Lesser pond sedge-Common reed
E2	*Glyceria maxima-Berula erecta*	Reed canary grass/Lesser water parsnip
E3	*Juncus effusus*	Soft rush
E4	*Phragmities australis*	Common reed
E5	*Scirpus maritimus-Scirpus lacustris subsp, tabernaemontani-Eleocharis uniglumis*	Saltmarsh bulrush-Common club rush-Slender spike rush
E6	*Scirpus maritimus-Juncus gerardii*	Saltmarsh bulrush-Saltmarsh rush

Personnel

4.1.25. All surveys will be undertaken by suitably experienced NVC surveyors, who are either members of CIEEM or act according to its code of conduct.

Survey timing, equipment and weather conditions

4.1.26. Although the optimal surveying window for the botanical survey was identified by the ITT as being between April and June, given the survey required identification of sedges and rushes the optimal period is May to late July / early August.

Additional information

4.1.27. A permit to survey within The River Wensum SAC will be required from Natural England.

4.1.28. Any locally scarce species will be noted with reference to A Flora of Norfolk (Beckett and Bull, 1999).

4.1.29. Any nationally scarce species will be noted with reference to The Vascular Plant Red Data List for Great Britain (Cheffings and Farrell (Eds), 2005).

4.2. Survey delivery

4.2.1. This Section details how the surveys were delivered in relation to the agreed protocol, identifies any deviations or modifications that took place during the delivery phase and highlights survey limitations.

4.2.1. Survey methodology as delivered

Access to survey sites

4.2.1.1. Access permission to the northern half of the River Wensum was not granted.

4.2.1.2. There were no other access restrictions.

Survey effort

4.2.1.3. There appeared to be two distinct grassland NVC community types identified during the walkover of the site. 14 quadrats of 2m x 2m, specified in accordance with Rodwell (2006) for short herbaceous vegetation, were randomly selected within these two areas (Figure 1).

4.2.1.4. Due to the depth of the river being too deep to wade in, and too wide to sample from the southern bank, the survey of the River Wensum was undertaken by canoe.

4.2.1.5. Due to the dangers of sampling the marginal vegetation of the River Wensum from the bank next to deep water and silt or from a canoe, the marginal vegetation was attributed a NVC community based on visual impression of the species present.

Dates of surveys

Table 6 : Dates, personnel and weather for vegetation surveys

Location	Visit Date	Time	Weather	Personnel
NVC Grassland	05/07/2017	10:00-17:00	2/8 cloud cover, BWS 1, dry, hot 27°C	Sally McColl Chris Smith
NVC Grassland	24/08/2017	08:00-15:00	2/8 cloud cover, BWS 1, dry with sunny spells, hot 24°C	Sally McColl Carolyn Smith
NVC River Wensum	28/07/2017	08:30-14:00	7/8 cloud cover, BWS 3, dry, cool with sunny spells	Sally McColl James Allitt
NVC Ditches	23/08/2017	08:00-15:00	2/8 cloud cover, BWS 1, dry, with sunny spells, hot 22°	Sally McColl Ben Moore
NVC Ditches	24/08/2017	08:00-15:00	2/8 cloud cover, BWS 1, dry with sunny spells, hot 24°C	Sally McColl Carolyn Smith

Personnel

4.2.1.6. All surveys were undertaken by suitably experienced NVC surveyors, who are listed in the table below. Other personnel mentioned in Table 6 were safety workers.

Table 7 : Personnel and relevant experience

Team Member	Experience
Chris Smith	20 years' experience within ecological consultancy and 25 years' experience of ecological surveying including NVC plant surveys.
Sally McColl	10 years' experience of ecological surveying, including aquatic plant surveys, condition monitoring and NVC plant surveys.
Carolyn Smith	4 years' experience of ecological surveying including NVC plant surveys.

Consent

4.2.1.7. A permit to survey within the SAC was received from Natural England on 24th July 2017 (Appendix 3).

4.2.2. Limitations

4.2.2.1. The NVC approach was not felt applicable to ditch vegetation within the site, due to the limitations of that classification for artificial dykes (Mountford, 2006). However the alternative use of Doarks and Leach (1990) is felt to be more robust and applicable in this instance and gives no significant limitations.

4.2.2.2. Limitations for each survey type are outlined in the Table below.

Table 8: Limitations and suggested impacts

Survey Type	Limitation	Impact of Limitation
Grassland Survey	No limitations	N/A
River Survey	Access to the northern half of the river was not given by the landowner, so the survey was carried out on the southern half;	Not significant – the emergent vegetation was visible from the southern half of the river, and the aquatic vegetation was fairly uniform.
	The marginal edge was too dangerous to sample from the bank or by canoe.	Not significant – the marginal edge consisted of a single species swamp community and was easily assessed by eye.
Ditch Survey	No limitations	N/A

5. Results

5.1. Maps showing sampling locations are shown in Appendix 1 (Figures 1-3).

5.2. Photographs taken at sampling locations are included in Appendix 2 (Figures 4-38).

5.3. Raw data tables and endgroup descriptions (Doarks and Leach, 1990) are attached as separate documents.

5.4. A map showing field names is attached in Appendix 6 and NVC map is attached in Appendix 7.

5.1. Grassland NVC survey

Overview

5.1.1. The site consists of a relatively flat floodplain, which nevertheless contains some variation in levels and drainage patterns. Areas closest to the river appear to have the highest water tables, and include areas with peaty soils (Fields 4, 7, 8 and 9) whereas the more southerly and westerly sections are drier and loamy (Fields 6 and 1). The site is roughly grazed throughout to varying degrees by cattle.

5.1.2. The site slopes down from the upland in the north easterly direction although the majority of the fields are undulating, with some lower wetter patches having impeded drainage. Penny Spot Beck and the River Wensum were embanked, whilst all other ditches graded into the surrounding grassland.

5.1.3. On the back of the floodbank, Field 9, there was a distinct patch of wetter vegetation. This is thought to be caused by seepage of water through the floodbank due to proximity to the river rather than soligenous water flow. Another distinct wetter area was on the edge of the survey area in Field 7, which is likely caused by natural undulation of the field. The remaining fields, although showing undulation with lower areas, appeared much drier.

5.1.4. The aquatic and marginal communities of the ditches are a prominent feature, but are dealt with in the subsequent sections.

5.1.5. The grassland appears to consist of the following vegetation communities:

- MG6 – *Lolium perenne-Cynosusus cristatus* grassland
- MG10 – *Holco-Juncetum effusi* rush pasture

5.1.6. MG6 is present throughout the southern and easterly parts of the site, whilst MG10 is confined to a small area at the back of the floodbank and the north western and north eastern (part of) marshes. These habitats are intrinsically linked with ground conditions, with MG6 located on free draining soil and on areas of higher ground, and MG10 being located on impeded soils and in lower areas.

5.1.7. There are overgrown hedgerows and scattered scrub throughout the site with species such as hawthorn *Crataegus monogyna* (which is classified as W21 – *Crataegus monogyna-Helix hedera* scrub (Target notes 1 and 3)), and sallow *Salix cinerea* with a bramble *Rubus fruticosus* understorey (which is classified as W2a *Salix cinerea-Betula pubescens-Phragmities australis, Alnus glutinosa-Filipendula ulmaria* sub community).

5.1.8. A line of oaks *Quercus robur* (Target note 4) and poplars *Populus spp.* (Target note 2) were recorded.

5.1.9. Field 10 was excluded from classification under NVC as it appeared to be in a cropping regime, and not grassland.

MG6 Lolium perenne-Cynosuretum cristati grassland

Description

5.1.10. The sampling locations were grass-dominant with species such as *Agrostis stolonifera*, *Holcus lanatus* and *L. perenne* having the highest constancy values as well as *Ranunculus repens*, which typically persists in grazed areas.

5.1.11. Herbs present with the highest constancy values are small creeping species such as *Potentilla repens*, *Trifolium repens*, and *Trifolium pratense* with taller herbs present at some sampling locations.

5.1.12. The MG6 grassland sampling locations were labelled as D1-D6.

5.1.13. On average between 10 and 20 species were recorded per sampling location, with over half of those recorded being grasses.

5.1.14. No nationally or locally scarce species were noted at any of the sampling locations.

Variation within community

5.1.15. There is variation between the fields within the site, as shown by the sample data.

5.1.16. At the south-east of the site, there was a lush, tussocky sward which had approximately four coarse grass species of equal abundance including *A. stolonifera* and *Festuca arundinacea* and appeared to have been grazed earlier in the season (Field 5).

5.1.17. At the back of the floodbank adjacent to the wetter MG10 community (Field 9), the vegetation here was less species rich and had coarse grasses such as *A. stolonifera*, *H. lanatus* and *F. arundinacea* in higher abundances.

5.1.18. Throughout the site, but especially on the eastern side the community was often transitional to the MG10 community and examples of samples within these areas had higher occurrence of *J. effusus*, *H.lanatus* and *R. repens* (Field 8).

5.1.19. As the ground rose towards the west the sward became drier (Field 6), and became a more closely grazed sward with more fine grasses evident. A lot of ruderal species such as *Circium arvense* and *Rumex obtusifolius* were evident.

5.1.20. At the south-west (Field 1) the sward was lusher, and lightly grazed with a higher proportion of herbs and *Juncus inflexus* present. However, the southern and eastern areas of this field appeared higher and drier. This location is very clearly transitional in places towards the *J. inflexus* variation of MG10 (Target note 5).

5.1.21. Fields 2, 3 and 4 were ungrazed at the time of survey and vegetation was very tall and had Arrhenatherum *elatioris* evident.

5.1.22. The back of the floodbank (Field 9) and Field 5 had a much more tussocky sward, consistent with a lighter grazing regime.

Goodness of fit to community

5.1.23. MG6 is described as “a short, tight sward which is grass-dominated. *Lolium Perenne* is usually the most abundant grass with varying amounts of *Cynosurus cristatus*. *Festuca Rubra* and *Agrostis capillaris* are frequent throughout and, in long-established pasture, they may be abundant. *Holcus lanatus and Dactylis glomerata* are also frequent but of somewhat patchy distribution. They may become more prominent as coarse tussocks if pasture is under-grazed and *H. lanatus* is often abundant and vigorous around cattle dung which the animals avoid.” (Rodwell,1992).

5.1.24. It is not an exact fit with MG6, as *C. cristatus* is only present at one of the quadrats, and *T. repens* is in a lower value. However this may be because many of the areas are

transitional to MG10 and are located within damper areas which are less favourable for *C. cristatus*.

5.1.25. MG6 is typical of grazed lowland pasture in Britain on moist freely draining soils, which is consistent with the site.

5.1.26. Ungrazed Fields 2 and 5 could potentially fit better with MG1-*A. elatioris* as it grades to the arable upland (Target notes 6 and 7)), where under grazing has allowed this grass to appear more dominant, or it could just be that a lighter grazing regime has led to this appearance of change.

Constancy table

5.1.27. The constancy table is shown below.

Table 9: Constancy table for MG6 Lolium perenne-Cynosuretum cristati

Species	Average for stand (DOMIN)	Constancy
Agrostis stolonifera (creeping bent)	4	V
Holcus lanatus (Yorkshire fog)	5	V
Lolium perenne (perennial ryegrass)	2	V
Ranunculus repens (creeping buttercup)	3	V
Taraxacum agg. (dandelion)	2	V
Festuca rubra (red fescue)	2	IV
Phleum pratensis (timothy)	3	IV
Arrhenatherum elatius (false oat grass)	2	III
Cerastium fontanum (common mouse ear)	1	III
Poa trivialis (rough meadow grass)	1	III
Bromus mollis (soft brome)	1	II
Carex hirta (hairy sedge)	1	II
Dactylis glomerata (cocks foot)	1	II
Festuca arundinacea (tall fescue)	2	II
Juncus inflexus (hard rush)	2	II
Plantago lanceolata (ribwort plantain)	1	II
Poa pratensis (smooth stalked meadow grass)	1	II
Potentilla repens (creeping cinquefoil)	1	II
Trifolium pratense (red clover)	1	II
Trifolium repens (white clover)	1	II
Agrostis capillaris (common bent)	1	I
Alopecurus geniculatus (marsh foxtail)	1	I
Brachythecium rutabulum (rough stalked feather moss)	0	I
Cynosurus cristatus (crested dogs tail)	0	I
Deschampsia cespitosa (tufted hair grass)	1	I
Glechoma hederacea (ground ivy)	0	I
Juncus effusus (soft rush)	1	I
Lathyrus pratensis (meadow vetchling)	1	I
Lotus corniculatus (bird's foot trefoil)	1	I
Potentilla anserina (silverweed)	1	I
Pulicaria dysenterica (common fleabane)	1	I
Rumex crispus (curled dock)	<1	I
Rumex obtusifolius (broad leaved dock)	1	I
Senecio jacobaea (ragwort)	<1	I
Urtica dioica (nettle)	<1	I
Vicia cracca (tufted vetch)	<1	I

MG10 – Holco-Juncetum effusi rush pasture

Description

5.1.28. These wetter grasslands were on peaty soils, located within the lowest areas within the site and are numbered W1-W7.

5.1.29. The species with highest constancy values are *J. effusus, A. stolonifera,* and *H. lanatus* with *R. repens* a constant but at a low abundance.

5.1.30. Sampling locations W1, W2, W6-W8 were taken along the back of the river bank to north/north-east of the site.

5.1.31. Sampling locations W3-W5 were taken in the northern marsh, although this habitat continued slightly to the south (Field 8).

5.1.32. No nationally or locally scarce species were noted at any of the sampling locations.

Variation within community

5.1.33. W5 (Field 7) was distinctly wetter and *Persicaria amphibia* was evident within the *J. effusus.*

5.1.34. W7 (Field 9) had *Glyceria maxima* present instead of *J. effusus*. These sampling locations were generally lightly or not grazed, although the grass sward between the tussocks were well grazed.

Goodness of fit to community

5.1.35. MG10 *Holco-Juncetum effusi* – "a sward with prominent tussocks of *Juncus effusus* up to 80cm tall in a generally species poor and shorter grassy ground. *Holcus lanatus* and *Juncus effusus* are the only constant grasses and each or both may be abundant" (Rodwell, 1992).

5.1.36. This community is characteristic of permanently moist sites, which is widely distributed in pastures and are usually grazed.

5.1.37. It is a good fit with this community type as *A. stolonifera*, *H.lanatus* and *J. effusus* are present at high constancies, although *R. repens* is at a lower occurrence.

Constancy table

5.1.38. The constancy table is below.

Table 10: Constancy table for MG10

Species	Average for stand (DOMIN)	Constancy
Agrostis stolonifera (creeping bent)	4	V
Holcus lanatus (Yorkshire fog)	5	V
Juncus effusus (soft rush)	5	V
Alopecurus pratensis (meadow foxtail)	2	IV
Arrhenatherum elatius (false oat grass)	2	IV
Festuca arundinacea (tall fescue)	2	IV
Filipendula ulmaria (meadow sweet)	2	IV
Stellaria graminea (lesser stitchwort)	1	IV
Potentilla anserina (silverweed)	2	III
Ranunculus repens (creeping buttercup)	1	III
Rumex acetosa (common sorrel)	1	III
Cerastium fontanum (common mouse ear)	1	III
Juncus articulatus (jointed rush)	1	II

Lathyrus pratensis (meadow vetchling)	1	II
Lotus pedunculatus (greater bird's-foot-trefoil)	1	II
Poa trivialis (rough meadow grass)	1	II
Taraxacum agg. (dandelion)	1	II
Carex acutiformis (lesser pond sedge)	1	II
Dactylis glomerata (cock's-foot)	1	II
Glechoma hederacea (ground ivy)	1	II
Glyceria maxima (reed sweet-grass)	1	II
Carex riparia (greater pond sedge)	1	II
Trifolium pratense (red clover)	<1	II
Carex hirta (hairy sedge)	<1	I
Circium arvense (creeping thistle)	<1	I
Lolium perenne (perennial ryegrass)	<1	I
Myosotis secunda (creeping forget me not)	<1	I
Persicaria amphibia (amphibious bistort)	1	I
Phalaris arundinacea (reed canary grass)	1	I
Urtica dioica (common nettle)	<1	I
Circium dissectum (meadow thistle)	<1	I
Equisetum palustre (marsh horsetail)	<1	I
Quercus spp. (oak sapling)	<1	I
Rumex conglomeratus (clustered dock)	<1	I
Rumex obtusifolius (broad leaved dock)	<1	I
Senecio aquaticus (marsh ragwort)	<1	I
Senecio jacobea (common ragwort)	<1	I
Trifolium repens (white clover)	<1	I

5.1.39. Full data tables are provided as an excel table in Appendix 4.

5.2. River Wensum SAC/SSSI survey

Description

5.2.1. The river was approximately 2m deep and 20m wide, with good marginal vegetation, often in floating and inaccessible mats.

5.2.2. There were no trees along the river banks of the southern stretch of the survey area. There were a few white willows *Salix alba*, along the southern banks between sampling locations 6 and 8, and some oaks *Quercus robur*, and alders *Alnus glutinosa* along the northern bank.

5.2.3. Two main vegetation communities were identified:

- A8a-*Nuphar lutea* community, species-poor sub community.
- S5-*Glycerietum maximae* swamp, *Alisma plantago-aquatica-Sparganium erectum* sub community.

S5-Glycerietum maximae swamp

5.2.4. There was a good marginal vegetation dominated by *G. maxima* with large mats of *Apium nodiflorum* stretching out into the river, narrowing the open water by up to 10m in certain areas. There were some floating mats of *P. arundinacea* and *Veronica catenata* throughout the sampled area. *Sparganium erectum* with some *Myosotis scorpioides* was present at sampling location 10. This emergent community was assessed as NVC S5-*Glycerietum maximae* swamp, *Alisma plantago-aquatica-Sparganium erectum* sub community.

A8a-Nuphar lutea community, species-poor sub community

5.2.5. The majority of the open water was generally covered by *N. lutea*, which persisted throughout the water column. The amount to which the *N. lutea* persisted through the water column varied along the length. It was estimated that *N. lutea* was present over 25% of the water column growing from the bed to 50cm below the surface at sampling locations 4 and 5, whereas at most other sampling locations *N. lutea* was evident on the water surface and was estimated to occupy an average of 25%-50% of the water column.

5.2.6. *N. lutea*, dominated the water column, with occasional species such as *Callitriche spp*., and *Elodea nuttalli* being recorded. The occasional strand of *M. spicatum* was noted floating on the water surface, but not picked up during the survey. Beds of this plant were noted upstream from the survey area.

5.2.7. The NVC community assigned to the aquatic communities is A8a-*Nuphar lutea* community, species-poor sub community.

Variation within community

5.2.8. This stretch of river was fairly uniform in terms of aquatic macrophyte diversity.

5.2.9. None of the following species listed within the Norfolk Vanguard Phase 2 Ecological Surveys Scope associated with the River Wensum SAC habitat were noted:

- pond water-crowfoot *R. peltatus*
- stream water-crowfoot *R. penicillatus ssp. pseudofluitans*
- river water-crowfoot *R. fluitans*

5.2.10. No locally or nationally scarce species were noted during the survey.

Goodness of fit to community

5.2.11. A8 is described in Rodwell (1995) "…Much of the vegetation is species poor, consisting of little else apart from *N. lutea*…"

5.2.12. The species-poor sub community is described in Rodwell (1995) as "*N. lutea* is sometimes the only plant here, with just very occasional *L. minor* on the surface, *Elodea canadensis*, *Callitrice stagnalis*, *Zannichellia* or *Ceratophyllum demersum* beneath and a few shoots or clumps of *Sagittaria*, *Apium*, *V. beccabunga* or *Mentha aquatica*."

5.2.13. The sampling locations fit well with the description of this community type.

Results table

5.2.14. Species and abundances of aquatic plants noted at each sampling location are listed in Table 10 below.

Table 11 : Species and abundances of aquatic plants at river sampling locations

		Species			
Point	**Sampling direction**	***Nuphar lutea*** **% cover**	***Callitriche spp.*** **% cover**	***Elodea nuttalli*** **% cover**	***Myosotis scorpioides*** **% cover**
1	NE	25	-	5	-
1	SW	25	-	-	-
2	NE	10	5	25	-
2	SW	-	5	20	-
3	NE	10	-	5	-
3	SW	50	-	-	-
4	NE	30	-	1	-
4	SW	10	-	15	-
5	NE	25	-	-	-
5	SW	10	-	5	-
6	NE	25	-	-	-
6	SW	30	-	-	-
7	NE	15	-	-	-
7	SW	20	-	-	-
8	NE	5	-	-	-
8	SW	-	-	-	-
9	NE	30	-	-	-
9	SW	30	-	-	-
10	NE	75	-	-	1
10	SW	75	-	-	-

5.3. Ditch survey

Ditch 1

Description

5.3.1. This was an agricultural field drain of approximately 2.5m wide and was fairly uniform along its length, with water being very shallow (10-30cm) and abundant vegetation cover.

Aquatic vegetation

5.3.2. *Polygonum amphibium* was locally dominant, at three of the sampling locations (1A, 1B, 1D) with *Potamogeton berchtoldii* being abundant at 1C.

5.3.3. The species recorded along this ditch length key out to three different End Groups. Species recorded at sampling locations 1A correspond to the End Group A6-*Callitriche stagnalis*/*platycarpa* which is a good fit with this group with both *C. spp.* and *L. minor* being present.

5.3.4. Species recorded at sampling location 1B key out to the End Group A7b-*Potamogenton pectinatus-Myriophyllum spicatum*, which doesn't fit well as none of the constant species for this group were recorded, and only keyed to this group due to the presence of *L. minor*.

5.3.5. Species recorded at sampling locations 1C and 1D key out to End Group A5b-*Lemna minor/Lemna trisulca*/filamentous algae. Despite two of the constant species not being recorded with only *L. minor* being present, it is a good fit to this group as it represents ditches with low species diversity with some *C. spp*. and *P. pusilus/berchtoldii* present. End Group A5b is the best fit with sampling locations 1B-1D.

Table 12 : Ditch 1 – Species and abundances of aquatic vegetation

Species	Sampling Location			
	1A	**1B**	**1C**	**1D**
Polygonum amphibium	A - LD	F	-	F - LD
Potamogeton bertoldii	O	A	A	R
Callitriche spp.	O - LD	-	R	-
Lemna minor	R	R	R	O
Aquatic End Group	**A6**	**A7b**	**A5b**	**A5b**

Emergent vegetation

5.3.6. Emergent vegetation was in general low growing with species such as *B. erecta*, frequently occurring. Other species such as *Mentha aquatica* were of rare occurrence. There were no dominant species at any of the points except at 1A where pendulous sedge *Carex pendula*, was locally dominant.

5.3.7. The emergent vegetation does not fill well with the End Groups due to the lack of dominant species resulting from shading.

Table 13: Ditch 1 – Species and abundances of emergent vegetation

Species	Sampling Location			
	1A	**1B**	**1C**	**1D**
Agrostis stolonifera	R	O	R	
Alisma aquatica			R	
Berula erecta		F	R	

Species	Sampling Location			
Cardamine pratensis		R	R	
Carex pendula	LD			
Carex spp.			O	
Epilobium hirsutum	R	R	R	
Equisetum palustris	R			
Juncus articulatus			O	
Juncus inflexus	R	R	A	
Mentha aquatica	O	O	F	R
Polygonum amphibium		F		
Ranunculus repens	R	R	R	
Salix cinerea		O	O	O
Solanum dulcamara	R			
Tussilago farfara			R	
Typha latifolia	O	O	O	
Emergent End Group	**E2**	**E3**	**E3**	**E2**

Summary

5.3.8. End Group A6-*Callitriche stagnalis*/*platycarpa* is typically found in ditches that border between the uplands and grazing marsh, which can dry out for periods in the summer. Land to the north of the ditch does slope downwards, and due to the woodland fringe on the south side it is thought likely that the ditch does dry out at times in the shallower areas. This group is most closely associated with emergent End Group E2-*Glyceria maxima-Berula erecta***.**

5.3.9. End Group A5b-*Lemna minor/Lemna trisulca*/filamentous algae is species poor, typically found in water depths of <20cm, and is associated with moderately eutrophic conditions.

5.3.10. None of the following species listed within the Norfolk Vanguard Phase 2 Ecological Surveys Scope associated with the River Wensum SAC habitat were noted:

- pond water-crowfoot *R. peltatus*
- stream water-crowfoot *R. penicillatus ssp. pseudofluitans*
- river water-crowfoot *R. fluitans*

Ditch 2

Description

5.3.11. This was an agricultural field drain of approximately 2.5m wide, 5-30cm water depth and was variable along its length in terms of vegetation cover.

Aquatic vegetation

5.3.12. Sampling locations 2C to 2E keyed out to End Group A5b – *Lemna minor-Lemna trisulca*-filamentous algae where species such as *C. spp*. and *P. berchtoldii* are often typical.

5.3.13. Sampling locations 2A and 2B could not be assigned aquatic End Groups due to the lack of water plants. These points were heavily overshadowed by dense hedgerow to the west and tall ruderal vegetation to the east. The water level was very low at these points, with the sandy substrate at the bottom of the ditch evident. However, the ditch is quite uniform along its length, and the End Groups are thought likely to follow the same community, if shading was reduced.

Table 14: Ditch 2 - Species and abundances of aquatic vegetation

Species	**Sampling Locations**				
	2A	**2B**	**2C**	**2D**	**2E**
Lemna triscula	-	-	R	A	-
Lemna minor	R	-	R	O	R
Calltitriche spp.	-	-	O-LD	R	R
Filamentous algae	-	-	F-LD	O	O
Hottonia palustre	-	-	F	O	-
Potamogeton bertoldii	-	-	F-LD	-	-
Elodea nuttalli	-	-	-	R	-
Aquatic End Group	**A5b**	**A5b**	**A5b**	**A5b**	**A5b**

Emergent vegetation

5.3.14. Emergent vegetation was generally low growing with species such as *B. erecta*, and *M. aquatica*, occurring with the highest scores at each sampling location. *P. arundinacea*, and *G. maxima* were locally dominant at sampling locations 2C and 2D.

5.3.15. Sampling location 2A was closest to emergent End Group E3-*Juncus effusus*, due to the presence of *Juncus effusus*, however this was only at rare occurrence and therefore sampling location 2A fits better with E2-*Glyceria maxima-Berula erecta* to which sampling locations 2B-2E also key out. However, only sampling location 2E has *G.maxima* present, whist sampling locations 2A and 2D have *B. erecta* present as abundant to dominant and sampling locations 2B and 2C have it occurring occasionally.

Table 15: Ditch 2 – Species and abundances of emergent vegetation

Species	**Point**				
	2A	**2B**	**2C**	**2D**	**2E**
Agrostis stolonifera	R	R			
Apium nodiflorum					R
Berula erecta	D	O	O	A	
Cardamine pratensis	R				R
Cerstium fontanum					R
Epilobium hirsutum	R	R			

Equisetum palustris					O
Eupatorium cannabinum	R				
Filipendula ulmaria				R	
Galium palustre					R
Glyceria maxima					A/LD
Holcus lanatus				R	
Iris pseudoacorus					O
Juncus effusus	R				
Juncus inflexus		R			
Mentha aquatica	F	F		F	R
Myosotis scorpidium			O	O	O
Phalaris arundinacea	O		A/LD	O	
Ranunculus repens	O			R	
Ranunculus scleratus					R
Salix cinerea	O				
Scrophularia auriculatum					R
Solanum dulcamara		R	R	R	R
Urtica dioica	R	O			
Valeriana officinalis	R	R			
Emergent End Group	**E3**	**E2**	**E2**	**E2**	**E2**

Summary

5.3.16. Ditch 2 was consistently classified as this End Group A5b-*Lemna minor/Lemna trisulca*/filamentous algae along its length.

5.3.17. End Group A5b-*Lemna minor/Lemna trisulca*/filamentous algae is a species poor community typically found in water depths of <20cm, and is associated with eutrophic conditions.

5.3.18. This aquatic community is often associated with the emergent vegetation End Group E2-*Glyceria maxima-Berula erecta* which is typical of eutrophic freshwater conditions with a high base status.

5.3.19. None of the following species listed within the Norfolk Vanguard Phase 2 Ecological Surveys Scope associated with the River Wensum SAC habitat were noted:

- pond water-crowfoot *R. peltatus*
- stream water-crowfoot *R. penicillatus ssp. pseudofluitans*
- river water-crowfoot *R. fluitans*

Ditch 3

5.3.20. This was an Internal Drainage Board (IDB) drain running along the back of the floodbank, which looked to have been cleared out within the last few years. This ditch was 2.5m wide and approximately 45-60cm deep.

Aquatic vegetation

5.3.21. Beds of *C. spp*., dominated under the water surface with *Lemna minuta* dominating at the water surface. *E. nuttalli* was also recorded at all 5 sampling locations. This was the most diverse of the four ditches sampled, with an average of 5-6 species per sampling location.

5.3.22. The End Group assigned to the aquatic vegetation in this ditch is A5b – *Lemna minor-Lemna trisulca*-filamentous algae.

Table 16: Ditch 3 – Species and abundances of aquatic vegetation

Species	Sampling Locations				
	3A	3B	3C	3D	3E
Lemna minuta	A	A	A	F	O
Calltitriche spp.	A	A	F	O	O
Filamentous algae	F	F	F	O	-
Certophyllum demursum	-	-	O	R	-
Elodea nuttalli	R	R	F	O	O
Hottonia palustre	-	F	O	R	-
Hydrodictyon algae	-	-	R	-	-
Polygonum amphibium	-	R	R	-	-
Potamogeton pusillus	R	R	-	-	-
Aquatic End Group A6	**A5b**	**A5b**	**A5b**	**A5b**	**A5b**

Emergent vegetation

5.3.23. Emergent vegetation had a good mix of species with *Sparganium erectum*, and *G. maxima* occurring abundantly within the sampling locations. Other typical swamp species such as *Filipendula ulmaria*, and *Galium palustre* were recorded at low abundances.

5.3.24. The End Group assigned to the emergent vegetation in this ditch is E2 – *Glyceria Maxima-Berula erecta*. It is a good fit with E2, as *G. maxima* was present at four of the sampling locations, and *A. stononifera* and *A. nodiflorum*/*B.erecta* were present at the majority of sampling locations.

Table 17: Ditch 3 – Species and abundances of emergent vegetation

Species	Sampling Locations				
	3A	3B	3C	3D	3E
Agrostis stolonifera	R		R		
Apium nodiflorum	R	R	F	R	R
Berula erecta			R		R
Carex riparia		R			
Cerstium fontanum			R	R	
Equisetum palustris			R		
Filamentous algae			F		
Filipendula ulmaria		R	R	R	R

Species	Sampling Locations				
Galium palustre			O	R	R
Glyceria maxima	O	F		O	
Hippuris vulgaris			F		
Holcus lanatus		R			R
Juncus articulatus		R			
Juncus effusus		R	R	R	
Mentha aquatica	R		O		
Phalaris arundinacea	R	R	R		O
Polygonum amphibium		R			
Ranunculus repens	R	R	R	R	R
Rumex conglemeratus			R		
Salix cinerea		O	O	R	
Scrophularia auriculatum		R			R
Solanum dulcamara					O
Sparganium emerusm	F				
Sparganium erectum	F	O		O	F
Stachys palustris	R		O		
Urtica dioica	R		R	R	R
Veronica beccabunga			O		
Emergent End Group	**E2**	**E2**	**E2**	**E2**	**E2**

Summary

5.3.25. Ditch 3 was consistently classified along its length as aquatic End Group A5b – *Lemna minor-Lemna trisulca*-filamentous algae. It is associated with the emergent End Group is E2 – *Glyceria Maxima-Berula erecta*, typical of high nutrient conditions.

5.3.26. None of the following species listed within the Norfolk Vanguard Phase 2 Ecological Surveys Scope associated with the River Wensum SAC habitat were noted:

- pond water-crowfoot *R. peltatus*
- stream water-crowfoot *R. penicillatus ssp. pseudofluitans*
- river water-crowfoot *R. fluitans*

Ditch 4 (Penny Spot Beck)

5.3.27. Penny Spot Beck meanders through the site where it flows out into the River Wensum. The ditch has steeply sloping sides, well vegetated with emergent vegetation, which encroach into the ditch significantly along the majority of its length causing significant shading. It is different from the other ditches sampled by having a slow flow, whereas other ditches were static.

Aquatic vegetation

5.3.28. This ditch had no aquatic plants at any of the sampling locations, except for filamentous algae at one point. The ditch had macrophytes present during the July grassland visit (pers. obs. Chris Smith 05/07/17).

5.3.29. At sampling location 4C, the ditch is approximately 5cm deep and is adjacent to a cattle drinking point. The substrate is gravelly and flowing with water with the odd piece of filamentous algae, caught on the stone. At sampling location 4B the ditch deepens to 30cm, the stony bottom is replaced by silt and there is encroachment from marginal vegetation. At sampling location 4C, the water is deeper to 45cm and becomes more turbid.

5.3.30. It is not clear why there were no plants growing within the ditch in the sample area, where the ditch is more open and not subject to significant shading. There was no sign of the ditch being recently cleared out, or any treatment by herbicides. It is unlikely that the cattle are the issue, as there is significant poaching by cattle on the other ditches surveyed. It is thought possible run-off from the arable land to the north may be responsible, although there were no blooms of algae present which are consistent with nutrient enrichment.

5.3.31. It is though likely that if aquatic vegetation was present, it would be consistent with a species poor community A5b – *Lemna minor-Lemna trisulca*-filamentous algae as environmental conditions within Penny Spot Beck appear similar to that of neighbouring ditches within the site. The A5b End Group was most frequently associated with E2 (Doarks and Leach, 1990), and were most frequently recorded together across the survey area.

Table 18: Ditch 4 - Species and abundances of aquatic vegetation

Species	**Sampling Locations**		
	4A	**4B**	**4C**
Filamentous algae	R	-	-
Aquatic End Group A6	**A5b**	**A5b**	**A5b**

Emergent vegetation

5.3.32. Emergent vegetation was dominated by single-species stands of reeds and grasses with limited associated species recorded at each point. *G. maxima*, *P. arundinacea*, and *C. riparia* were recorded as the most abundant species.

5.3.33. Sampling locations D2 and D3 keyed out to emergent End Group E2, whilst D1 keyed out to group E1 – *Carex riparia/acutiformis-Phragmities australis* due to the presence of *C. riparia* at the water line. Although all sampling locations seem more consistent with E2 it is however a poor fit as two of the constant species, *B. erecta* and *A. stolonifera* were not present.

Table 19: Ditch 4 – Species and abundances of emergent vegetation

Species	**Sampling Locations**		
	4A	**4B**	**4C**
Agrostis stolonifera			

Species	Sampling Locations		
Apium nodiflorum			R
Berula erecta			
Carex riparia	O		
Cerstium fontanum			
Equisetum palustris			
Filamentous algae			
Filipendula ulmaria			
Galium palustre			
Glyceria maxima	F	A	
Hippuris vulgaris			
Holcus lanatus			
Juncus articulatus			
Juncus effusus			
Mentha aquatica			
Phalaris arundinacea	O	O	F
Polygonum amphibium			
Ranunculus repens		R	R
Rumex conglemeratus			
Salix cinerea			
Scrophularia auriculatum			
Sparganium emerusm			
Sparganium erectum			
Stachys palustris			
Urtica dioica			
Veronica catenata			R
Emergent End Group	**E1**	**E2**	**E2**

Summary

5.3.34. No aquatic species were evident along the beck within the survey area. The majority of the beck is very narrow, with steep banks and very tall emergent vegetation which is shading the ditch. It is thought likely that if vegetation were to be present it would be consistent with A5b – *Lemna minor-Lemna trisulca*-filamentous algae. The majority of emergent vegetation along the beck is classified as emergent End Group E2 – *Glyceria maxima-Berula erecta* which is consistent with the lack of grazing along this ditch length.

5.3.35. None of the following species listed within the Norfolk Vanguard Phase 2 Ecological Surveys Scope associated with the River Wensum SAC habitat were noted:

- pond water-crowfoot *R. peltatus*
- stream water-crowfoot *R. penicillatus ssp. pseudofluitans*
- river water-crowfoot *R. fluitans*

5.4. Incidental observations

5.4.1. A number of signal crayfish *Pacifastacus leniusculus*, were seen whilst carrying out the survey of the River Wensum.

6. Conclusions

Grassland NVC Survey

6.1. The semi-improved grassland found adjacent to the River Wensum consisted of two main NVC communities, which were often transitional to each other:

- MG6 – *Lolium perenne-Cynosusus cristatus* grassland
- MG10 – *Holco-Juncetum effusi* rush pasture

6.2. MG10 is a species poor community and characteristic of permanently moist sites, which are widely distributed in grazed pastures. It is a good fit with this community type.

6.3. MG6 is typical of short, tight grass-dominated swards found on free draining soil within grazed lowland pastures, which is consistent with the study area. It is not an exact fit with MG6 because many of the areas are transitional to MG10 and are located within damper areas, and some ungrazed areas could fit better with MG1.

River Wensum SAC/SSSI Survey

6.4. The section of the River Wensum within the study area is dominated by beds of *N. lutea* and is classified as NVC community A8a-*Nuphar lutea* community, "species-poor" sub community. Marginal vegetation consists of NVC community S5-*Glycerietum maximae* swamp, *Alisma plantago-aquatica-Sparganium erectum* sub community.

Ditch Survey

6.5. The ditches varied depending on location and land management. They were classified according to Doarks and Leach (1990) as being:

- Aquatic End Group A5b – *Lemna minor-Lemna trisulca*-filamentous algae
- Aquatic End Group A6 - *Callitriche stagnalis*/*platycarpa*
- Aquatic End Group A7b - *Potamogenton pectinatus-Myriophyllum spicatum*
- Emergent End Group E1 – *Carex riparia/acutiformis-Phragmities australis*
- Emergent End Group E2 – *Glyceria Maxima-Berula erecta*
- Emergent End Group E3 - *Juncus effusus*

6.6. Some ditches were very shaded or for other reasons lacked aquatic vegetation.

6.7. Despite the variation in appearance of vegetation communities the best fit End Groups across the study area appeared to be species poor End Groups A5b – *Lemna minor-Lemna trisulca*-filamentous algae and E2 – *Glyceria Maxima-Berula erecta* associated with eutrophic conditions.

Ranunculecae floating beds

6.8. None of the following species, associated with the River Wensum SAC habitat were recorded during the botanical survey within the River Wensum or its floodplain:

- pond water-crowfoot *R. peltatus*
- stream water-crowfoot *R. penicillatus ssp. pseudofluitans*
- river water-crowfoot *R. fluitans*

Presence of springs and seepage

6.9. There was no evidence of calcareous ground water spring or seepage activity with the study area. The MG10 community at the back of the flood bank is likely to be a result of river

water seepage through the flood bank, as this area is isolated, not extensive and is in close proximity to the river. Other wetter communities on the site, such as MG10, and dyke vegetation such as A5b are more consistent with lateral water flows or impeded drainage rather than soligenous water movement.

7. References

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8. Appendix 1 – Map of sampling points

Figure 1: Grassland sampling point map

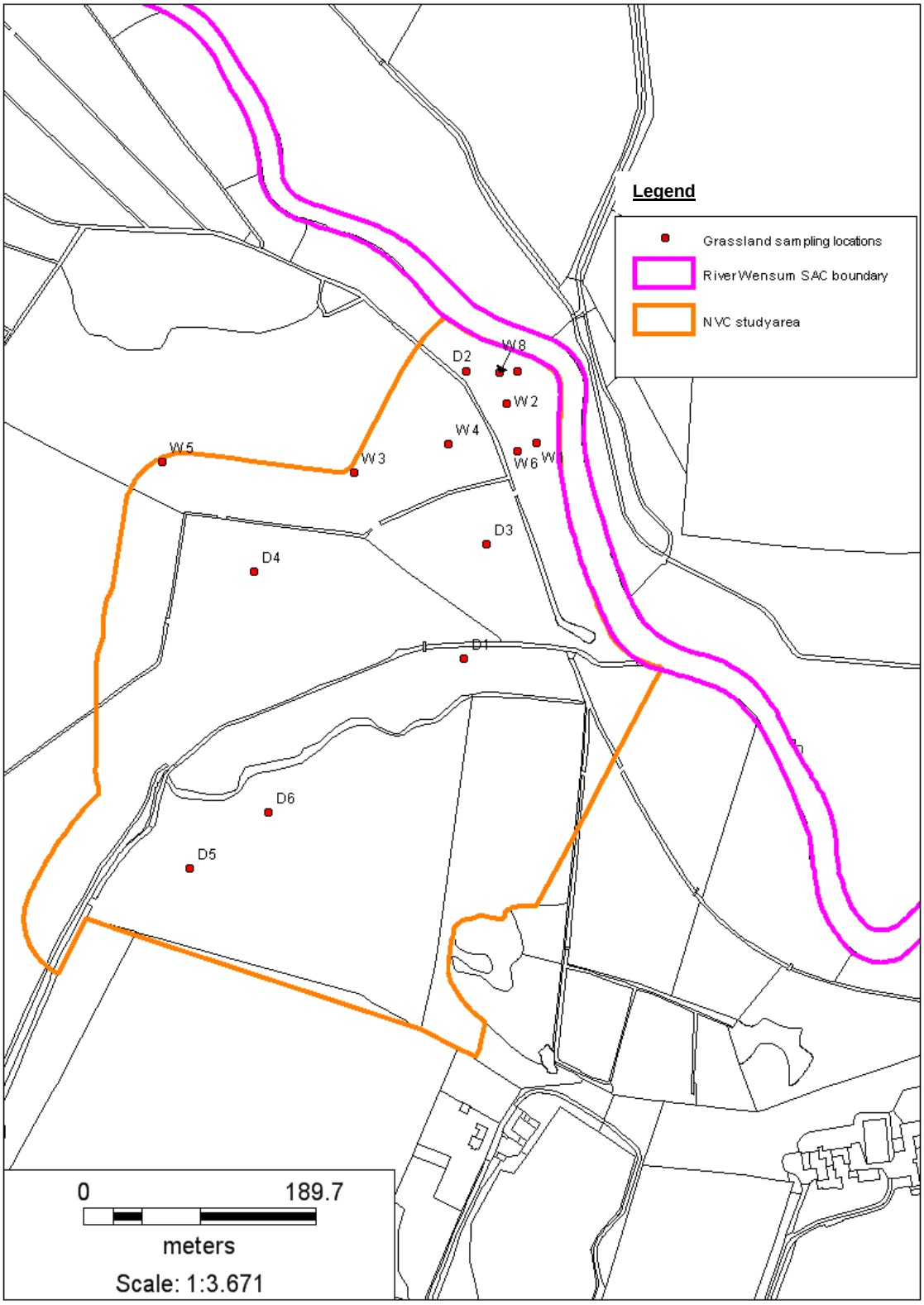


Figure 2: River survey sampling point map

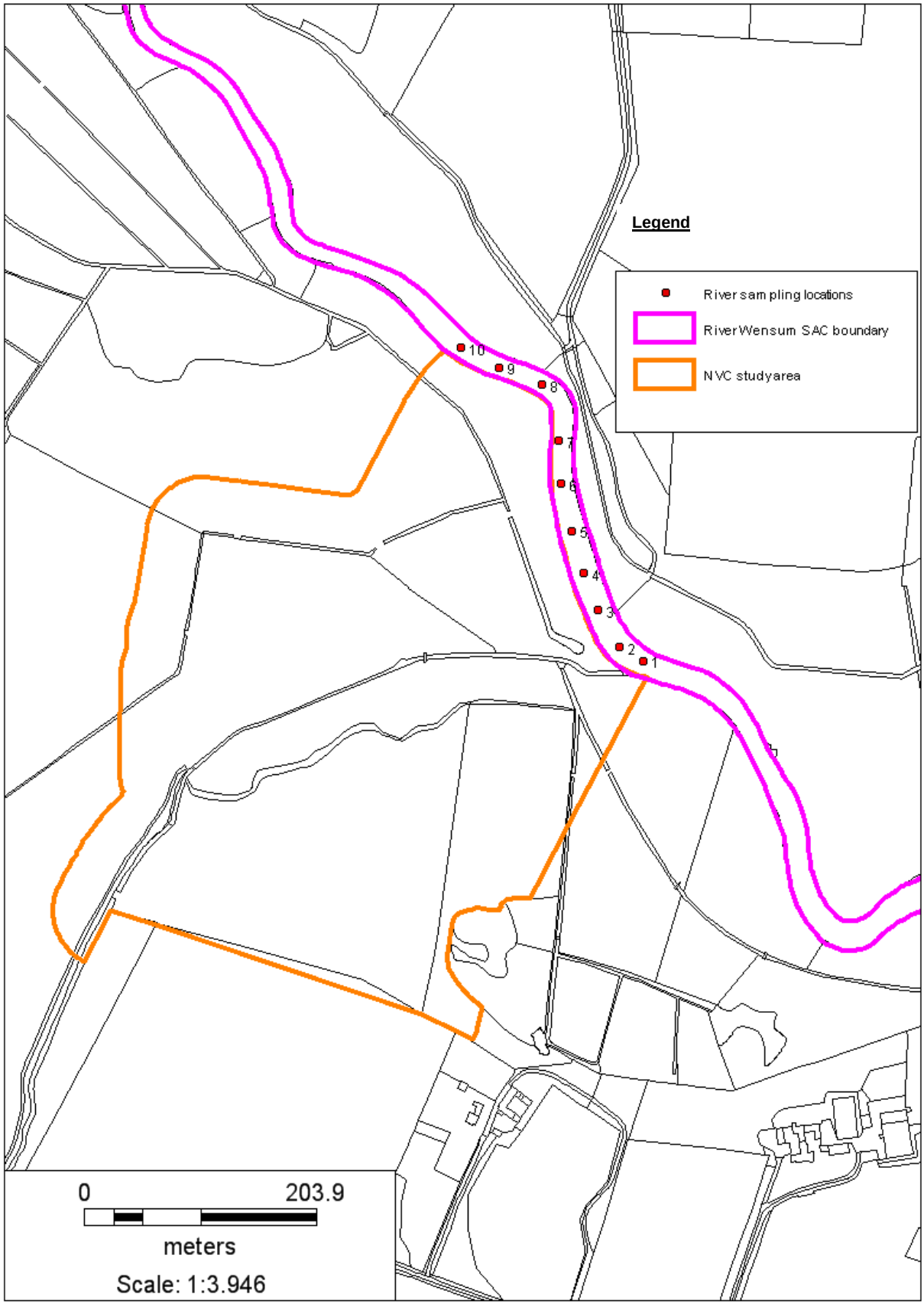
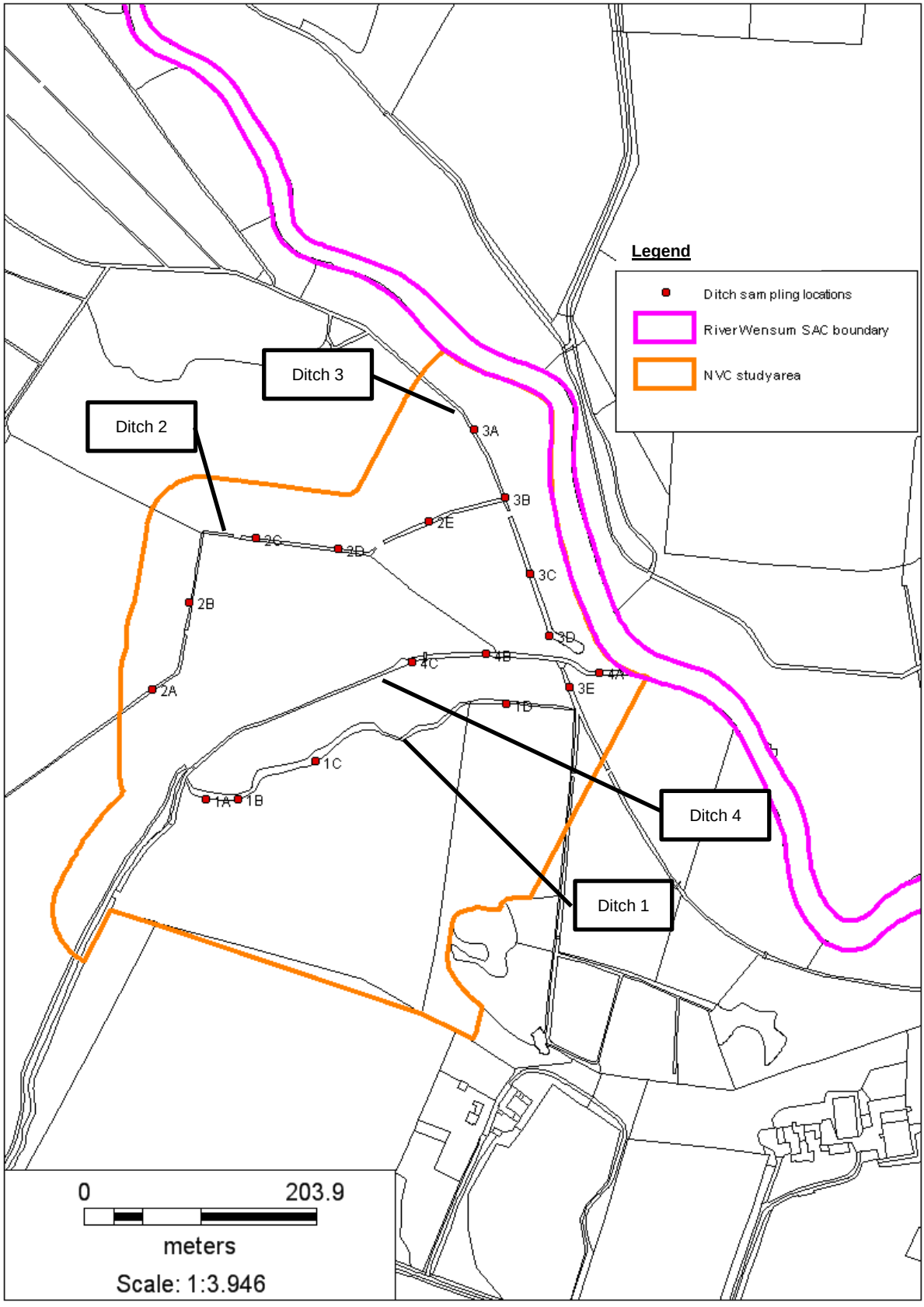


Figure 3: Ditch survey sampling point map



9. Appendix 2 – Photographs

Figure 4 : Grassland survey sampling point W1 – MG10

Figure 5 : Grassland survey sampling point W2 – MG10

Figure 6 : Grassland survey sampling point W3 – MG10

Figure 7 : Grassland survey sampling point W4 – MG10

Figure 8 : Grassland survey sampling point W5 – MG10

Figure 8 : Grassland survey sampling point W7 – MG10

Figure 10 : Grassland survey sampling point W8 – MG10

Figure 11 : Grassland survey sampling point D1- MG6

Figure 12 : Grassland survey sampling point D2 - MG6

Figure 13 : Grassland survey sampling point D3 - MG6

Figure 14 : Grassland survey sampling point D4 - MG6 on driest part of site with many ruderals

Figure 15 : Grassland survey sampling point D5 - MG6

Figure 16 : Grassland survey sampling point D6 - MG6

Figure 17 : Ditch survey sampling point 1A – A6 / E2

Figure 18 : Ditch survey sampling point 1B – A7b / E3

Figure 19 : Ditch survey sampling point 1C – A5b / E3

Figure 20 : Ditch survey sampling point 1D – A5b / E2

Figure 21 : Ditch survey sampling point 2A – A5b / E3

Figure 22 : Ditch survey sampling point 2C – A5b / E2

Figure 23 : Ditch survey sampling point 2D – A5b / E2

Figure 24 : Ditch survey sampling point 3A – A5b / E2

Figure 25 : Ditch survey sampling point 3B – A5b / E2

Figure 26 : Ditch survey sampling point 3C – A5b / E2

Figure 27 : Ditch survey sampling point 3D – A5b / E2

Figure 28 : Ditch survey sampling point 3E – A5b / E2

Figure 29 : Ditch survey sampling point 4A – E1

Figure 30 : Ditch survey sampling point 4B – E1

Figure 31 : River survey sampling point 2 – A8a

Figure 32 : River survey sampling point 3 – A8a

Figure 33 : River survey sampling point 4 – A8a

Figure 34 : River survey sampling point 5 – A8a

Figure 35 : River survey sampling point 6 – A8a

Figure 36 : River survey sampling point 8 – A8a

Figure 37 : River survey sampling point 9 – A8a

Figure 38 : River survey sampling point 10 – A8a

10. Appendix 3 – Consent

River Wensum Site of Special Scientific Interest Norfolk ("the SSSI")
River Wensum Special Area of Conservation (SAC)

CONSENT OF NATURAL ENGLAND

Section 28E(3)(a) of the Wildlife and Countryside Act 1981 (as amended and inserted by section 75 and Schedule 9 of the Countryside and Rights of Way Act 2000)
Regulation 21 of the Conservation of Habitats and Species Regulations 2010

To:

Mr Carrick

Of:

Castle Farm, Swanton Morley, Dereham, NR20 4JT

You have Natural England's consent to carry out, cause or permit to be carried out the operations specified below, on the land specified below.

This consent covers the period to 31st August 2017.

The specified operations:

Aquatic plant and Desmoulin whorl snail surveys

Timing of the operations:

24th July 2017 to 31st August 2017

Land on which the operations are to be carried out:

The River Wensum and adjacent land and ditches as shown on the attached maps.

Signed for Natural England:

Date: **24/07/2017**

11. Appendix 4 – Raw data tables

These excel files are available electronically at www.vattenfall.co.uk/norfolkvanguard.

12. Appendix 5 – Endgroup descriptions

3.9 The Lemna minor - Lemna trisulca - filamentous algae (A5b) endgroup

Constant species

Lemna minor, filamentous algae (Cladophora spp.), Lemna trisulca.

Nationally rare/scarce species

Ceratophyllum submersum, Myriophyllum verticillatum, Oenanthe fluviatilis, Potamogeton acutifolius, Potamogeton coloratus, Potamogeton friesii, Potamogeton trichoides, Ranunculus baudotii, Stratiotes aloides.

Regionally rare species

Nitella flexilis var. flexilis, Scirpus fluitans.

Physiognomy

The A5b endgroup is of low species diversity, possessing a mean of 5.1 aquatic species per sample, with a range of 1-11. Typically stands of the endgroup had the water surface totally covered with a mixture of Lemna minor, Lemna trisulca and Enteromorpha spp., with possibly a few rosettes of Hydrocharis morsus-ranae, whilst the ditch bottom had a blanket of filamentous algae (Cladophora spp), amongst which small clumps of submerged aquatics sometimes occurred. Ceratophyllum demersum, Callitriche spp., and Potamogeton berchtoldii/pusillus were the most frequently represented. The poorest stands of this endgroup contained only Lemna minor.

Although this endgroup possessed several nationally and regionally rare/scarce species, they were all recorded at low frequencies, and were invariably better represented within other endgroups. Ceratophyllum submersum was the only exception, occurring at its second highest frequency (0.7%) within this endgroup.

The A5b endgroup was found in association with all the emergent endgroups, but was most frequently associated with the "freshwater" Glyceria maxima - Berula erecta endgroup (E2) ($p<0.001$). The brackish endgroups E4, E5 and E6 were all significantly negatively correlated with the A5b endgroup at ($p<0.001$) ($p<0.001$) and ($p<0.01$) respectively.

Habitat

The A5b endgroup was found widely on freshwater marsh levels and rarely on those marsh levels where oligohaline conditions prevail. It occurred on all substrates, although showed a slight preference for peaty and sandy soils ($p<0.05$). 78% of stands were from ditches with water conductivities of less than 2,000 uS/cm, while 22% were classified as oligohaline (2,001-10,000 uS/cm). This was the only freshwater endgroup not to be significantly positively associated with the conductivity class of <1,000 uS/cm but instead showed a strong association with

the 1,001-2,000 uS/cm class ($p<0.001$). It was also the only freshwater endgroup that did not show a significant disassociation with the oligohaline (2,001-10,000 uS/cm) class. This suggests that A5b is probably best regarded as intermediate between the strictly freshwater and the obviously brackish endgroups. It was found within a broad range of water widths, although a relatively large proportion were below two metres (42%), while 9% were less than one metre ($p<0.001$). It was also found within the whole range of water depths, but showed a stronger preference for shallow water of <20 cm depth ($p<0.001$) than other aquatic endgroups, except for A6. The aquatic vegetation of ditches which had been choked by emergents or covered by a floating mat of swamp vegetation (eg. Glyceria fluitans/plicata, Berula erecta and Nasturtium officinale) was usually classified as A5b, as it often consisted of nothing more than a sparse cover of Lemna minor growing on what little water surface was available. These neglected ditches accounted for a large proportion of the A5b vegetation found in shallow water.

At the other extreme, A5b was also frequently found in newly cleaned ditches. Lemna spp. are mobile, ubiquitous species that are able to proliferate rapidly and so are often early re-colonisers of 'empty' ditches.

This endgroup also included eutrophic ditches in which a degraded species-poor flora exists, predominantly comprising of Lemna minor, Lemna trisulca, filamentous algae (Cladophora spp.) and Enteromorpha spp.

Succession

A newly dredged ditch containing the A5b endgroup could feasibly change to any of the aquatic endgroups, although A1 and A7b would be unlikely due to the low incidence in these endgroups of Lemna minor; however, if after a couple of years the ditch was still A5b, then there would be few endgroups to which it would be likely to change. A5b could change to A5a, although this would depend on the species present and/or their cover. Some A5b stands resembled A4 except for their larger filamentous algae and/or Enteromorpha component. A5b also showed floristic similarities with the A7a endgroup, both being relatively species-poor endgroups dominated by filamentous algae and Entermorpha spp., although Lemna spp. are not so prominent in A7a and many species found at low constancy in A5b are absent from A7a. However, many species able to tolerate eutrophic conditions are also characteristic of oligohaline vegetation - eg. Zannichellia palustis, Potamogeton pectinatus and Myriophyllum spicatum - and so are found in both A5b and A7a.

Distribution

A5b was by far the most common aquatic endgroup accounting for 30% of the ditches sampled. It was found to be ubiquitous in Broadland, except on Haddiscoe Island (LCT) which supports only the oligohaline endgroups A7a and A7b. A5b was also found at a lower concentration on the oligohaline marsh levels of Halvergate (LBH) and the upper Thurne (HW).

Affinities

Ditches within the A5b endgroup generally comprised the NVC Lemna minor (A2A/B) community and little else, although a few had the Elodea canadensis sub-community of the Potamogeton pectinatus - Myriophyllum spicatum (A11B) community, the Ceratophyllum demersum (A5) community or the Callitriche stagnalis (A16) community. The A5b endgroup has a clear affinity to Group D of the preliminary classification of Broadland dyke vegetation (Driscoll 1983) in that it represented impoverished ditches that possessed filamentous algae and Enteromorpha sp. at their highest frequency. However some of the richer stands within the A5b endgroup resemble Group C.

Table 7. Constancy table for the Lemna minor-Lemna trisulca-filamentous algae (A5b) endgroup

Species Name	Constancy %	DAFOR Values
LEMNMINO	95	1-5
FILAALGA	75	2-5
LEMNTRIS	75	1-5
ENTESPP.	60	1-5
CERADEME	33	1-5
CALLSPP.	33	1-5
POTABERC	17	1-4
POLYAMPH	13	1-4
HYDRMORS	12	1-4
ELODCANA	9	1-4
POTAPECT	9	1-5
ZANNPALU	9	1-3
UTRIVULG	8	1-5
MYRISPIC	7	1-4
LEMNGIBB	5	2-5
SAGISAGI	4	1-2
POTAFRIE	4	1-3
SPAREMER	4	1-2
CERASUBM	4	1-4
AQUAMOSS	3	1-4
CHARSPP.	3	1-4
ELODNUTT	2	1-4
LEMNPOLY	2	1-3
HOTTPALU	2	1-4
POTACRIS	2	1-2
STRAALOI	1	2
AZOLFILI	1	1-4
NUPHLUTE	1	1-3
RANUAQUA	0.5	1
RICCNATA	0.5	4
SCIRFLUI	0.5	3
RICCFLUI	0.5	5
POTALUCE	0.5	3
POTAACUT	0.5	1
NITESPP.	0.5	1
RANUBAUD	0.5	2
FONTANTI	0.5	5
RANUCIRC	0.5	1

Average species per sample = 5.1 (1-11)
Number of samples = 204
Total number of species = 38

The first four letters of the Species Name code refers to the genus, while the last four letters the species. Species not obvious from their codes can be identified against the full list of aquatic species encountered during this survey, Appendix 5.

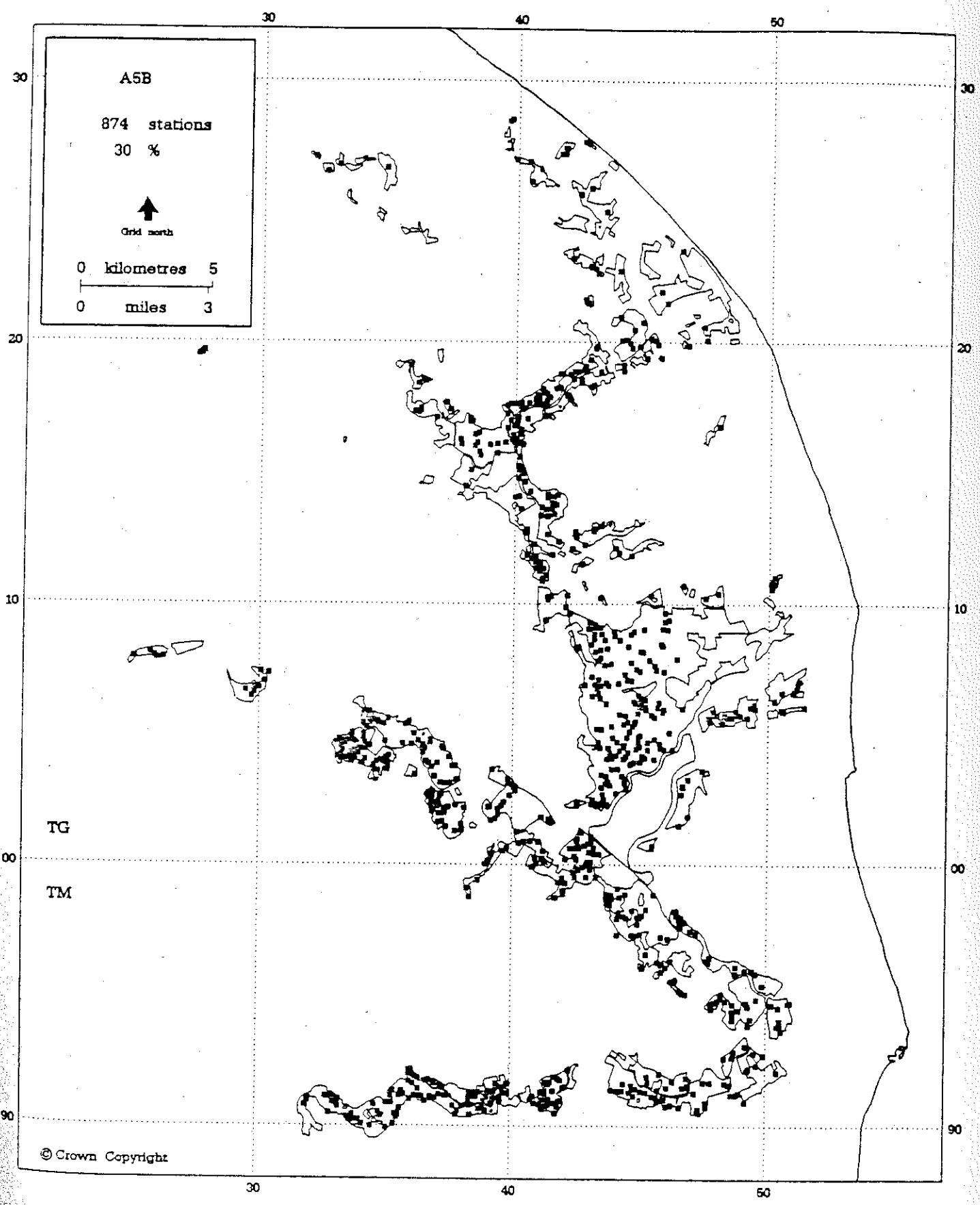


Fig. 7 The distribution of the A5b endgroup in Broadland

3.10 The Callitriche stagnalis/platycarpa (A6) endgroup

Constant species

Callitriche stagnalis/platycarpa, Lemna minor.

Nationally scarce species

Myriophyllum verticillatum, Potamogeton friesii, Ranunculus baudotii.

Regionally rare species

Nitella flexilis var. flexilis

Physiognomy

During this survey all the Callitriche species were grouped together, as Callitriche stagnalis, Callitriche platycarpa and Callitriche hamulata are often difficult to distinguish without fruit (Wigginton & Graham 1981). Much of the material identified was Callitriche stagnalis, although Callitriche platycarpa was recorded frequently. Stands within this endgroup were usually of very low species diversity, with a mean of 3.2 aquatic species per sample, and with a range between 1 and 7. The stands were typically dominated by Callitriche spp. with Lemna minor being the only other species occurring at high constancy, although usually at lower cover than the Callitriche component. The other species recorded in this endgroup were generally present at very low constancy and cover.

Nationally and regionally scarce/rare species were found at very low frequencies, and all occurred in other endgroups at much higher frequencies.

This endgroup was found in association with all emergent endgroups except the mesohaline E6. However it was usually accompanied by the freshwater emergent endgroups, particularly Glyceria maxima-Berula erecta (E2) ($p<0.001$).

Habitat

This endgroup appeared to be confined to three distinct dyke habitats in Broadland. Firstly, it was frequently found in ditches on the border between the "uplands" and the grazing marsh levels; such ditches often become dry for periods during the summer months, and may also be bounded by a hedge or woodland fringe, traditional in Broadland. Of all the aquatic species, Callitriche spp. are the ones most able to thrive under such conditions as they are both tolerant of shade and able to withstand long periods out of water.

Secondly, it was more frequently recorded in recently dredged ditches (6.2%) than would be expected by examination of the frequency of occurrence within the whole data-set (3.2%). This is probably due to the capacity of Callitriche spp. to rapidly invade new habitats, both by seed and stem fragment.

Thirdly, this endgroup only occurred at high frequency (31%) within the Waveney Valley (WV) IDB sub-area, which is one of very few gravity drained levels in Broadland. Under such conditions the water levels in the ditches can fluctuate widely, with an increased likelihood of ditches drying out during periods of drought, conditions under which Callitriche spp. are able to flourish. In some situations, if fed by springs, the water in the ditch may sustain a periodic flow. Callitriche spp. have been shown to survive in swift flowing streams (Haslam 1978), hence would easily exploit this rare flowing water habitat in Broadland.

The results show the endgroup to be found in waters of low conductivity. 75% of the stands had a conductivity of less than 1,000 uS/cm ($p<0.01$) while 98% were below 2,000 uS/cm. The Callitriche endgroup was found on the whole range of soil types, although it showed a preference for peaty ($p<0.001$) and sandy ($p<0.01$) soils, and in comparison with other freshwater endgroups tended to avoid clayey soils ($p<0.001$). The endgroup had a high proportion of its ditches with water widths of less than one metre (14%) ($p<0.01$), and with water depths of less than 20 cms (28%) ($p<0.001$), this further highlights its preference for ditches that are likely to become temporarily dry.

Succession

Callitriche spp. were recorded within all the aquatic endgroups except A1 (Potamogeton natans-Scirpus fluitans) and A3b (Stratiotes aloides-Hydrocharis morsus-ranae). However, Callitriche spp. only become dominant, with the exclusion of nearly all other aquatics, within the A6 endgroup. Once established it is likely to persist unchanged for many years, although if an A6 ditch is deepened so as to contain water throughout the year it would probably change initially, under eutrophic conditions, to the A5b endgroup. Indeed, a few stands within the A5b endgroup had abundant Callitriche spp., but with the addition of several species usually only found at low cover and constancy within A6, e.g. Lemna trisulca, filamentous algae, Ceratophyllum demersum and Potamogeton bechtoldii/pusillus. A few stands within the A6 endgroup contained more mesic elements with Potamogeton natans, Myriophyllum verticillatum, Hottonia palustris and Sparganium emersum present at low cover. Under more mesotrophic conditions where the ditch contains water throughout the year, the A2 endgroup (Potamogeton natans-Myriophyllum verticillatum, Hottonia palustis) might be expected to develop.

Distribution

The A6 endgroup occurred at a low frequency in the EFU survey being found in only 3% of the ditches sampled. This is probably an underestimation of its frequency as the survey deliberately excluded 'dry' ditches, many of which are likely to have contained this endgroup. A6 was mainly found in the middle and upper reaches of the river valleys. However it also occurred within the levels on the south side of the lower

reaches of the River Waveney, where it was associated with spring water flow. By far the greatest concentration of this endgroup is to be found within the upper-most reaches of the Waveney Valley (WV).

Affinities

The A6 endgroup closely resembles a rather species-poor version of the NVC Callitriche stagnalis (A16) community. Callitriche vegetation was not represented in the preliminary classification of Broadland dyke vegetation (Driscoll 1983). However, Callitriche sp. was found at its highest constancy within the Group A of this classification.

Table 8. Constancy table for the Callitriche stagnalis/platycarpa (A6) endgroup

Species Name	Constancy %	DAFOR Value
CALLSPP.	95	1-5
LEMNMINO	77	2-4
FILAALGA	18	2
LEMNTRIS	18	1-3
HOTTPALU	14	1
POLYAMPH	14	2-3
POTANATA	14	1
ZANNPALU	9	1-4
ENTESPP.	9	1-2
CERADEME	9	1-2
RANUBAUD	9	1
CHARSPP.	9	1
SPAREMER	5	1
POTABERC	5	4
MYRIVERT	5	5
ELODCANA	5	1
HYDRMORS	5	1
UTRIVULG	5	3

Average species per sample = 3.2 (1-7)
Number of samples = 22
Total number of species = 18

The first four letters of the Species Name code refers to the genus, while the last four letters the species. Species not obvious from their codes can be identified against the full list of aquatic species encountered during this survey, Appendix 5.

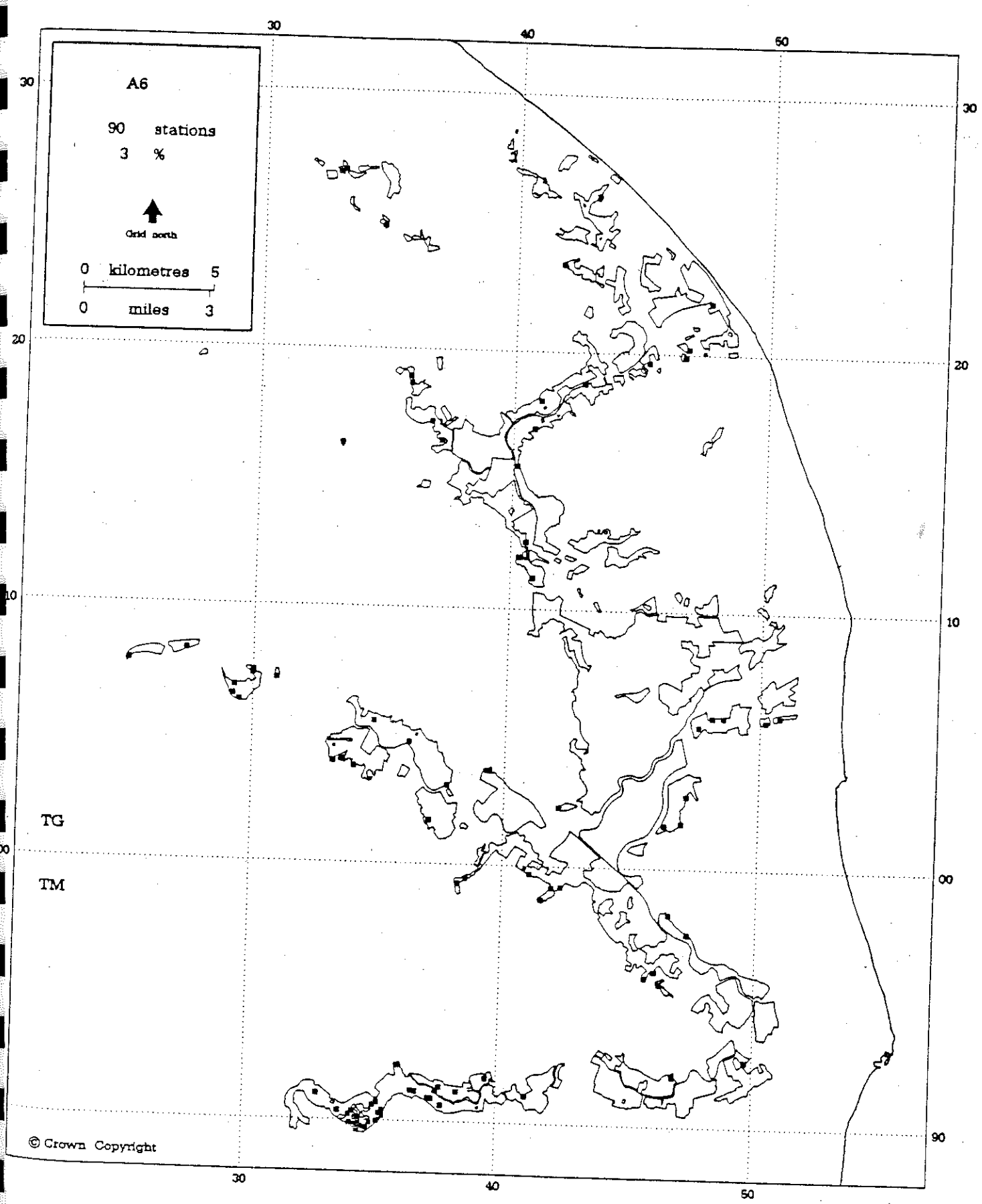


Fig. 8 The distribution of the A6 endgroup in Broadland .

3.12 The Potamogeton pectinatus-Myriophyllum spicatum (A7b) endgroup

Constant species

Myriophyllum spicatum, Potamogeton pectinatus, Lemna trisulca

Nationally scarce species

Ceratophyllum submersum, Myriophyllum verticillatum, Potamogeton coloratus, Potamogeton friesii, Potamogeton trichoides, Ranunculus baudotii, Stratiotes aloides, Chara aspera var. aspera.

Regionally rare species

Myriophyllum alterniflorum

Physiognomy

Stands within this endgroup were generally of low species diversity, possessing a mean of 4.3 aquatic species per sample, with a range of 1-11.

The most important floating species within this endgroup was Lemna trisulca, with both Enteromorpha spp. and Lemna minor at lower frequency and rarely present in any quantity. Stands were therefore relatively clear of surface vegetation, especially when much of the Lemna trisulca was growing submerged. The submerged macrophyte flora was usually dominated by mixtures of Potamogeton pectinatus and Myriophyllum spicatum, although in some stands one species was dominant in the absence of the other. Interestingly, Zannichellia palustris was rare within this endgroup (c.f. A7a). The bottom of the ditch frequently had variable amounts of filamentous algae (Cladophora spp.) while in some stands the bottom was dominated by the aquatic moss Drepanocladus sp.

The nationally scarce Ceratophyllum submersum occurred at its highest frequency (1.4%) within this endgroup, as did Ranunculus baudotii (4.4%). One of only two sites for the regionally important Myriophyllum alterniflorum was encountered within this endgroup (although note that the specimen collected could have been depauperate Myriophyllum spicatum).

Like A7a, this endgroup was found with all six emergent endgroups, although it was strongly associated with the brackish E4, E5 and E6 endgroups (all at $p<0.001$).

Habitat

The A7b endgroup was found widely dispersed throughout the oligohaline marsh levels while within freshwater grazing marsh it was usually associated with the soak dyke and adjoining ditches. Most ditches in this endgroup were brackish, 58% of the samples being oligohaline (2,001-10,000 uS/cm) ($p<0.001$), and 28% being mesohaline (10,001-20,000 uS/cm) ($p<0.001$). Like A7a, a high proportion (88%) of samples were situated on clay soils ($p<0.001$) and were found in ditches covering the whole

range of water widths and depths. However, unlike A7a it showed a strong preference for wider ditches (greater than 3 metres) ($p<0.001$) containing a greater depth of water; the 81-99cm ($p<0.01$) and the 100+cm ($P<0.05$) depth categories were preferred by this endgroup.

This endgroup is more closely associated with brackish conditions than A7a. Within the freshwater marshes, A7b ditches were often confined to the soak dyke while adjoining ditches further away from the river wall were A7a. Its affinity for soak dykes may explain its apparent preference for deep, wide ditches. Material extracted from the soak dyke is used in the maintenance of the river walls and, as a consequence of this, the soak dyke is usually the deepest and widest ditch on the marsh level. Also, many oligohaline marsh levels contained ditches that were wider and deeper than those found on comparable areas of freshwater grazing marsh.

Succession

Myriophyllum spicatum was found within all the aquatic endgroups with the exception of A6 (Callitriche spp.), while Potamogeton pectinatus was present within seven of the ten aquatic endgroups. Despite both species occurring in a wide range of endgroups, occasionally at high cover, they are best represented both in terms of constancy and cover within the oligohaline A7a and A7b endgroups.

Due to the tolerance of Myriophyllum spicatum and Potamogeton pectinatus to nutrient enrichment it is possible to envisage A7b occurring under eutrophic freshwater conditions. However this would be exceptional, as generally other species with a more freshwater bias would also be present, thus producing an A5b or perhaps A5a. Where A7b did occur in freshwater situations it was considered to be a modified form of the A5b endgroup.

There are many similarities between A7b and A7a and, as already noted, a change in endgroup could occur merely by a shift in the relative abundance of Potamogeton pectinatus, Myriophyllum spicatum, Zannichellia palustris and Lemna trisulca.

Distribution

A7b occurred at a moderate/high frequency within the Broadland grazing marshes, representing 15% of the ditches sampled. It was almost exclusively found within the most saline levels of Haddiscoe Island (LCT), Lower Bure and Halvergate (LBH) and the upper Thurne (HW). Over the rest of Broadland it occurred at very low frequency, often associated with soak dykes and river water seepage.

Affinities

The A7b endgroup is most closely related to the Potamogeton pectinatus - Myriophyllum spicatum (A11) community. This endgroup appears to be a fusion of Groups F and G in the preliminary classification of Broadland dyke vegetation (Driscoll 1983).

Table 10. Constancy table for the Potamogeton pectinatus - Myriophyllum spicatum (A7b) endgroup

Species Name	Constancy %	DAFOR Value
MYRISPIC	87	2-5
POTAPECT	83	1-5
LEMNTRIS	61	1-4
FILAALGA	57	1-5
ENTESPP.	30	1-5
AQUAMOSS	24	1-5
POTABERC	22	1-4
LEMNMINO	13	1-3
CERADEME	13	1-4
CALLSPP.	9	1-4
RANUBAUD	7	1-2
ZANNPALU	5	1
AZOLFILI	5	1-4
RANUCIRC	4	1-2
POTANATA	2	2-5
MYRIVERT	2	3
CHARHISP	1	4
POTACRIS	1	1
STRAALOI	1	2
CHARSPP.	1	3
UTRIVULG	1	4

Average species per sample = 4.3 (1-11)
Number of samples = 82
Total number of species = 21

The first four letters of the Species Name code refers to the genus, while the last four letters the species. Species not obvious from their codes can be identified against the full list of aquatic species encountered during this survey, Appendix 5.

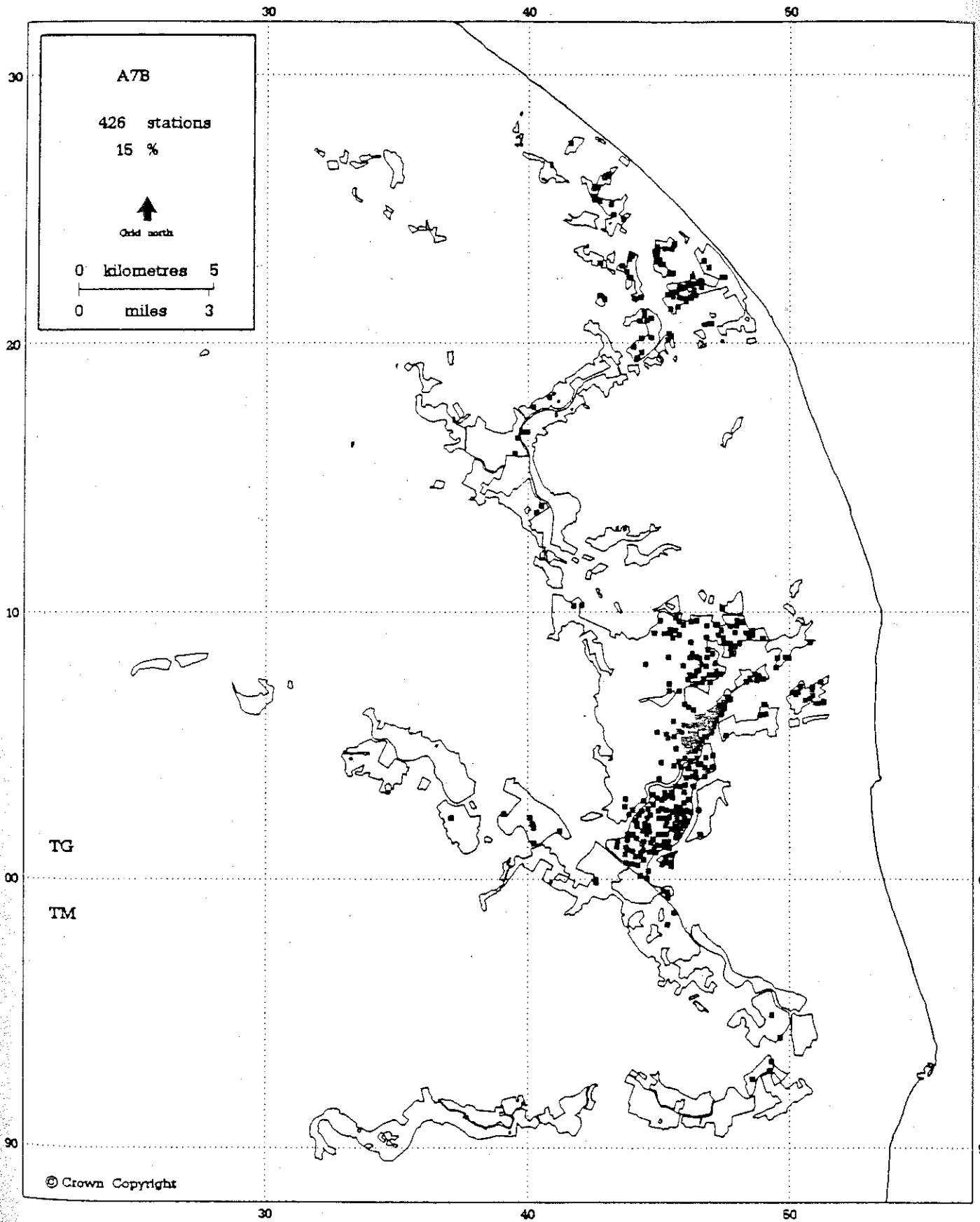


Fig. 10 The distribution of the A7b endgroup in Broadland

3.13 The Carex riparia/acutiformis - Phragmites australis (E1) endgroup

Constant species

Carex riparia/acutiformis, Phragmites australis.

Nationally scarce species

Eleocharis acicularis, Sium latifolium.

Regionally rare species

Baldellia ranunculoides, Ranunculus lingua.

Physiognomy

The E1 endgroup was of moderate species diversity, having a mean of 6.1 emergent species per sample, with a range of 1-13. The endgroup had Carex riparia/acutiformis and Phragmites australis at high constancy and, although usually present as co-dominants, in some stands one species was dominant in the absence of the other. A range of other species were frequently encountered, including Sparganium erectum, Glyceria maxima, Berula erecta, Nasturtium officinale, Mentha aquatica and Myosotis scorpioides, and a great number of other species were present at low constancy and generally low cover.

The vegetation tended to be dominated by tall perennial emergent species capable of invasive vegetative growth. Phragmites australis and Sparganium erectum often grew throughout the aquatic zone, while other species such as Carex riparia, Glyceria maxima, Berula erecta and Nasturtium officinale formed floating 'rafts' extending out from the ditch banks.

Together with E2 this endgroup possessed the greatest concentration of the nationally scarce Sium latifolium, with a frequency of 1.9%, while the only site encountered in Broadland for Eleocharis acicularis was present within this endgroup.

E1 was found in association with all ten aquatic endgroups, and showed a strong preference for the freshwater endgroups, A3a ($p<0.001$) and A3b ($p<0.001$), A4 ($p<0.01$), A2 ($p<0.05$) and A5a ($p<0.05$); while the brackish endgroups A7a and A7b were very poorly represented ($p<0.001$).

Habitat

E1 was found throughout the freshwater marsh levels, associated with upland margins, the open marsh and ditches close to the soak dyke that were often associated with enriched conditions. It was however only very rarely found within brackish grazing marsh levels. This distribution was reflected in the endgroup's preference for low conductivities, with only 20% of samples having conductivities greater than 2,001 uS/cm ($p<0.001$).

This endgroup was found within ditches covering the whole range of water widths and depths, on both peaty and clay substrates (no significant correlations). It was the least grazed of the emergent endgroups ($p<0.001$) and had the lowest occurrence of poached and shelved bank edges ($p<0.001$); both Carex riparia, Carex acutiformis and Phragmites australis are tough and unpalatable, and are usually ignored by domestic grazing animals, although they may be eaten by geese and other wild animals such as the water vole Aruicola terrestris amphibus. During late March and April these species are at their most palatable, but this also coincides with the spring flush of grass which is preferentially grazed.

Their litter is also persistent, with this vegetation often appearing as a fringe of tall fresh growth intermixed with the previous year's litter, and forming a relatively dense barrier. Although not stock proof, cattle appear to avoid it, gaining access to the ditch for drinking water where there is a break in the vegetation. E1 was frequently associated with marshes cut for silage, where the ditch edge was not mown, where ditches had been fenced and those bordering ungrazed marsh tracks, fen and carr woodland. It was also found with the E4 endgroup along soak dyke banksides adjoining the river wall.

Succession

Many factors could cause a shift in the competitive balance between the dominant species. However an increase in Phragmites australis at the expense of Carex riparia/acutiformis would lead to E1 changing to E4; this could happen as a result of increasing salinities, as Phragmites australis is more tolerant of such conditions. Stands in which Carex riparia/acutiformis is dominant, and in which Phragmites australis is absent (or only present at low cover) would be classified as either E1 or E2 depending on the other associated species. The presence of Agrostis stolonifera, Glyceria fluitans/plicata, Eleocharis palustris and Ranunculus repens would cause the stand to be classified as E2, whereas an absence of such species would indicate E1. It appears likely that increased grazing and trampling pressure would cause an E1 bankside sward to change to an E2 as the vigour of both Carex riparia/acutiformis and Phragmites australis would be reduced; at the same time a bare mud habitat would be created giving an opportunity for grazing-tolerant species indicative of E2 (Glyceria maxima, Glyceria fluitans/plicata and Agrostis stolonifera) to become established.

Distribution

E1 occurred at high frequency in Broadland, being found in 29% of the ditches sampled. It was common throughout the freshwater levels of the upper and middle reaches of the Broadland river valleys, and was also encountered within slightly saline levels such as Halvergate (LBH), but at a much lower frequency. On the more saline grazing marshes it was rare, and on some was absent altogether, eg. Haddiscoe Island (LCT).

Affinities

In NVC terms the E1 endgroup most closely resembles a transition between Phragmites australis (S4) and Carex riparia (S6) swamp communities, frequently with Sparganium erectum swamp (S14) in deeper water; a few stands of Carex acutiformis (S7) and Glyceria maxima (S5) are also included in this endgroup.

Table 11. Constancy table for the Carex riparia/acutiformis - Phragmites australis (E1) endgroup

Species Name	Constancy	DAFOR Values	Species Name	Constancy	DAFOR Values
CARERIPA	85	1-5	CAREDIST	2	1-3
PHRAAUST	74	1-5	SCIRTABE	2	1-2
SPARAREC	48	1-5	LYTHSALI	2	1-2
GLYCMAXI	44	1-5	DUPACANN	2	1-3
BERUEREC	42	1-5	ALOPGENI	2	1-2
NASTOFFI	39	1-5	CAREOTRU	2	1-2
MENTAQUA	21	1-4	EPILPARV	2	1-3
ALISPLAN	20	1-3	SCIRMARI	2	1-2
MYOSSCOR	20	1-4	GALIPALU	2	1-3
EQUIFLUV	14	1-4	CARECUTA	1	2-5
APIUNODI	13	1-5	HOLCLANA	1	2-4
OENAFIST	13	1-4	RANUREPE	1	3
JUNCSUBN	12	1-5	HIPPVULG	1	2-4
AGROSTOL	11	1-4	CALTPALU	1	1-2
GLYCSPP.	9	1-4	BIDECERN	1	2-3
JUNCEFFU	9	1-5	SAMOVALE	1	2
RUMEHYDR	8	1-3	HYPETETR	0.5	2
ELEOPALU	8	1-4	AGROREPE	0.5	3
MYOSLAXA	8	1-2	IMPACAPE	0.5	2
POLYAMPH	8	1-3	ELEOUNIG	0.5	3
CAREPSEU	7	1-4	LOLIPERE	0.5	2
EPILHIRS	6	1-3	TYPHLATI	0.5	3
EQUIPALU	6	1-2	GALIAPAR	0.5	2
IRISPSEU	6	1-4	FESTRUBR	0.5	4
PHALARUN	5	1-4	PULIDYSE	0.5	1
URTIDIOI	5	1-3	SALICINE	0.5	4
JUNCINFL	4	1-4	ARRHELAT	0.5	2
LYCOEURO	4	1-2	MOLICAER	0.5	4
VEROCATE	4	1-3	CAREELAT	0.5	2
BUTOUMBE	4	1-2	HORDSECA	0.5	1
JUNCARTI	3	1-5	TRIGPALU	0.5	2
SOLADULC	3	1-4	LYCHFLOS	0.5	2
VEROBECC	3	1-4	RANUSCEL	0.5	1
RUMECONG	3	1-2	ACORCALA	0.5	2
POLYHYDR	3	1-2	RUBUFRUT	0.5	2
SIUMLATI	3	1-3	CIRSARVE	0.5	1
CAREROST	3	1-3	STACPALU	0.5	4
CARDPRAT	3	1-3			
SCROAURI	3	2-4			

Average species in sample = 6.1 (1-13)
Number of samples = 182
Total number of species = 76

The first four letters of the Species Name code refers to the genus, while the last four letters the species. Species not obvious from their codes can be identified against the full list of emergent species encountered during this survey, Appendix 6.

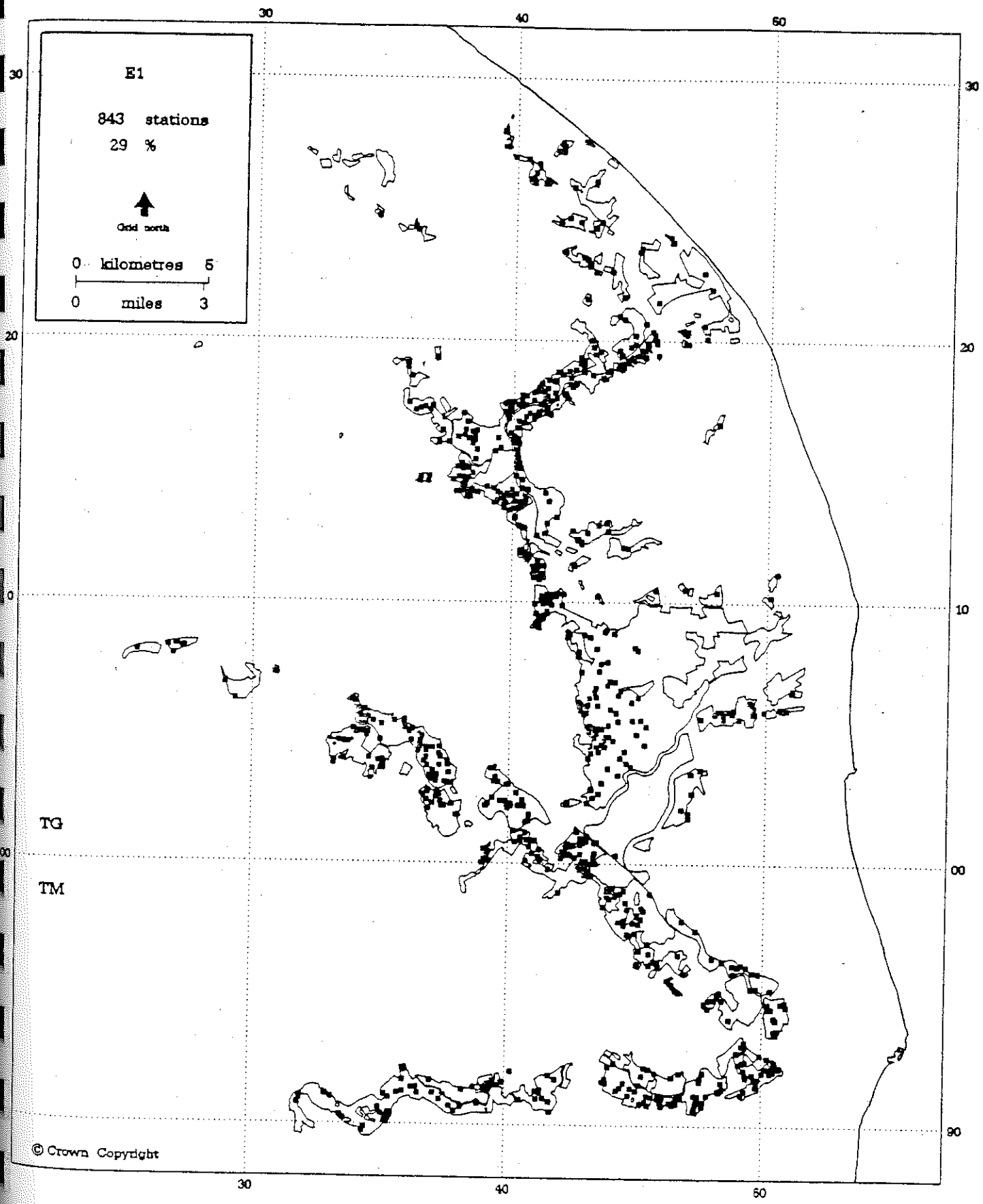


Fig. 11 The distribution of the E1 endgroup in Broadland

3.14 The Glyceria maxima - Berula erecta (E2) endgroup

Constant species

Glyceria maxima, Berula erecta, Agrostis stolonifera

Nationally scarce species

Rumex palustris, Sium latifolium

Regionally rare species

Baldellia ranunculoides, Hypericum elodes, Ranunculus lingua

Physiognomy

Stands within the E2 endgroup were of high species diversity, having a mean of 10.3 emergent species per sample, with a range of 1-27. Unlike E1 and E4, Phragmites australis was poorly represented within this endgroup, occurring in one-third of the ditches, and usually present at low cover. Unlike E3, Juncus effusus was not well represented, found within only 16% of the ditches and never as a dominant component of the flora. Conversely, species that were frequent and often at high cover included Glyceria maxima, Berula erecta, Agrostis stolonifera, Carex riparia, Nasturtium officinale, Glyceria fluitans/plicata, Sparganium erectum and Oenanthe fistulosa. E2 thus comprises all those species-rich stands in which a number of the species listed above are present as co-dominants, together with a varied array of other species at low cover. The species-poor stands found within this endgroup were frequently dominated by floating 'rafts' Glyceria maxima and or Glyceria fluitans/plicata.

As with E1, this endgroup contains an important concentration of the nationally scarce Sium latifolium, which was encountered at a frequency of 1.6%.

The endgroup was found in association with every aquatic endgroup, but tended to avoid the acid mesotrophic A1 ($p<0.05$), and the oligohaline A7a ($p<0.01$) and A7b ($p<0.001$). Many species found in this endgroup are typical of eutrophic freshwater having a high base status, eg Glyceria maxima and Berula erecta, and it is therefore not surprising that these aquatic endgroups tend not to be associated with E2. Conversely, the A5a and A5b and A6 endgroups are all positively associated with this endgroup ($p<0.001$).

Habitat

Conductivities were very similar to those recorded for E1, with 86% of stands found in freshwater ditches within the conductivity ranges of <1,000 uS/cm ($p<0.01$) and 1,001-2,000 uS/cm ($p<0.05$). E2 was found on both clayey and peaty soils although there was a preference for the latter ($p<0.001$). In common with E1, it was found within ditches covering the whole range of water widths and depths (no significant correlations).

However, unlike E1, this endgroup was frequently subjected to a higher level of grazing pressure. Some species found at high constancy and cover within this endgroup, notably Glyceria maxima, Glyceria fluitans/plicata and Agrostis stolonifera, are much favoured by grazing animals. Increased grazing pressure was also responsible for the moderate amounts of bankside poaching and shelf formation recorded. The constant disturbance caused by poaching and the shallow shelf it produces creates a range of microhabitats favouring development of a more diverse flora, with new species able to get established, particularly those germinating from seed and broken stem fragments. Species such as Berula erecta, Nasturtium officinale, Oenanthe fistulosa, Mentha aquatica and Alisma plantago-aquatica were frequently well represented in these disturbed areas. It is interesting to note that none of the grazing and bank poaching categories were significantly related to this endgroup. However, moderately shelved banks were more frequently encountered ($p<0.001$).

Succession

Reduction or cessation of grazing would probably cause some E2 stands, especially those with a moderate representation of Phragmites australis, Carex acutiformis and Carex riparia, to change to E1. Under such conditions these tall densely growing species would increase and shade out many of the lower growing grasses and herbs, while the persistent litter layer they produce would further inhibit the growth of species such as Agrostis stolonifera, Glyceria fluitans/plicata and Ranunculus repens.

There are many similarities between the E2 endgroup and some E3 stands, although the conditions under which the Juncus effusus and/or Juncus articulatus become dominant is not known. However they do appear to favour a more mesotrophic organic substrate.

Distribution

The E2 endgroup occurred at a high frequency within the Broadland grazing marshes, representing 32% of the ditches sampled. It is found throughout the freshwater levels of the upper and middle reaches of the Broadland river valleys. It was also encountered within the slightly saline levels of Halvergate (LBH), but at a much reduced frequency. It is rare in the more saline levels of Haddiscoe Island (LCT), the lower reaches of the River Bure and Halvergate (LBH) and the upper Thurne (HW).

Affinities

In NVC terms the E2 endgroup is mainly Glyceria maxima swamp (S5), although frequently forming mixed stands with Phragmites australis (S4) or Carex riparia (S6); ditches in this endgroup often having fringing Eleocharis palustris swamp (S19) and water-margin vegetation dominated by such species as Glyceria fluitans, Apium nodiflorum and Nasturtium officinale (S22, S23). As with E1, stands of Sparganium erectum (S14) are frequent in deeper water.

Table 12. Constancy table for the Glyceria maxima-Berula erecta (E2) endgroup

Species Name	Constancy %	DAFOR Values	Species Name	Constancy %	DAFOR Values
GLYCMAXI	78	1-5	SOLADULC	2	1-2
BERUEREC	62	1-4	LOTUULIG	2	1-3
AGROSTOL	60	1-5	PULIDYSE	2	1-4
CARERIPA	55	1-5	SAMOVALE	2	1
NASTOFFI	54	1-5	STACPALU	2	1-3
GLYCSPP.	50	1-5	ACORCALA	2	1-4
SPARAREC	46	1-5	HIPPVULG	2	1-4
ELEOPALU	37	1-5	CAREHIRI	1	1-4
OENAFIST	35	1-5	SIUMLATI	1	1-4
PHRAAUST	34	1-5	POTEANSE	1	1
MENTAQUA	34	1-4	SCROAURI	1	1-3
ALISPLAN	33	1-3	SCUTGALE	1	1-2
MYOSSCOR	32	1-4	CALIPALU	1	1-2
RANUREPE	27	1-4	SENEAQUA	1	3
EQUIFLUV	27	1-4	HYPETETR	1	1-2
PHALARUN	21	1-5	FESTRUER	1	2-3
APIUNDOI	18	1-5	GALIULIS	1	1-2
ALOPGENI	17	1-5	AGROREPE	1	1-2
MYOSLAXA	17	1-3	CAREACUT	1	2
JUNCINFL	17	1-5	STELPALU	1	1-2
JUNCARII	16	1-4	BALDRANU	1	1-2
JUNCEFFU	16	1-5	CAREPANI	1	2-4
GALIPALU	15	1-4	VALEOFFI	1	1
IRISPSEU	13	1-3	TYPHANGU	1	1-2
EQUIPALU	11	1-4	RANUFLAM	0.5	1
POLYAMPH	11	1-3	THALFLAV	0.5	1
VEROCATE	10	1-4	RANUSARD	0.5	1
EPILHIRS	9	1-2	RUMECRIS	0.5	1
CAREDIST	8	1-4	JUNCACUT	0.5	2
POLYHYDR	8	1-5	PHLEPRAT	0.5	2
URTIDIOI	8	1-2	EPILOBSC	0.5	1
HOLCLANA	7	2-4	CERAFONT	0.5	1
SCIRTABE	7	1-4	JUNCGERA	0.5	2
CAREOTRU	7	1-3	RANUACRI	0.5	2
LYTHSALI	6	1-2	POA.TRIV	0.5	2
LYCOEURO	6	1-3	CATAAQUA	0.5	5
VEROBECC	5	1-5	GLECHEDE	0.5	2
JUNCSUBN	5	1-5	SALICINE	0.5	1
CARDPRAT	5	2-3	FESTARUN	0.5	1
RUMEHYDR	5	1-3	CAREELAT	0.5	2
EPILPARV	5	1-3	RUMEPALU	0.5	1
RANUSCEL	5	1-3	PEUCPALU	0.5	2
RUMECONG	4	1-2	EQUIARVE	0.5	2
CIRSARVE	4	1-2	MYRIGALE	0.5	1
ELEOUNIG	4	1-4	LYSIVULG	0.5	1
BIDECERN	4	1-2	EPILPALU	0.5	2
FILIULMA	4	1-2	RUMEOBTU	0.5	1
BUTOUMBE	4	1	GERADISS	0.5	1
CAREPSEU	3	1-4	HYDRVULG	0.5	1
SCIRMARI	3	1-5	EUPACANN	0.5	1
TYPHLATI	3	1-4	MENYTRIF	0.5	1
CAREROST	3	1-5	FESTPRAT	0.5	3
LOLIPERE	3	1-4	POTEREPT	0.5	2
TRIFREPE	3	1-3			

Average species per sample = 10.3 (1-27)
Number of samples = 224
Total number of species = 107

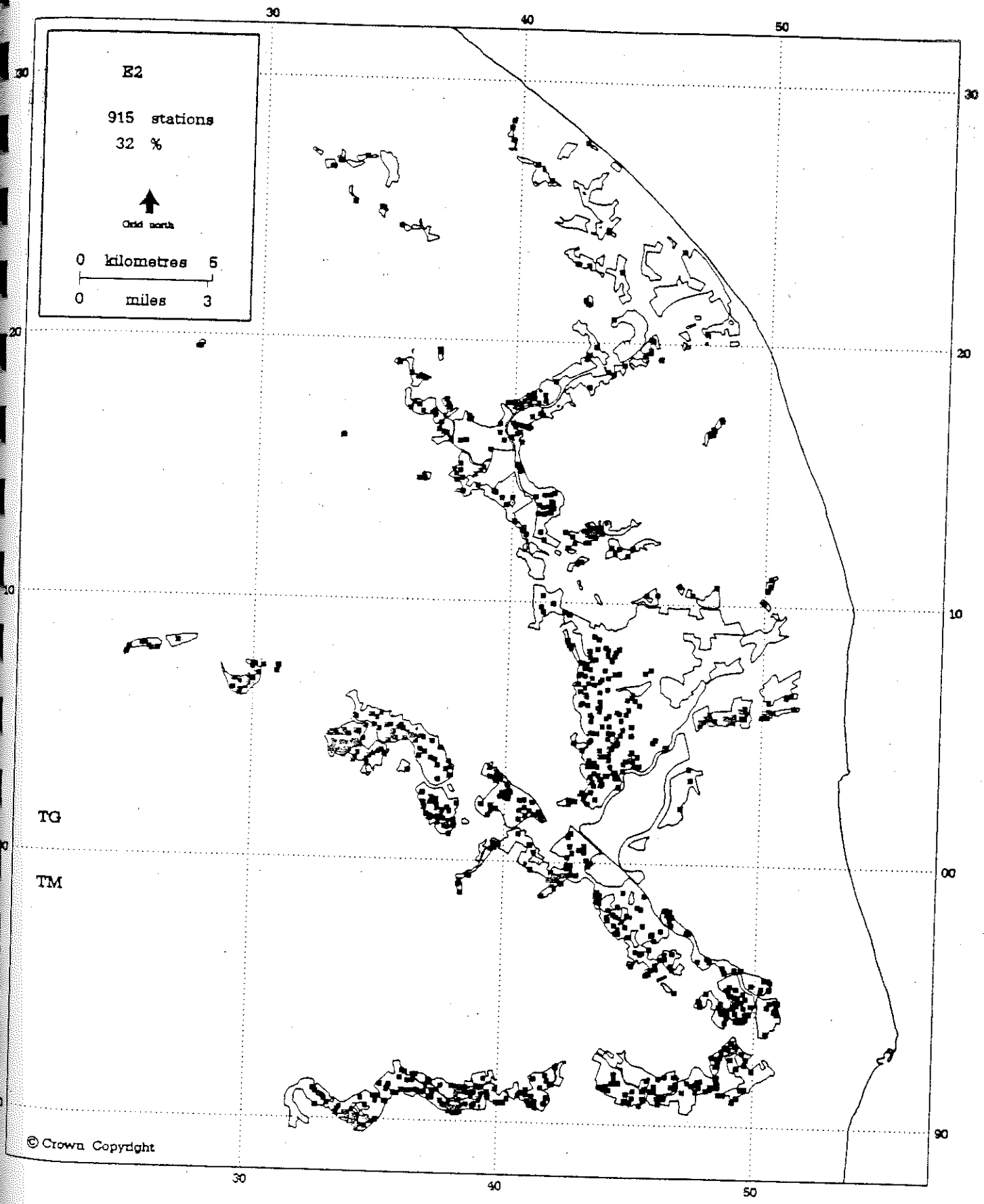


Fig. 12 The distribution of the E2 endgroup in Broadland

3.15 The Juncus effusus (E3) endgroup

Constant species

Juncus effusus

Nationally scarce species

Rumex palustris, Sium latifolium

Regionally rare species

Baldellia ranunculoides, Ranunculus lingua

Physiognomy

This endgroup had the highest species diversity of any of the emergent endgroups, with a mean of 12.0 emergent species per sample, with the range of 2-28.

Many E3 stands resembled those of E2, with Glyceria maxima, Berula erecta, Agrostis stolonifera and Glyceria fluitans/plicata well represented, however these were joined by Juncus effusus and/or Juncus articulatus at high constancy and cover. E3 was the major locus for a number of species typical of organic soils of more mesotrophic status including Cardamine pratensis, Juncus subnodulosus, Hydrocotyle vulgaris, Ranunculus flammula, Carex rostrata, Carex disticha and Lotus uliginosus.

Nationally scarce species were poorly represented, although the regionally rare Baldellia ranunculoides and Ranunculus lingua were most frequently recorded within E3, at 2.4% and 2.1% respectively.

Although E3 was found in association with every aquatic endgroup, the mesotrophic A1 and A2, and meso-eutrophic A3a and A3b were best represented (all at $p<0.001$). The only other positively correlated aquatic endgroup was the species-rich A5a ($p<0.05$). E3 tended not to occur with the species-poor A5b ($p<0.05$) and the oligohaline A7a and A7b ($p<0.001$) endgroups.

Habitat

The E3 endgroup was found throughout the freshwater marsh levels, although frequently associated with the more mesotrophic margin that abuts the uplands. This is reflected in the conductivities, with 69% of samples being less than 1,000 uS/cm ($p<0.001$), and 91% less than 2,000 uS/cm. This endgroup, although being found on both clay and peaty soils, showed a very clear preference for the latter ($p<0.001$). In common with the previous freshwater endgroups, it was found within ditches covering the whole range of water widths and depths. However it did show a preference for narrow ditches 1-2 metres wide ($p<0.01$).

This endgroup predominantly contained stands associated with peaty mesotrophic and meso-eutrophic conditions. Base-poor

stands were highlighted by its association with the acid mesotrophic endgroup (A1) and the incidence of Juncus articulatus, Hydrocotyle vulgaris and Juncus bulbosus (Clapham, Tutin & Warburg 1962, Nature Conservancy Council 1989), species indicative/tolerant of base-poor conditions. Conversely base-rich stands were associated with the meso-eutrophic base-rich endgroups(A3a and A3b) and plants typical of base-rich organic soils were well represented, eg Juncus subnodulosus (Clapham, Tutin and Warburg 1962).

E3 was subjected to moderate grazing pressure, although often slightly less than that experienced by the E2 endgroup. Several of the species found as frequent components of this endgroup are highly palatable to grazing animals, eg Agrostis stolonifera and Glyceria fluitans/plicata. However, these are interspersed by the fibrous and much less palatable Juncus component. The bankside zone often appeared as a well grazed sward interspersed by large Juncus effusus tussocks, although these sometimes formed an unbroken line along the ditch edge. Associated with the grazing pressure, the banks were often moderately poached, however an extensive bankside shelf was less frequently noted in E3 than in E2. This was probably due to the presence of the Juncus effusus tussocks along the ditch edge preventing its formation. The bare soil habitat created by poaching provides ideal opportunities for the establishment of new species, particularly those germinating from seed or broken stem fragments. Species exploiting this niche included Cardamine pratensis, Alisma plantago - aquatica, Lycopus europaeus, Galium palustre, Ranunculus flammula, Ranunculus sceleratus and Myosotis laxa. The E3 endgroup did not show any significant relationship with the three factors of bank grazing, poaching and bankside shelf.

Succession

There are floristic similarities between some stands of E3 and E2. However the exact conditions under which the Juncus effusus and/or Juncus articulatus become a dominant component of the sward are not known. However it is known that Juncus effusus produces formidable quantities of seed (Chippindale and Milton 1934, Milton 1936, 1948, Moore & Burr 1948), and that two factors have to be fulfilled for germination, these being light and a permanently moist soil surface (Moore & Burr 1948, Lazenby 1955 and Agnew 1961). Therefore successful invasion of Juncus effusus is most readily achieved on grazed, poached ditch margins. Once established a Juncus dominated sward is inherently stable, being relatively resistant to the effects of grazing and mowing. Indeed there is some evidence that the tussock form of Juncus effusus is a response to pasturing (Agnew 1961). The E3 endgroup also demonstrated the greatest affinity to mesotrophic conditions and an organic substrate than any other endgroup.

Distribution

E3 occurred at a moderate frequency within the Broadland grazing marshes, representing 11% of the ditches sampled. The majority of the samples were situated within the upper and

middle reaches of the Broadland river valleys. The endgroup was also recorded at a very low frequency within a few of the slightly saline grazing marshes, eg. Halvergate (LBH).

Affinities

The E3 endgroup is difficult to place within the NVC, although it has distinctive fringing vegetation that bears some resemblance to Juncus subnodulosus - Cirsium palustre fen-meadow (M22), Filipendula ulmaria - Angelica sylvestris (M27) mire and Holcus lanatus - Juncus effusus rush-pasture (MG10); otherwise, this endgroup contains a similar range of communities to those occurring in E1 and E2, although it sometimes has fragmentary stands of Carex pseudocyperus swamp (S17).

Table 13. Constancy table for the Juncus effusus (E3) endgroup

Species Name	Constancy %	DAFOR Values	Species Name	Constancy %	DAFOR Values
JUNCEFFU	69	3-5	CAREOTRU	7	1-2
AGROSTOL	54	1-5	SCIRTABE	7	1-2
ALISPLAN	53	1-3	EPILPARV	5	1
SPAREREC	49	1-4	MYOSSCOR	5	1-3
GLYCSPP.	49	1-4	CARENIGR	5	1-3
BERUEREC	47	1-4	CIRSPALU	5	1-2
JUNCARTI	44	1-4	SCUTGALE	5	2
ELEOPALU	42	1-4	SOLADULC	5	1-2
CARERIPA	39	1-5	SALICINE	3	1
CAREPSEU	39	1-4	LYTHSALI	3	3
MENTAQUA	39	1-3	TRIFREPE	3	2
PHRAAUST	37	1-4	POLYPERS	3	1-2
GLYCMAXI	36	1-5	TRIGPALU	3	1-2
EQUIFLUV	36	1-2	CALTPALU	3	1-2
CARDPRAT	32	1-3	TYPHANGU	3	2-3
RANUREPE	32	2-4	BIDECERN	3	1
HOLCLANA	29	3-4	ERIOANGU	3	1-3
LYCOEURO	27	1-2	LOLIPERE	3	2
JUNCSUBN	24	1-4	SALICAPR	3	1
HYDRVULG	22	1-4	CAREHIRT	3	1
PHALARUN	22	1-3	CAREECHI	3	2
OENAFIST	20	1-3	SENEAQUA	2	2
IRISPSEU	19	1-3	SAMOVALE	2	1
GALIPALU	19	1-3	PHLEPRAT	2	2
RANUFLAM	19	1-3	RANUSARO	2	1
MYOSLAXA	17	1-3	BALDRANU	2	3
NASTOFFI	17	1-2	CIRSARVE	2	1
POLYAMPH	14	1-3	ALNUGLUT	2	1
CAREROST	14	2-5	MENYTRIF	2	2
CAREDIST	14	1-3	FILIULMA	2	2
TYPHLATI	12	1-5	EUPACANN	2	2
EPILHIRS	12	1-2	HIPPVULG	2	1
RANUSCEL	10	1-2	LYCHFLOS	2	2
JUNCINFL	10	2-4	FESTARUN	2	2
LOTUULIG	10	1-4	POA.ANNU	2	2
POLYHYDR	8	1-4	POLYMITE	2	1
RUMEHYDR	8	1-2	ATRIPATU	2	1
FESTRUBR	7	2-4	RUMECONG	2	2
EQUIPALU	7	1-4	HYPETETR	2	1
APIUNODI	7	1-2	SCIRMARI	2	3
ALOPGENI	7	1-4	STELPALU	2	1
URTIDIOI	7				

Average species per sample = 12.0 (2-28)
Number of samples = 59
Total number of species = 83

The first four letters of the Species Name code refers to the genus, while the last four letters the species. Species not obvious from their codes can be identified against the full list of emergent species encountered during this survey, Appendix 6.

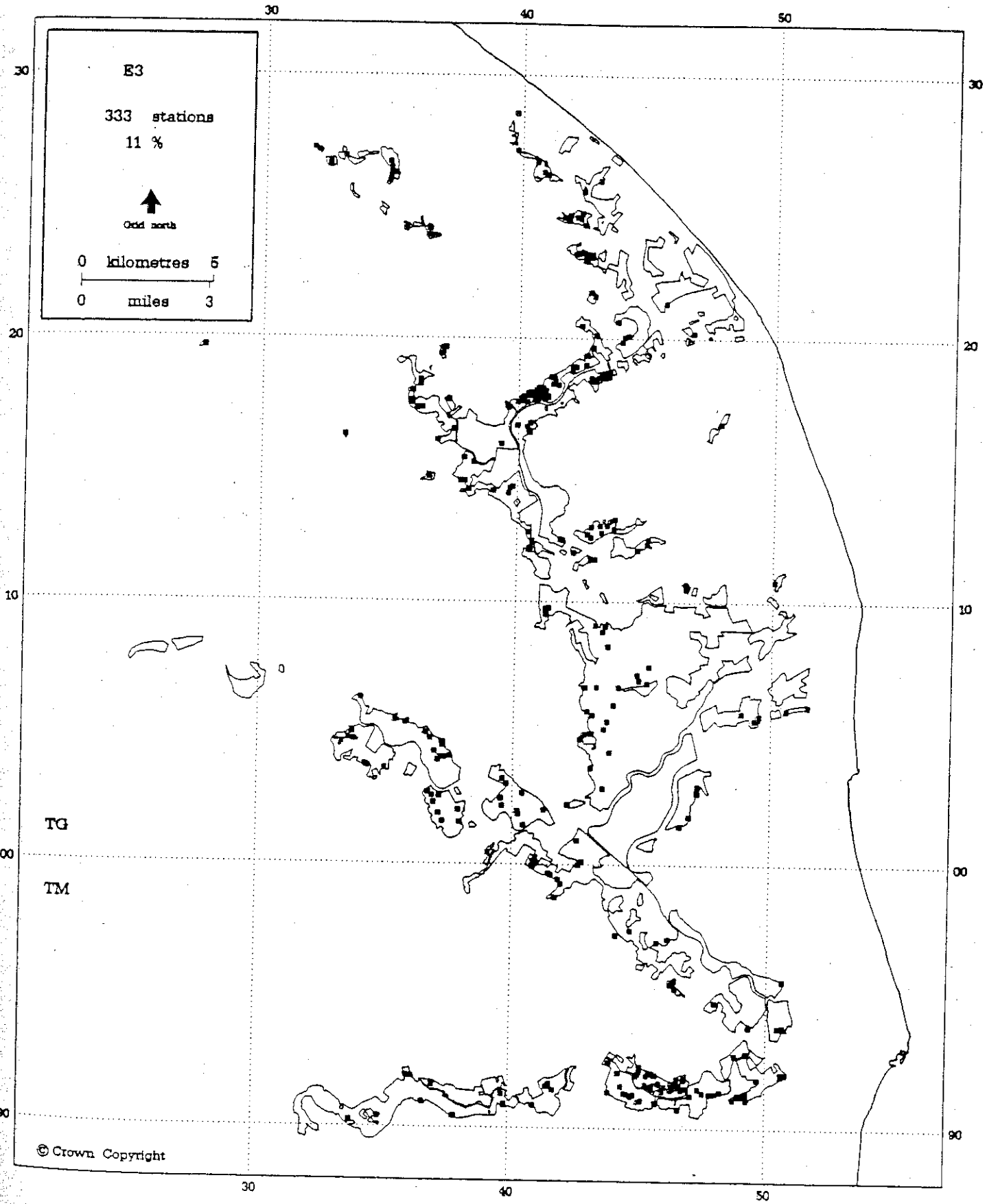
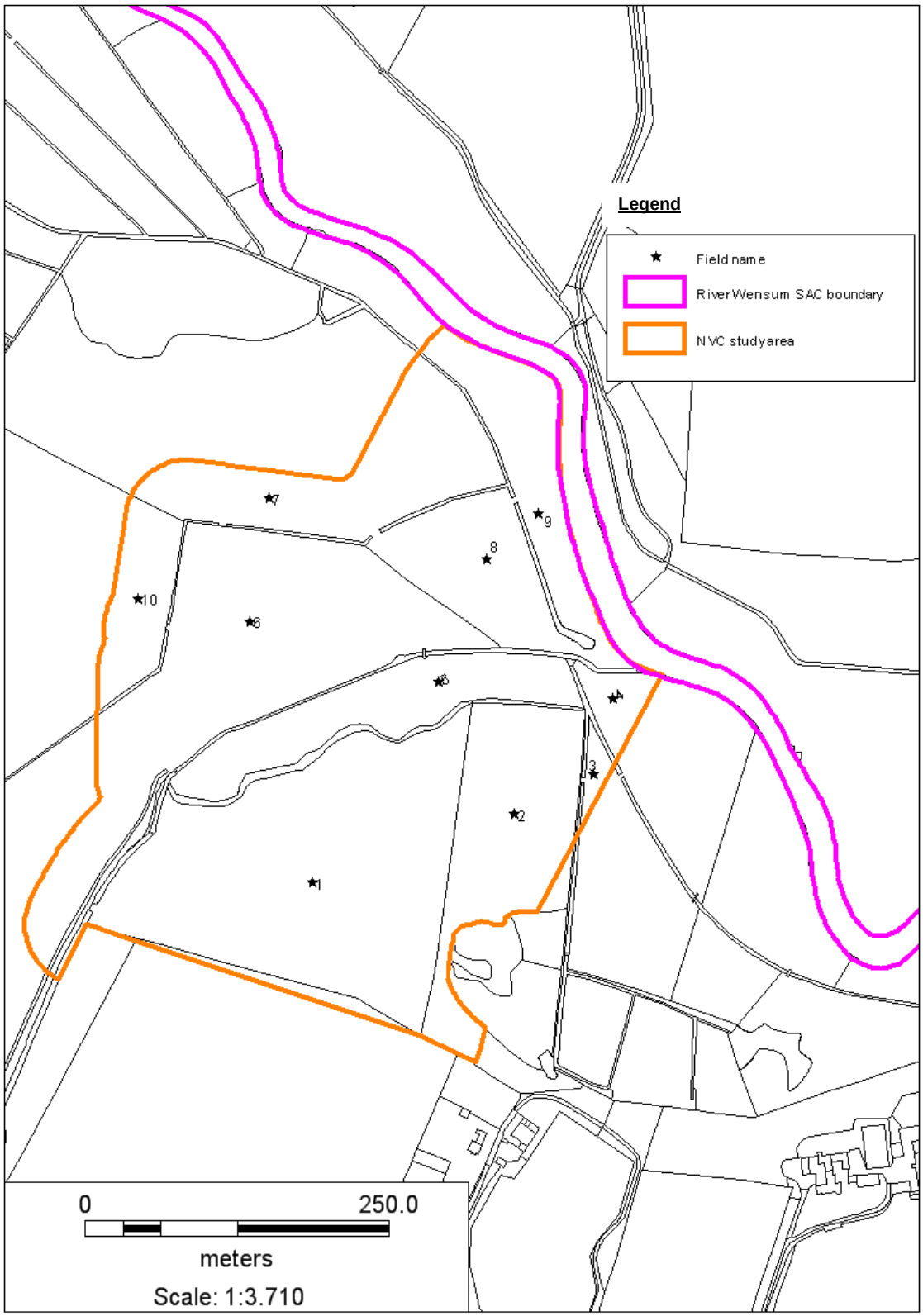
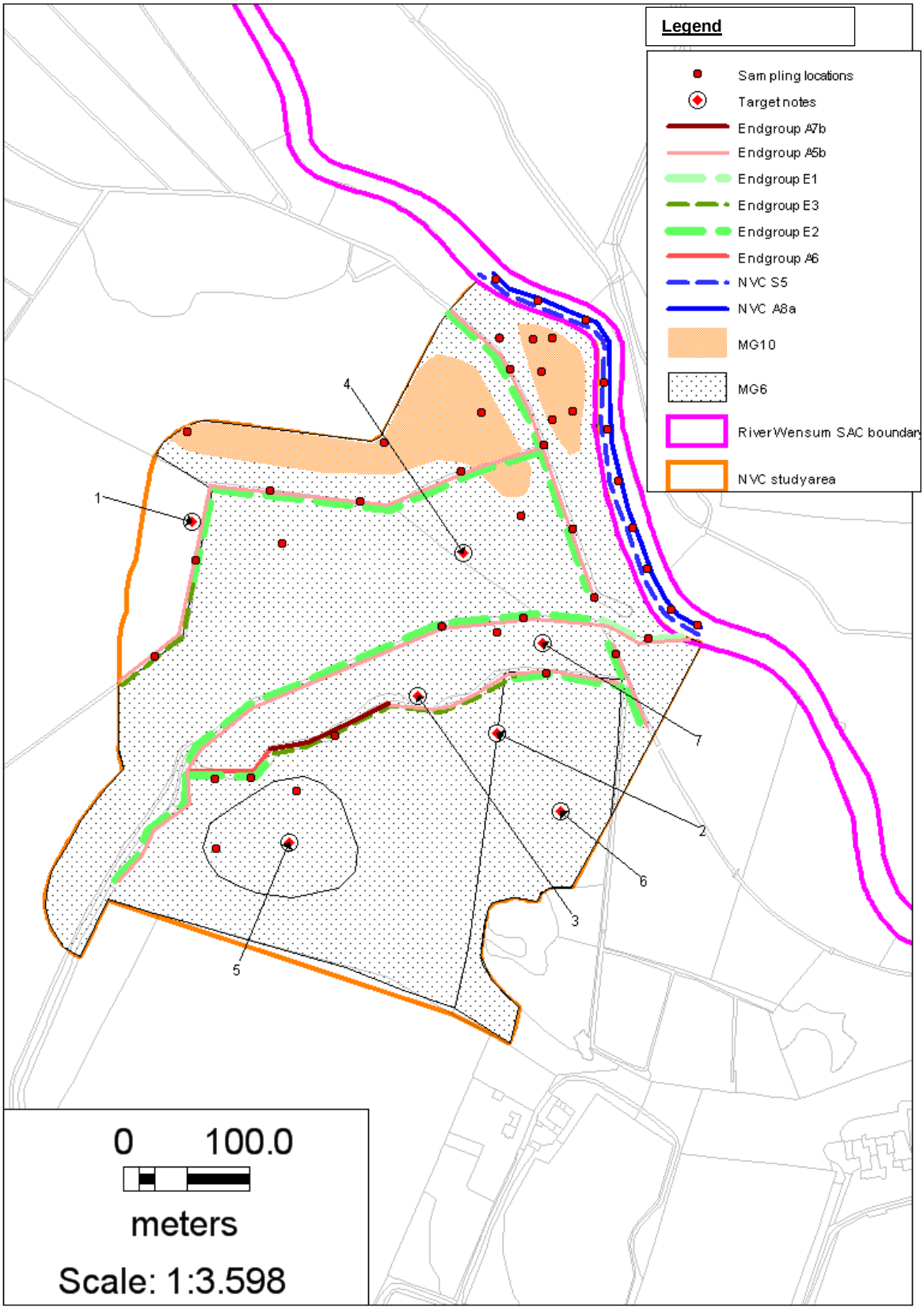


Fig. 13 The distribution of the E3 endgroup in Broadland

13. Appendix 6 – Field Name Map



14. Appendix 7 – NVC/End Group Map



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