A comparative ecological study of the spider (Araneae) faunas of East Anglian fens, England: regional differences and conservation

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Summary

For 5 years, in 1969–72 and 1974, the first detailed survey was made of the spider fauna of 44 sites on 39 East Anglian fens. These were distributed in three geographical groups, the Breckland Edge fens in north-west Norfolk, the Norfolk Broads in the east of the county, and the Suffolk Coastal fens. The aims were to compare the three faunas in relation to the ecological characteristics and differences of the regions, identify vulnerable species, and assess their conservation status and needs. Studies were also made of the past land-use of the fens during the previous 200 years and its influence on the fauna. A comparison between the distribution of surviving fens and those shown on early 19th century maps indicates severe losses.

Each region has its own characteristic fauna which can be related to the local ecological conditions and past history. An assessment of the rarer species (Nb to RDB1) showed that the Breckland Edge fens recorded the highest Conservation Quality Index, with the Norfolk Broads a close second and the Suffolk Coastal fens some way behind. However, if all the common species are included in the scoring system, statistical analysis of the Species Conservation Value Index shows that the Norfolk Broads had significantly rarer species than the other two regions, while there was little difference between the Breckland and Suffolk fens.

Ten rare species are discussed in detail and reasons considered for their present rarity status. A comparison is made of the condition of some Breckland Edge fens in 1969–74 and in 2007.

Introduction

The three counties of Norfolk, Suffolk and Cambridgeshire in East Anglia share the richest and most extensive fen habitats for fauna and flora in lowland Britain (Wheeler & Shaw, 1992). The best known, because of many years of protection, are the Cambridgeshire sites of Wicken Fen (320 ha) (Nellist, 2000), owned by the National Trust since 1899, Woodwalton Fen (208 ha), which has been a National Nature Reserve for over 50 years and first became a private nature reserve in 1910 (Bristowe, 1925; Duffey, 1973), and Chippenham Fen (117 ha), which has been studied for a shorter period but became a National Nature Reserve in 1963. All three have rich invertebrate faunas, but little was known of the spider fauna of the numerous other fens in the region. Wheeler & Shaw (1992) list approximately 150 fen areas in their botanical study of East Anglia and Lott *et al*. (2002) name 87 trapping stations for their fen invertebrate survey of 1988–90.

The purpose of the study described in this paper was to compare the spider faunas of the fens in three geographical areas in terms of species differences and relative abundance in relation to local ecological conditions. All species contribute to species richness, and this is described in detail, but we are primarily concerned with those species whose conservation needs are greatest because of habitat destruction, degradation or isolation. These factors influence especially those species with a low habitat tolerance, as they are often susceptible to even minor habitat changes. It was assumed that environmental factors such as previous land-use, reclamation for agriculture or drainage would have influenced the fauna, and an attempt was made to investigate this where evidence was available. The work was carried out on 44 fen sites (Fig. 1), which were sampled systematically over 5 years in 1969–72 and 1974. Some fens covered large areas and in these cases two or more sites were chosen for sampling. Most sites were visited once but two were sampled twice and one three times. Thirty-seven of the sites were grouped in the following geographical regions: Breckland Edge, Norfolk Broads and Suffolk Coast. A further 7 fens which were included in the survey are widely scattered in north and central Norfolk and on the Norfolk/Suffolk border and are referred to here as "Other Fens". They were not included in the analysis because of their scattered distribution. The surveys were carried out on the following dates, which were based on when enough participants were available to take part: 14–21 June 1969, 19–26 September 1970, 11–18 September 1971, 16–23 September 1972 and 8–15 June 1974. No surveys were done in 1973. The authorities for spider names are given in Appendix 1.

For unavoidable reasons the work could not be written up earlier but the delay presents an opportunity to assess some of the losses of habitat and species during the last 33–38 years. Frequent reference is made to the 1988–90 survey of Lott *et al*. (2002), who studied several groups of fen invertebrates including spiders but used different collecting techniques (pitfall and water traps). Consequently the results can only be compared in terms of presence or absence of species.

Breckland Edge

The area designated as Breckland Edge refers to a series of small fens, mostly isolated and situated in river or stream valleys or fed by springs. The water courses along which they are found mainly flow west across the sandy, often calcareous, heathlands of the Breckland region and are fed by many springs from the underlying chalk, while others flow through more acidic greensand soils into the Fenland Basin (Beckett *et al*., 1999). These

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fens also include periglacial wetlands known as pingoes, created during the last ice-age when springs continued to rise from deep below the ground ice, preventing the calcareous soils above from freezing so deeply and pushing up large mounds of chalk. With the final period of thawing the ice cores collapsed, leaving circular hollows which are all that remain of the pingoes. They were little disturbed throughout the millennia and are now one of the least altered habitats in the Norfolk Breckland. However, in contrast to the permanence of the water table in the Norfolk Broads, some of the Breckland fens have suffered from prolonged desiccation as the demand for water for agriculture and the public supply increased (Fojt, 1992). Deep boreholes have been drilled in recent years, lowering the water table so that some fens have now almost dried out. Of the survivors, the pingo fens of Foulden, East Walton and Thompson Commons are in the best condition.

In the following account these fens will be referred to as "Breckland".

Norfolk Broads

This series of lakes, known as Broads and often surrounded by extensive fenland in five river valleys in eastern Norfolk, is managed by the Broads Authority as a National Park. The water surface area of the individual Broads varies from 140 ha to less than 0.25 ha, and in the period 1971–78 totalled 835 ha excluding the rivers (George, 1992). The area of undrained herbaceous fen in

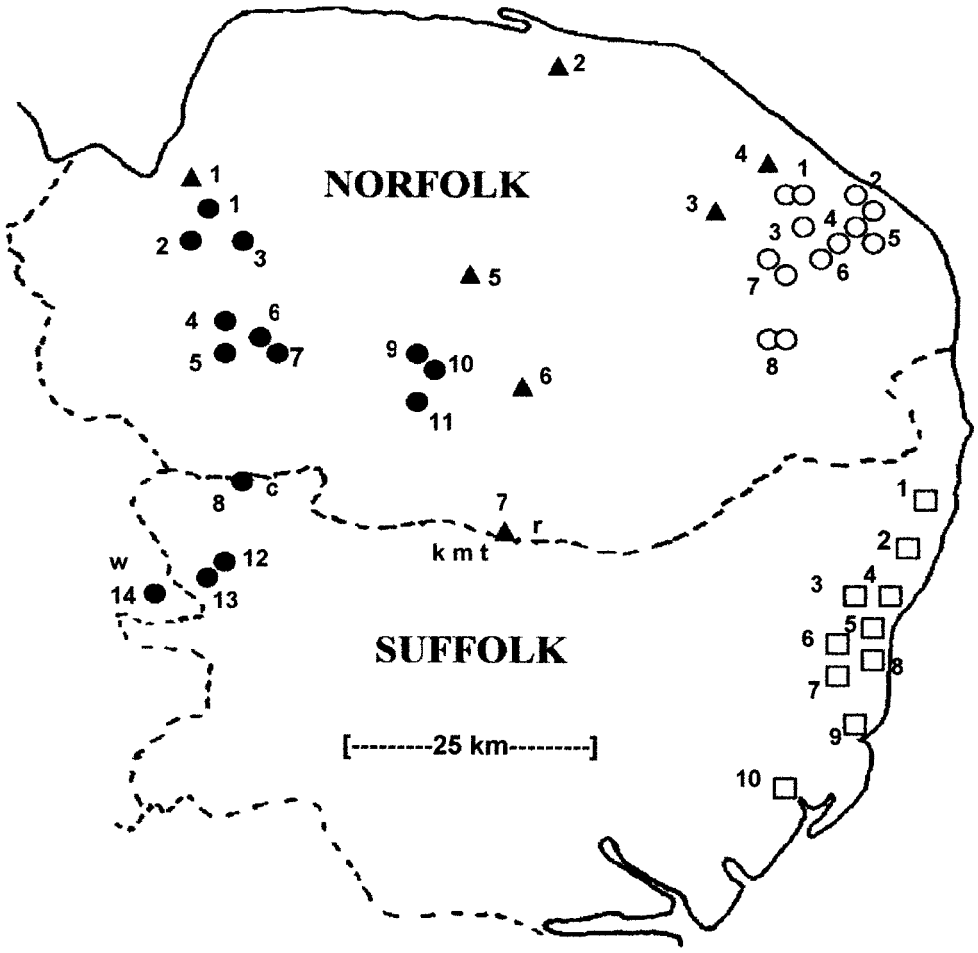


Fig. 1: Locations and names of the 39 East Anglian fens surveyed in 1969–74 and the 6 additional sites mentioned in the text which were not surveyed. ● Breckland; ○ Broadland; □ Suffolk; ▲ Other Fens.

●
1. Sugar Fen
2. East Winch Common
3. East Walton Common
4. Caldecote Fen
5. Stoke Ferry Fen
6. Borough Fen
7. Foulden Common
8. Pashford Fen
9. Thompson Common
10. Cranberry Rough
11. East Wretham Heath
12. Icklingham Poor's Fen
13. Tuddenham Fen
14. Chippenham Fen

○
1. Sutton Broad *a*
   Sutton Broad *b*
2. Hickling Broad (Meadow Dyke)
   Hickling Broad (Meadow Marsh)
3. Hoveton Broad
4. Catfield Common
5. Heron's Carr (Barton Broad)
6. How Hill Marsh
   Reedham Marsh
7. Woodbastwick *a*
   Woodbastwick *b*
8. Wheatfen *a*
   Wheatfen *b*

□
1. Benacre Broad
2. Easton Broad
3. Fen Hill Carr
4. Walberswick Common
5. Westwood Marshes
6. Sandy Lane Dunwich
7. Minsmere River Marsh
8. Dunwich Common
9. North Warren Fen
10. Butley Creek

c Wangford Carr
k Kenninghall Fen
m Market Weston Fen

▲
1. Roydon Common (Norfolk)
2. Holt Lowes
3. Buxton Heath
4. East Ruston Common
5. Scarning Fen
6. Swangey Fen
7. Redgrave and Lopham fens

r Roydon Fen (Suffolk)
t Thelnetham Fen
w Wicken Fen.

the river valleys, sometimes with a few bushes and trees, was 1649 ha in 1998, based on aerial photographs (S. Tolhurst, pers. comm. via M. George). Earlier, a Broads Authority survey of 1982 (George, 1992) identified 5500 ha of combined woodland, fen and water as well as 4000 ha of marsh grassland. Marsh grassland was not included in our survey as much is in agricultural use.

The Broads have been shown to be man-made peat excavations of the early middle ages (Lambert *et al.*, 1965). Peat excavation was at its height from 1100 to 1300 but by the end of the 14th century the pits had become filled with water. In the second half of the 20th century tourism increased rapidly, with a large number of boats using the 170 km of navigable waterways. Pollution of the water, mainly from sewage treatment plants and run-off from arable land, raised nutrient levels and caused vegetation changes. In addition there was evidence of increasing penetration of salt water into the river systems and some Broads (Moss, 1979). Nevertheless wetland conditions are maintained and the flora and fauna are rich in species which need permanent moisture.

In the following account these fens will be referred to as ''Broadland''.

Suffolk Coast

Although three of these sites are known as Broads they are ecologically unlike those in east Norfolk. The smallest was not studied but the other two, Benacre and Easton Broads, were included in the survey. They are small wetlands which formed near the outfalls of minor rivers where sandbars had blocked the flow. Both Broads were formerly much larger areas of open water, as shown in an early map of East Suffolk (Hodgkinson, 1787) and in the first 1 in. = 1 mile (2.5 cm = 1.6 km) Ordnance Survey map of 1836–40 (Ordnance Survey, 1982). However, marsh is not indicated on these maps although there are symbols available for both marsh and reedbeds. Today marsh is more extensive than open water. A little further south on the Suffolk coast are two considerably larger fens at Westwood Marshes (514 ha) and Minsmere (595 ha). Before World War II most of both areas had been drained to form meadows for cattle. The O.S. map of 1836–40 shows no marsh but there was a large reedbed south of Minsmere. At the outbreak of WWII both areas were flooded as a defence against invasion and some parts became reed beds (*Phragmites australis* (Cav.) Trin ex Steud.) with open-water areas. After the war Westwood Marshes were not reclaimed because of drainage difficulties on an eroding coastline and eventually became a National Nature Reserve. The Minsmere Marshes were bought by the Royal Society for the Protection of Birds and became one of their principal reserves for wetland birds.

The other coastal fens are smaller, isolated sites including wet heathland, marsh around a man-made lake, a meadow and marsh close to the coast near Dunwich, and a freshwater marsh which merges into the long arm of an estuary.

In the following account these fens will be referred to as ''Suffolk''.

Other Fens

As these fens do not form a coherent geographical group they were not used in the analysis but are included in the distribution maps and Appendix 1. Roydon Common in the north-west near Kings Lynn has a relic late-glacial flora of *Eriophorum angustifolium* Honck., *E. vaginatum* Linn., *Narthecium ossifragum* (Linn.) Huds. and *Vaccinium oxycoccus* Linn., which is more characteristic of northern regions of England (Beckett *et al.*, 1999). At Holt Lowes in the north and Buxton Heath in mid-Norfolk other bog plants characterise the flora, while in the south, on the Suffolk border, *Phragmites australis* and *Cladium mariscus* (Linn.) Pohl are dominant plants in the Redgrave and South Lopham Fens in the Ouse and Waveney valleys. The rich fen flora and fauna of East Ruston Fen in north-east Norfolk were largely destroyed by a serious fire following desiccation by two boreholes. Later excavation of the burnt peat created a lake when the boreholes were removed (Duffey, 2007).

Material and methods

Land use history of the fens and influence on the fauna

An historical study of the exploitation of nine of the Breckland fens over a period of 200 years before 1974 was made by Mrs G. Crompton on behalf of the spider survey team. The aim was to discover whether the intensity of disturbance and change had influenced the richness of the spider fauna. Research on the history of land-use is often difficult because the record is seldom complete and assumptions have to be made. Although activities such as grazing, peat-digging, draining and sedge (*Cladium*) or reed (*Phragmites*) harvesting are mentioned in surviving documents, it is not always possible to say how much of the fen was affected, nor the intensity of the exploitation. Tithe maps and estate survey maps prepared when land was sold usually recorded the area of the site, and there is ample evidence to show that the majority of fens had been lost and the survivors much reduced in area by the 20th century (Clarke, 1910; Ordnance Survey, 1982).

Most fens were originally set aside as commons for the use of local people who had the rights to graze stock, cut hay, dig peat and harvest various fen products. Some fens were more suitable for grazing while others with peat deposits were important sources for fuel. Mrs Crompton found that most of the acidic surface peat had been removed from the fens during the long period of exploitation and the exposed fen peat had been influenced by calcareous upland water. This, and the alternate ditch and ridge surface left when peat-digging ceased, may have caused considerable changes to the vegetation.

Fens which survived the Enclosure Acts of the 18th and 19th centuries as Poor's Land set aside for the local

community often did not suffer major change. Grazing a few animals, collecting rushes to make candles, reed and sedge for thatching, digging peat for fuel, were shared and controlled activities which allowed invertebrate habitats to survive. Fens transferred to private owners by the Enclosure Acts were vulnerable to drainage and exploitation for agriculture. By the 20th century some rural communities had achieved higher standards of living and fenland products were no longer needed. Poor's Land became neglected and used only for game shooting, allowing trees and bushes to spread.

The main conclusion of Mrs Crompton's study was that hydrological change is the most important factor in the survival of ancient fenland. The late Dr E. A. Ellis (Ellis, 1976) refers to rapid changes in the flora and fauna when a permanent water table is lowered by even a small amount. This often leads to the spread of bushes and trees, which take up more moisture and shade out some of the important plants. Ellis describes the Broadland fens of Norfolk as an ideal situation because there is a permanent high water table and some areas are subject to a daily small rise and fall due to tidal influence on the rivers. This allows aeration of the matted litter layer which benefits the microflora and numerous invertebrate animals. Chippenham Fen recorded the richest spider fauna in the Breckland group. Although used for peat-digging for many years, with occasional grazing up to 1840, there is no recorded serious attempt at drainage, although some was probably necessary during the period of peat exploitation. From about 1900 it was used only for game shooting until it was scheduled as a Site of Special Scientific Interest (SSSI) in 1951 before becoming an NNR. It is a spring-fed fen with a stable water source. This history makes it the least disturbed site. It is also larger than most other Breckland fens and these factors may be responsible for the survival of its particularly rich spider fauna and flora.

Fen habitats selected for the spider study

It was not always possible to select the same type of vegetation in which to make our collections of spiders. Where possible we chose an open herbaceous fen with a rich flora. Sometimes we had to accept a scattering of shrubs and trees, and elsewhere, especially in Broadland, two collections were made along the fringes of reed beds and, if there was no open ground, in dykeside vegetation. In the Breckland fens there was a much greater variety of fen types because the hydrology also varied, unlike Broadland. The fens sometimes consisted mainly of wet grassland and sedges rather than reedswamp and marsh plants. The litter layer of dead vegetation was usually deeper and coarser in the Broadland fens, especially in the non-commercial reedbeds, than in the Breckland fens where grasses and *Carex* spp. created a shallower layer of small fragments.

Habitat structure is discussed by the contributors to Bell *et al.* (1991) but the emphasis is on the measurement of the structural components to assess habitat complexity. Of equal importance are the microhabitats characterised by moisture, light or shade and exposure to sun and wind. Small changes in the density of the vegetation and the composition of the litter layer can make the habitat more, or less, favourable for some species.

Choice of sampling technique appropriate for site comparisons

In view of the large number of sites sampled and the 5-year period of study one might have been tempted to use pitfall traps as large numbers can be operated by one or two people. This was rejected because there is no means of assessing how well pitfall catches represent the true fauna. The disadvantages are as follows: (1) pitfall catches are biased in favour of those species which are active enough to fall into the traps; (2) it is impossible to assess the true relative abundance of species caught in pitfall traps (Topping, 1993); (3) they take species mainly from the ground surface and few from the higher levels in the vegetation; (4) they catch more specimens in open sparsely vegetated habitats where there are few obstacles to movement than where there is a well-developed dense vegetation; (5) the sex ratio is biased as usually more males are taken than females; (6) pitfalls are static and sample only a limited area; (7) their efficiency may be reduced by flooding, wind-blown debris, small mammals seeking insect prey, and from vandalism. Many arachnological studies using pitfall traps refer to collections made every 2 weeks but my own experience has shown that such traps need to be checked for obstructions almost every day, especially in wet and windy weather. Topping & Sunderland (1992) comment that "inappropriate use of the pitfall trap method is still common".

The method chosen was timed hand-collecting linked to a specific habitat for which a short description was made. Each member of the survey party collected within the habitat formation selected by the organiser and dispersed over an area of about 0.5 ha, but this was variable. The collections were made in units of 1 h, each of which was bottled separately and labelled. Initially we tried to work for 2 h in the morning and 2 h in the afternoon on a different site, but this could not be maintained and all the collections referred to in this paper were based on 2 h per person per day. The survey party varied in number depending on when volunteers were available but the majority of sites were each sampled for 9 h. In order to avoid bias the collectors were asked to take all specimens seen during each hour whether small or large, immature or adult. Only the adults have been used in the analysis because not all species can be accurately identified in the immature stage.

Although we decided that timed hand-collecting was the most accurate collecting technique it is not fault-free. There are differences in the efficiency of individual collectors and very dense vegetation is difficult to search for spiders. However, marsh vegetation is not usually too dense except where there are *Carex* tussocks. The wet ground usually has deep litter layer or a moss cover, both easy to examine. Tiredness can reduce collecting efficiency and this is why we changed our original plan to collect for 4 h/day to 2 h, one in the morning and one in the afternoon.

Efficiency of the timed hand-collection method

It is important to assess the effectiveness of any survey method which tries to record the majority of the fauna of a habitat together with a reliable estimate of the relative numbers of each species. We hoped to achieve the latter by eliminating bias in the selection of spiders collected. The separate hourly collections were intended to show how the number of newly recorded species fell in relation to duration of collecting. When an hourly collection revealed no unrecorded species it was assumed that most of the available fauna in that area had been detected. The method was first used on coastal sand-dune habitats (Duffey, 1968) from the drift-line on the beach to dune meadow which was the furthest inland. The method showed that in complex and permanent habitats, collecting had to continue for a longer period before there was a nil return. For example, figs. 3 and 4 in Duffey (1968) show that 4 h were sufficient to record the species in the transient and simple drift-line habitat but in the varied vegetation of the dune meadow the graph of the number of newly recorded species against collecting time levelled off after about 10 h although occasional previously unrecorded species might occur even after 30 h. This may have been due to some species being very rare or to new species arriving from time to time by aeronautic dispersal. Because a large number of sites were surveyed and time was short, we assumed that most of the spider species present in the area of fen being studied had been recorded when an hourly collection resulted in a nil return of unrecorded species or when 9 h collecting had been completed. Table 1 shows 24 examples of the above from the three geographical regions.

	1 h	2 h	3 h	4 h	5 h	6 h	7 h	8 h	9 h
Breckland									
East Winch Common	23	12	8	4	3	2	1	0	0
Thompson Common	18	7	7	4	3	3	1	0	0
Tuddenham Fen	24	10	7	7	7	6	3	3	0
Stoke Ferry Fen	15	10	6	3	2	2	1	1	0
East Walton Common	30	11	6	6	3	3	1	1	0
Foulden Common Sept 70	14	6	6	5	5	4	2	2	1
Foulden Common June 69	25	8	6	4	3	3	2	2	2
Chippenham Fen	22	13	7	4	2	2	1	1	1
Broadland									
Sutton Broad *a*	14	8	4	2	2	1	1	0	0
Sutton Broad *b*	18	3	2	2	2	1	1	1	1
Meadow Marsh	18	9	6	4	5	2	2	0	0
Hoveton Broad	11	5	3	3	3	2	1	1	1
Heron's Carr	16	8	2	2	2	1	1	0	0
How Hill Marsh	18	10	4	4	3	3	3	1	0
Reedham Marsh	20	7	3	3	3	2	1	1	1
Walberswick *a*	19	11	5	4	3	2	2	1	0
Suffolk									
Butley Creek	15	7	3	2	2	1	1	0	0
North Warren Fen	23	6	6	4	2	1	1	0	0
Minsmere River Marsh	25	8	5	4	4	2	2	2	1
Dunwich Common Marsh	22	6	4	3	3	1	0	0	0
Easton Broad	22	6	4	4	2	2	0	0	0
Walberswick Common	26	11	8	2	2	2	1	1	0
Sandy Lane Marsh	24	14	6	6	5	2	2	1	1
Westwood Marshes	23	10	10	8	5	5	4	1	0

Table 1: Number of newly recorded species taken with each additional hour's collection for 8 sites in the 3 geographical regions. Not all 9-h sessions ended in a nil return.

Data analysis

The species collected and the number of adult specimens of each were entered into the Fungib programme (Feest, 2006). The following biodiversity indices were calculated: species richness; biodiversity index (Simpson's, Shannon-Wiener, Berker-Parker, although only Simpson's was used in the statistical analysis since it has the largest range of values which are close to the values of other indices); species conservation value index (SCVI); standard deviation (SCVI SD); biomass index. The different sets of sites were compared by a non-paired t-test for differences in time of hand-collection. The mean values for the biodiversity indices for each set of sites were also compared by a non-paired t-test.

Results

According to the modelled species richness, including all sites, the effectiveness of the hourly collections was estimated at 70%, although in some cases Table 1 shows that it was better than this. Table 2 (a, b and c) includes the site values for each of the calculated indices. A non-paired t-test showed that the number of hours collecting was not significantly different between the three regions. In comparing the three sets of sites, non-paired t-tests of mean values for the various indices showed the following significant differences.

The headings below (in italics, see also Table 2) are defined as follows (as in Magurran, 1988): *Species richness*=the number of species in a unit sample; *Simpson's Index*=a measure of evenness/dominance calculated from the number of adult spiders of each species as a proportion of the total population; *Population*= the total numbers of adult spiders of all species; *Biomass*=the relative body mass of all adult spiders (derived from body lengths of each species as given in Roberts, 1985, 1987).

Species richness: Breckland sites (46.8 ± 10.8) vs Broadland (36.9 ± 9.92), $p=0.019$.

Simpson's Index: Breckland (15.75 ± 4.4) vs Broadland (10.67 ± 6.79), $p=0.036$.

Population: Broadland (301 ± 60.7) had a significantly ($p=0.0043$) lower population than Suffolk (452 ± 125), with Breckland (261.7 ± 83.4) even lower ($p=0.0009$).

SCVI: Broadland (7.35 ± 0.75) had significantly rarer species than either Breckland (3.924 ± 0.367, $p=0.0008$) or Suffolk (4.139 ± 0.19, $p=0.0013$).

SCVI SD: similar result to SCVI, with the differences being significant at the $p=0.0004$ and 0.0005 levels.

Biomass index: Suffolk had a significantly higher biomass (1364 ± 329) than either Breckland (889 ± 299, $p=0.0016$) or Broadland (897 ± 153, $p=0.0014$).

The above analysis infers that Broadland differs from the other sites in having fewer spiders and species but rarer spiders.

The population characteristics can be taken further by consideration of the data in Appendix 1. About one-third (34%) of the 231 species were recorded in all three regions, emphasising the large proportion of common species. The values are higher when the species recorded

Site/Index	Species Richness	Simpson	Population	SCVI	SCVI SD	Biomass	Hours
(a) Breckland							
Caldecote Fen	42	12.76	261	3.98	1.83	825	7
Chippenham Fen	51	21.65	263	4.63	3.23	850	10
Cranberry Rough	54	23.82	281	3.17	0.86	847	7
East Walton Common	61	19.60	384	4.02	2.66	1359	9
East Winch Common	53	18.53	305	3.93	2.56	1153	9
East Wretham Heath	56	13.01	451	4.00	2.74	1309	6
Foulden Common (June 1969)	47	18.20	226	4.04	1.98	851	9
Foulden Common (Sept 1970)	38	15.69	143	3.97	1.98	526	10
Foulden Common (June 1974)	27	12.54	158	4.78	2.54	462	8
Icklingham Poors Fen	39	15.47	170	3.77	1.64	595	6
Pashford Fen	33	8.37	197	3.70	1.75	595	7
Stoke Ferry Fen	41	13.50	205	3.83	1.89	566	9
Sugar Fen	57	19.66	353	3.56	1.27	1159	7
Thompson Common (June 1969)	48	13.43	312	4.02	2.65	1254	7
Thompson Common (Sept 1970)	47	14.86	235	3.87	2.54	717	9
Tuddenham Fen (June 1969)	34	7.77	204	3.68	1.79	802	6
Tuddenham Fen (Sept 1970)	67	18.83	301	3.75	2.29	1242	9
(b) Broadland							
Catfield Common	52	23.32	218	8.25	18.76	795	8
Heron's Carr	32	5.03	367	3.88	1.52	991	9
Hoveton Broad	30	5.09	318	4.10	1.40	906	9
How Hill Marsh	47	20.22	251	5.68	13.93	869	9
Meadow Dyke Hickling	31	6.64	341	10.70	23.67	1122	9
Reedham Marsh	41	7.97	305	6.54	15.23	954	9
Sutton Broad *a*	32	7.40	249	7.84	17.06	719	9
Sutton Broad *b*	29	4.31	337	10.90	24.46	891	9
Wheatfen *a*	22	6.06	390	4.09	1.50	1044	8
Wheatfen *b*	30	7.52	198	10.80	24.05	565	4
Woodbastwick *a*	50	16.67	290	7.56	18.91	878	9
Woodbastwick *b*	47	17.83	348	7.94	19.35	1032	9
(c) Suffolk							
Benacre Broad	29	4.40	411	5.72	5.06	1433	9
Butley Creek	30	6.93	364	4.07	1.46	1077	9
Dunwich Common Marsh	39	13.74	297	4.00	2.90	849	9
Easton Broad	40	15.93	363	4.20	2.88	1013	9
Fen Hill Carr	46	8.37	540	3.57	0.95	1700	7
Minsmere River Marsh	53	13.89	562	3.92	2.55	1432	9
North Warren Fen	43	15.30	412	3.65	1.63	1320	9
Sandy Lane Dunwich	61	21.36	397	4.13	2.61	1344	9
Walberswick Common	53	16.11	454	4.08	2.69	1512	9
Westwood Marshes	66	9.75	725	4.05	3.08	1960	9

Table 2: The calculated indices for Species Richness, Population, Species Conservation Value with SD, and Biomass for the three regions in (a) Breckland, (b) Broadland, and (c) Suffolk.

in two regions are counted: Broadland fens and Suffolk fens shared 38%; Breckland and Broadland 43.9%; and Suffolk and Breckland fens 46%. This agrees with the statistical analysis which showed a similar species richness between the Suffolk and Breckland fens. Further information on the differences between the faunas of the three regions is shown by the numbers of species found only in one region. The Broadland fens score only 3.9% of the 231 total; Suffolk 7.8% and Breckland 21.2%. This sequence of an increasing proportion of the total species follows the same trend of increasing habitat diversity from the Broadland fens to the Breckland fens.

Species Conservation Value Index

For statistical purposes this index was calculated by giving arbitrary values to each group of species from the very common to the most rare. These were: Abundant, 2 points; Common, 3; Frequent, 4; Local, 5; Rare, 10; Very rare, 20; Most rare, 100. Species were assigned to each category based on the comments given in Harvey *et al.* (2002). The index values were: Broadland 7.35 ± 0.75; Suffolk 4.139 ± 0.19; Breckland 3.85 ± 0.162, the SCVI SD differences being significant at $p = 0.0004$ and 0.0005 levels. The conclusion was that Broadland had significantly rarer species than either Breckland or the Suffolk fens.

However, it is possible to calculate a Conservation Quality Index (Table 3) by including only those species which have been assessed by Harvey *et al.* (2002) as very local or rare. Using a rarity system based on field experience (Merrett, 1990), scarce species were classified as Notable B (Nb), Notable A (Na) or RDB (Red Data Book, Bratton, 1991), RDB3, 2 or 1 in a sequence of increasing rarity. Values were allocated as follows: Nb, 3; Na, 4; RDB3, 6; RDB2, 8; RDB1, 10. The common species, which form the largest part of any collection, are widely distributed and usually with great habitat

Species	CQI	Breck	Broads	Suff.	Other
Clubiona rosserae	RDB1	+	–	–	–
Dolomedes plantarius	RDB1	–	–	–	+
Robertus insignis	RDB1	–	(+)	–	–
Baryphyma gowerense	RDB2	–	(+)	–	+**
Carorita paludosa	RDB2	–	+	–	–
Centromerus semiater	RDB2	–	+	–	–
Clubiona juvenis	RDB2	(+)	+	–	–
Neon valentulus	RDB2	+	–	–	+
*Zora armillata**	Na	+	–	–	–
Glyphesis servulus	Na	+	–	–	–
Hygrolycosa rubrofasciata	Na	+	–	–	–
Donachocara speciosa	Na	–	+	+	–
Entelecara omissa	Na	+	+	+	+
Marpissa radiata	Na	+	+	–	+
Hypomma fulvum	Na	(+)	+	+	–
Maso gallicus	Na	+	–	–	–
Walckenaeria corniculans	Na	–	–	+	–
Gongylidiellum murcidum	Nb	+	+	–	+
Centromerus serratus	Nb	–	–	+	–
Notioscopus sarcinatus	Nb	+	–	–	+
Saloca diceros	Nb	+	–	+	+
Walckenaeria incisa	Nb	–	–	+	–
Sitticus caricis	Nb	+	+	–	+
Crustulina sticta	Nb	+	–	+	+
Theridiosoma gemmosum	Nb	+	+	+	+
Total CQI		60 [72]	49 [67]	31	52

Table 3: Conservation Quality Index values for recorded rarities in the three regions and the ''Other Fens''. The CQI assessments (RDB1 to Nb) follow Harvey *et al.* (2002) except for *B. gowerense* which was not included (this assessment is my own).
( ) Recorded by Lott *et al.* (2002) but not by 1969–74 survey.
[ ] Total CQI score if Lott *et al.* (2002) and earlier records of *Z. armillata* are included.
*Not recorded in 1969–74 or in 1988–90 but there are earlier records (Harvey *et al.*, 2002).
**11 specimens of this species were taken in June 1974 at East Ruston Common but later the fen was drained and burnt. Natural England decided to excavate and two lakes were formed (Duffey, 2007). Not known whether *B. gowerense* has survived.
Scores: RDB1=10; RDB2=8; RDB3=6; Na=4; Nb=3.

tolerance, were not included. For completeness, Table 3 also includes a few rare species recorded by Lott *et al.* (2002) but not by our survey. Breckland scored the highest CQI followed by Broadland with Suffolk some way behind. The CQI values provide another aspect of the conservation interest of the three regions.

Faunal differences between two collecting sites on the same fen

The collections of spiders were made in a limited area of each fen because the party was small and we worked in a specific type of vegetation. However, it is well known that the species and their numbers are generally not identical when taken from different areas of the same fen. On three occasions we were able to collect in two separate areas within the same fen, at Wheatfen, Woodbastwick and Sutton Broad in the Norfolk Broads. Table 4 illustrates examples of the differences in numbers and species on the two sites in each of these three fens.

Wheatfen Broad

Collecting in each site resulted in 22 species on site *a* and 30 on site *b*, all the more remarkable as twice as many hours were spent collecting in *a*. However, the differences in fen vegetation were very obvious. Wheatfen *a* was a relatively uniform sward of *Glyceria maxima* (Hartm.) Holmb., most of which had fallen horizontal. The soil was waterlogged and the litter layer 15 cm deep with many holes and fibrous roots. Site *b* had a more varied flora with a field layer of 50 cm to over 1 m. The flora included *Juncus subnodulosus* Schrank, *Rumex hydrolapathum* Huds., *Peucedanum palustre* (Linn.) Moench, *Filipendula ulmaria* (L) Maxim., sedges and grasses. The soil was waterlogged with a deep litter layer. Site *b* recorded 4 spider rarities not found in site *a*, *Carorita paludosa*, *Centromerus semiater*, *Donacochara speciosa* and *Entelecara omissa* (Table 5).

Sutton Broad

Site *a* vegetation was very varied, with *Phragmites*, *Cladium*, *Peucedanum palustre*, *Myrica gale* Linn. and *Salix repens* Linn. The peaty soil and leaf litter were wet. Site *b* was much more open with short vegetation, not shaded by tall plants, consisting mainly of *Carex* sp. tussocks growing through a carpet of mosses. A few taller plants were present: *Juncus subnodulosus*, *Molinia caerulea* (L.) Moench and *Schoenus nigricans* Linn. The moss carpet recorded particularly high numbers of *Carorita paludosa* and *Sitticus caricis* (Table 5).

	Wheatfen			Sutton			Woodbastwick		
	a	*b*	Total	*a*	*b*	Total	*a*	*b*	Total
Number of species	22	30	32	32	29	43	47	50	61
Total adult spiders	388	198		253	337		258	236	
Total number of adult and immature spiders	1069 (1203)	573 (1289)		926	1136		877 (1128)	1360 (1224)	
Number h collecting	8	4		9	9		7	10	
Number of species occurring in both sites	20 (62.5%)			18 (41.9%)			36 (59.0%)		

Table 4: A comparison of the numbers of species and spiders collected on the same day at two different sites on each of three fens in Broadland; Woodbastwick Fen 22 September 1970, Wheatfen and Sutton Fen 17 September 1971. Figures in brackets=totals adjusted to 9 h collecting.

	Wheatfen		Sutton		Woodbastwick	
	a	*b*	*a*	*b*	*a*	*b*
Stenotopic species						
Carorita paludosa	0	21	5	155	1	5
Centromerus semiater	0	1	0	8	1	18
Sitticus caricis	0	0	0	31	0	0
Hypomma fulvum	0	0	3	0	0	0
Donacochara speciosa	0	5	2	0	0	0
Mesotopic species						
Aphileta misera	0	0	14	0	0	0
Diplocephalus permixtus	20	8	0	2	1	0
Allomengea vidua	15	21	38	9	1	1
Leptorhoptrum robustum	4	0	0	0	7	5
Walckenaeria antica	0	0	1	0	6	19
Entelecara omissa	0	1	3	0	0	1
Rugathodes instabilis	0	0	1	0	1	0
Eurytopic species						
Bathyphantes approximatus	130	58	63	8	19	20
Bathyphantes gracilis	21	5	48	8	10	12
Lophomma punctatum	60	21	6	4	14	3
Tallusia experta	35	7	1	11	37	20
Antistea elegans	28	11	7	10	6	5
Pachygnatha clercki	6	1	11	18	15	18
Porrhomma pygmaeum	9	2	5	15	41	41
Gnathonarium dentatum	3	4	9	1	2	13

Table 5: Numbers of some stenotopic, mesotopic and eurytopic species collected from two different sites on each of three Broadland fens, September 1974.

Woodbastwick Fen

The vegetation at the two sites was similar in plant species. Site *a* was a narrow zone of uncut *Thalictrum flavum* Linn., *Calamagrostis canescens* (F. H. Whig.) Roth and sedges, *Phragmites* and *Cladium* in wet litter and moss. Site *b* was similar but less varied and shaded by alder (*Alnus glutinosa* (Linn.) Gaertn.) and sallow (*Salix* sp.) bushes. There were many similarities between the faunas of sites *a* and *b* but the shade effect may have contributed to the larger numbers of *Centromerus semiater* (18) in site *b* and only one in site *a*. More immature spiders were recorded in site *b* (total 1124, at a rate of 112.4/h) while site *a* recorded 619 (88.4/h).

The results of this test show that different parts of the same fen had different faunas on the same day. This is to be expected where there is a change in the vegetation. Even uniform swards such as the *Glyceria maxima* at Wheatfen *a* recorded variations in species and numbers within the same collecting area. The main conclusions are that by surveying a second site on the same fen the percentage of additional species may be increased by as much as 41.2% (range 29.8–48.3%). The number of spiders, adult and immature, did not vary greatly when the Wheatfen and Woodbastwick totals are adjusted to 9 h collecting. This may suggest that there is a limit to the number of spiders which can be maintained by the food and other resources of the habitat irrespective of the number of species present. The variation in the percentage overlap does not appear to be influenced by species richness or by vegetation changes.

On the other hand, individual species are often greatly influenced by vegetation differences. Table 5 classifies some species recorded at Wheatfen, Sutton and Woodbastwick fens according to ecological characteristics. The habitat specialists which are tolerant of only a narrow range of biotopes are termed ''stenotopic'', while the more tolerant which may favour a particular habitat or more than one, but are less frequent elsewhere, are ''mesotopic'', and the most common, often found in a wide range of different environments, are ''eurytopic''. This classification of species in 3 Broadland fens is supported by the values of Species Richness and means of SCVI in Table 2(b).

There are no firm boundaries between these groups because the ecological differences between species are infinite and complex, forming a topocline from narrow specialisation to a wide tolerance of habitat types. Stenotopic species are generally rare or very local because their specialised habitats are rare, while those classified as eurytopic form the majority of most general collections.

The diplostenoecious phenomenon

This describes the widespread ability of some species to change their habitat tolerance according to the geographical region in which they occur, a characteristic first described by Bristowe (1939) but not named. *Clubiona juvenis* (Fig. 2) was widespread in the Broadland fens and also taken in Breckland by Lott *et al.* (2002). On the continent of Europe it is widespread but recorded mainly from wetlands (Pühringer, 1975; Decleer & Bosmans, 1989; Hänggi *et al.*, 1995; Van Helsdingen, 2006; Le Peru, 2007). On the German Baltic coast (von Bochmann, 1941) it was common on mobile and fixed dunes. It also occurs on coastal dunes on the east coast of Ireland (Locket & Millidge, 1951), where I have collected it. This adaptation by *C. juvenis* to two contrasting habitats has so far been recorded only in northern Europe. Other examples are described in Duffey (2005).

The genus Walckenaeria

Of the 21 species of this genus on the British list, 14 were recorded in the 3 groups of fens (Table 6). Six were found in all regions including the ''Other Fens''. *Walckenaeria antica* and *W. nodosa* were more common in Broadland and *W. vigilax* in Breckland, where the genus was otherwise poorly represented. Suffolk, which scored the lowest CQI (Table 3), having few national rarities, recorded 12 out of the 14 species including the least common, as well as the highest score for 4 others. Of the 30 *W. kochi* taken in Suffolk, 27 were collected in Butley Creek marsh, which is situated at the inland end of a long estuarine creek influenced by the rise and fall of the tide. The 5 singletons in our list, *W. monoceros*, *W. cuspidata*, *W. furcillata*, *W. corniculans* and *W. incisa*, were all taken in Suffolk but it is not possible to say whether this has any ecological significance. However, the large number of *Walckenaeria* species and the second highest total number of species (Appendix 1) are probably responsible for the SCVI means for Suffolk being comparable with those of Breckland (Table 2(c) and (a)), 4.14 and 3.92 respectively.

Discussion

The ecological characteristics of the three regions include differences in numbers of species and their representation. Some of the clearest differences are in the distribution and numbers of national rarities. Few were found in Suffolk but more in Breckland and Broadland, where each had different species.

Causes of rarity

Rarity in plants and animals has been discussed by numerous authors (Kunin & Gaston, 1997). There are many possible causes including competition, predators, trophic levels, evolutionary traits, genetics, and tolerance or intolerance of particular habitats. Rosenzweig & Lomolino (1997) comment that as rare species are often conservative in variation a side effect is the risk of being abandoned in an ecological backwater. Such species may occur in rare specialised habitat patches too small for panmixis with related species. In addition, Bonte *et al.* (2003) concluded that where habitats have become fragmented and separated by longer distances, the dispersal ability of rare spiders becomes less effective so that they are exposed to higher extinction chances than their more eurytopic conspecifics. This seems to be supported by the information on habitat and distribution of some rare spiders taken in this survey, though we still know nothing about the dispersal abilities of these species.

Neon valentulus (Fig. 3) is an RDB2 species in Britain with a distribution confined to East Anglia. The known records are Chippenham and Wicken fens (Cambs), Foulden Common and Roydon Common (Norfolk) and Roydon Fen (Suffolk). In the pingo fens of Foulden, where it was frequent in 1969–74, the habitat was rather short vegetation of sedges, grasses and *Juncus* sp. with mosses by the margins of standing water. At Roydon Common only one specimen has been taken (♀), in low, open vegetation of sedges, grasses and *Narthecium ossifragum* on firm but moist ground. In Chippenham Fen it occurred in moist grassland, mostly *Molinia caerulea*, not far from open water and reedswamp, the whole forming a clearing in a bush-covered area. In Sweden it occurs in *Sphagnum* and lichens in bogs and in litter under juniper (Almquist, 2006). In the Czech Republic it is ''rare, among moss on marshy pond margins and on peat bogs'' (Buchar & Růžička, 2002). In France Le Peru (2007) reports four records but the habitat information is not detailed. *Neon valentulus* does not seem to occur in tall reedswamp and prefers shorter marginal vegetation. The East Anglian habitat data show two important characteristics: (1) all the known sites are of ancient origin and have persisted as fens probably for several hundreds of years; (2) three fens close to Foulden Common (Caldecote, Borough and Stoke Ferry), where it may have occurred in the past, have now been so disturbed, converted to agricultural use or drained, that the habitat is no longer suitable. *Neon valentulus* is a stenotopic species in Britain and sensitive to habitat change. Its scattered distribution in East Anglia seems to indicate a relic population, formerly more widespread.

Species	Breckland	Broadland	Suffolk	Other Fens
acuminata	13	5	29	4
nodosa	5	37	5	2
nudipalpis	7	18	24	2
unicornis	6	11	41	7
kochi	3	17	30	1
antica	5	124	–	11
atrotibialis	9	2	2	7
vigilax	24	–	–	7
monoceros	2	–	1	–
cucullata	–	–	2	1
cuspidata	–	–	1	–
furcillata	–	–	1	–
incisa	–	–	1	–
corniculans	–	–	1	–
Totals	74	214	138	42

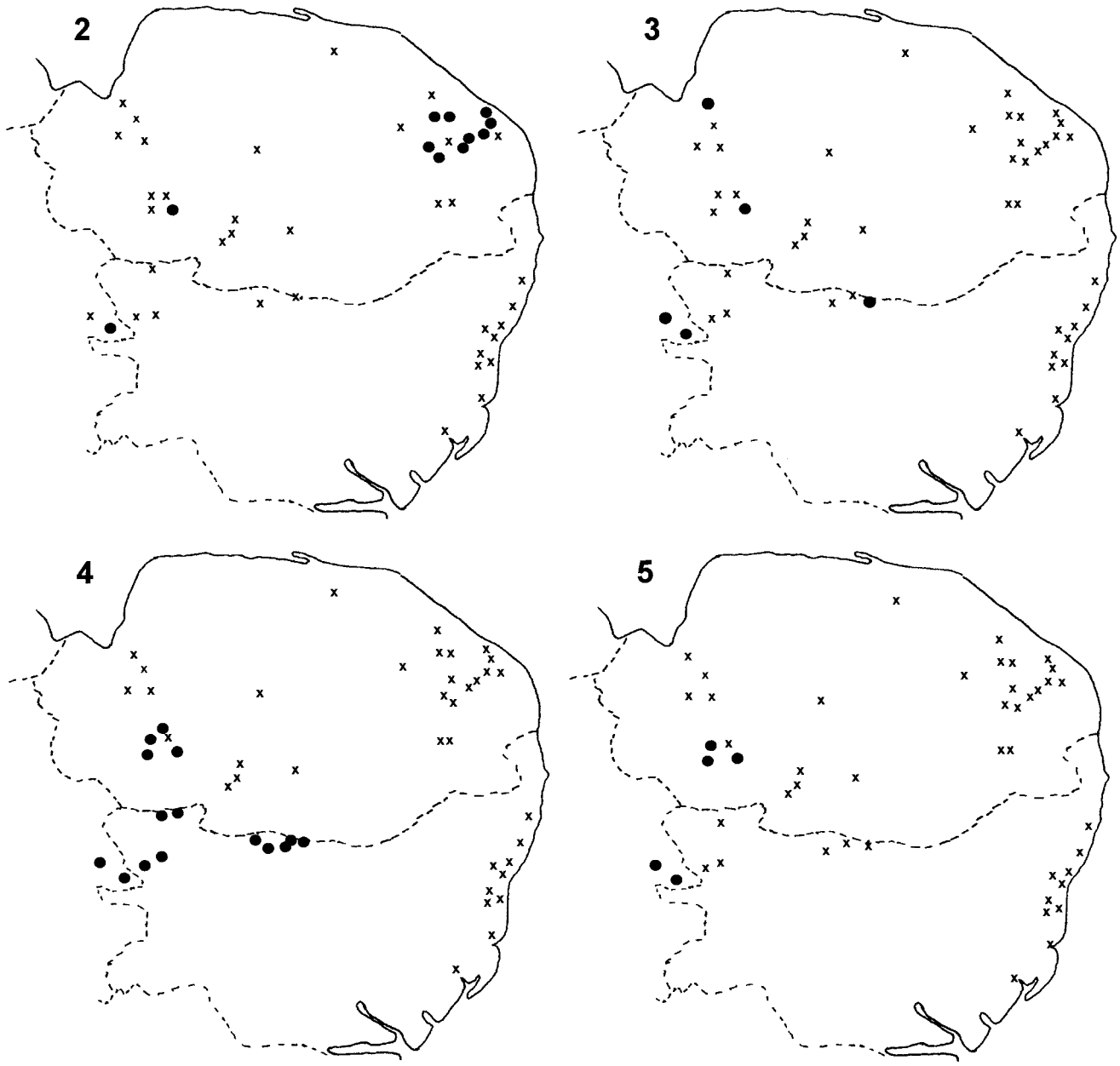
Table 6: Fourteen *Walckenaeria* species recorded in 1969–74 based on 9 h collections. Broadland did best for numbers but Suffolk scored 12 species and the Broads only 7. The high numbers for a particular region may indicate habitat preferences but more research is needed.

The mesotopic *Hygrolycosa rubrofasciata* (Na) may also be in decline. It has a wider distribution than *N. valentulus* and was confined to Breckland in our survey but other known records are marked in Fig. 4 (Lott *et al.*, 2002; Harvey *et al.*, 2002). The most frequently recorded habitat was wet open woodland, as at Foulden Common, Stoke Ferry Fen, Caldecote Fen, Pashford Fen, Tuddenham Heath and Chippenham Fen. However, at Icklingham Poor's Fen the habitat was open mixed fen with large tussocks of *Carex paniculata* and *C. appropinquata* Schumach. Relatively dry open fen was recorded by Lott *et al.* (2002) at Boughton and Kenninghall Fens (both in Breckland), but at Wangford Carr (close to Pashford Fen) *H. rubrofasciata* was taken in a small clearing in oak/birch (*Quercus*/*Betula*) woodland where the *Phragmites* and *Calamagrostis canescens* may also have been relatively dry. In Sweden *H. rubrofasciata* is recorded from fens with shrubs, bogs and damp meadows (Almquist, 2006); in the Czech Republic from alder forest, marshy pine forests and reedswamps (Buchar & Růžička, 2002); in France, from a river margin, marsh by a canal, pine forest, heathland, bogs, grassland and an abandoned field (Le Peru, 2007). These habitat details are not sufficiently precise to enable one to assess the range of habitat tolerance, but although rather scarce or even rare in parts of continental Europe it is associated with a wide range of habitats, some of which are not fens.

The main concern about *H. rubrofasciata* in East Anglia is that so many of the Breckland fens, where it was recorded in 1969–74, have been degraded, drained or used for other purposes. Stoke Ferry Fen is now very overgrown, Pashford Fen has been used for intensive cattle grazing, Icklingham Poor's Fen has been destroyed by drainage for agriculture, and Caldecote Fen is drier and thickly overgrown. Both Stoke Ferry Fen and Caldecote Fen have been removed from the SSSI list by Natural England. In Suffolk the records are widely

scattered. There are two records for Redgrave and Lopham Fens in 1960 but none since. The recently changed management regime, including pony and sheep grazing on part of this nature reserve, may have resulted in modified habitats unfavourable for this lycosid. I have recorded it in Market Weston Fen in an open area of sedges, grasses and reed adjacent to bush-covered dry land, and there are records for Reydon Wood (Wangford) in East Suffolk (Harvey *et al.*, 2002). Although *H. rubrofasciata* is clearly tolerant of open fens and some relatively dry habitats its preference for wetlands with trees and bushes but short ground vegetation is repeated in several European records. Unfortunately it is this habitat which is disappearing from the Breckland fens, or the surviving sites are changing by neglect.

Most of the other Notable species in Breckland are not confined to fen habitats and tolerate a wider habitat range. *Maso gallicus* (Nb: Fig. 5) was recorded only in the Breckland fens both in our survey and in Lott *et al.* (2002). This species was fairly frequent in Foulden Common, Stoke Ferry, Caldecote and Chippenham Fens, but outside East Anglia it is well known from dry limestone grassland sites. *Notioscopus sarcinatus* is widespread in Britain but there are few records (Fig. 6). We recorded it at Foulden Common in Breckland, four "Other Fens" (Buxton Heath, East Ruston Fen, Swangey Fen and Roydon Common, Norfolk), and at two fens in West Suffolk (Redgrave and Lopham Fens and Market Weston). It is widespread in Europe but there are few records. In France (Le Peru, 2007) and the Czech Republic (Buchar & Růžička, 2002) habitat records refer mainly to wetlands (fens, bogs, wet meadows) but also forests and grassy roadside verges. It appears to be mesotopic but data are insufficient to be more precise.

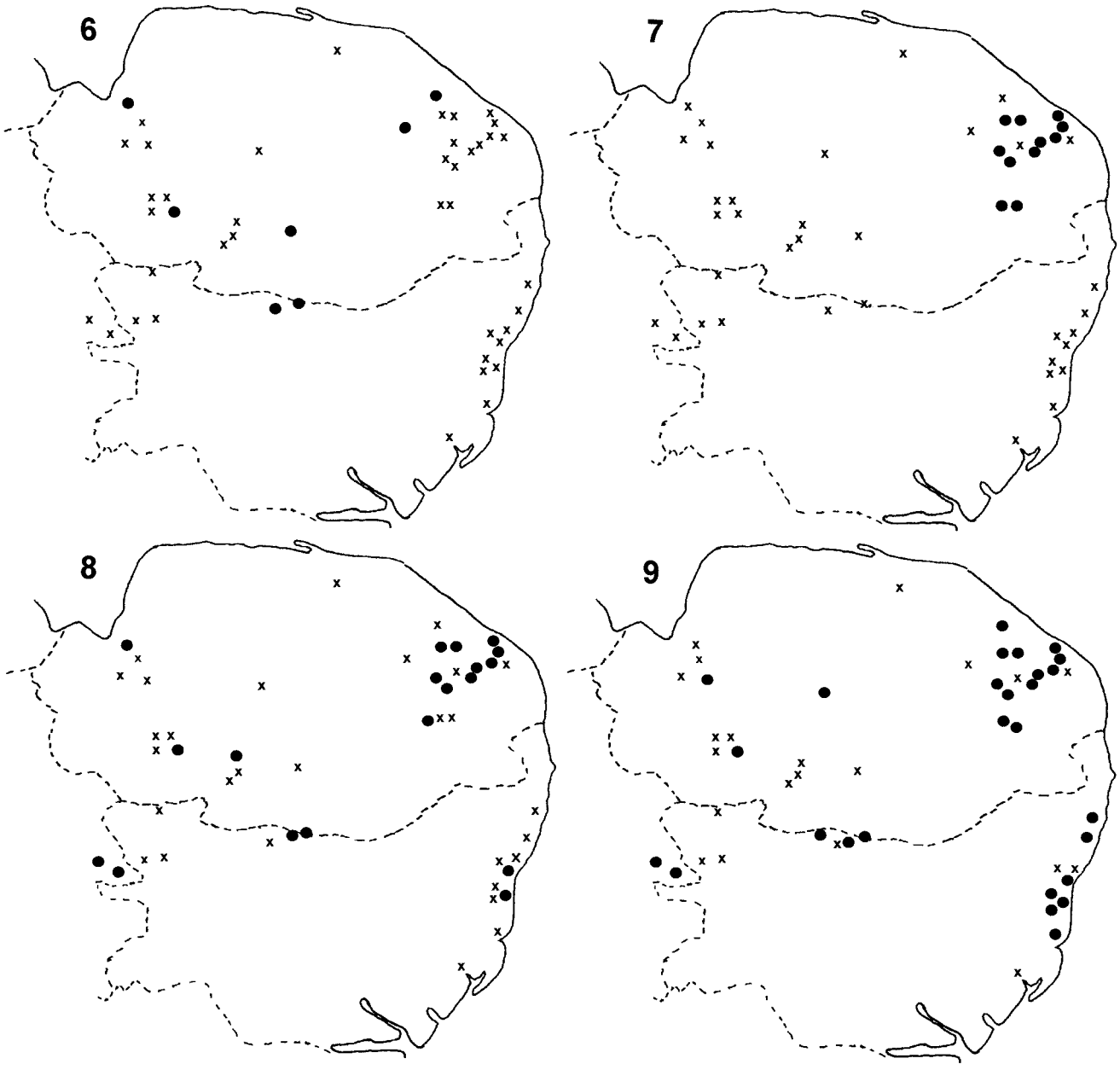


Figs. 2–5: Distribution maps of 4 rare species in East Anglian fens, 1969–74 ●=recorded; × =not recorded. **2** *Clubiona juvenis*; **3** *Neon valentulus*; **4** *Hygrolycosa rubrofasciata*; **5** *Maso gallicus*.

Broadland

Two RDB2 stenotopic species were recorded only from the Broadland fens, *Centromerus semiater* and *Carorita paludosa* (Fig. 7). *Centromerus semiater* was rediscovered in Britain in 1970 after an absence of 57 years (Duffey, 1971b). It was found in only three of the Broadland fens, Wheatfen, Sutton Broad and Woodbastwick (1 in Woodbastwick *a* and 18 in Woodbastwick *b*, all in September). They were collected in the wet leaf litter of marginal vegetation of *Thelypteris palustris* Schott. and *Calamagrostis canescens* in a fen carr (*Alnus* and *Salix*) and in the leaf litter by the edge of a reedswamp. Only one specimen was taken at Wheatfen but 1♂, 7♀ were collected from wet moss around small sedge tussocks in an unshaded fen at Sutton Broad, so it tolerates open fen as well as the shade in fen carr. Lott *et al*. (2002) record a fourth locality for *C. semiater* in the Bure Marshes complex of which Woodbastwick is a part. There is only one record for France, where it was found in a "marsh or swamp" (Le Peru, 2007), and it is described as rare in the Czech Republic "among moss and detritus in marshy habitats, usually on pond margins" (Buchar & Růžička, 2002). The distribution and habitat in Europe are reviewed by Decleer & Bosmans (1989). It is widely distributed from Switzerland to arctic Scandinavia and is tolerant of a wide range of wetland vegetation, mostly mesotrophic but including oligotrophic *Sphagnum* on a peat moor. It tolerates shade but is not found under a closed canopy.

Carorita paludosa was first discovered as new to science in 1969 in a sparsely vegetated abandoned peat cutting in County Clare, Republic of Ireland (Duffey, 1971a). In 1970 it was found in Broadland on 7 different fens. Eleven sites are marked on Fig. 7 because it was recorded on different parts of large fen areas. Generally



Figs. 6–9: Distribution maps of 4 rare species in East Anglian fens, 1969–74 ●=recorded; × =not recorded. **6** *Notioscopus sarcinatus*; **7** *Carorita paludosa*; **8** *Hypomma fulvum*; **9** *Entelecara omissa*.

numbers were small, yet at Sutton Broad *b* 155 were collected, but only 5 at Sutton Broad *a*, 21 at Wheatfen, 10 at Catfield Common and 5 at Woodbastwick *b*. The habitat where *C. paludosa* was most numerous consisted of an open fen of small *Carex* sp. tussocks growing through a carpet of wet moss and leaf litter in which most of the spiders were found. Elsewhere it occurred in *Molinia* grassland with some *Phragmites* and *Cladium* and in a rich herbaceous fen vegetation of *Juncus subnodulosus*, *Rumex hydrolapathum*, *Peucedanum palustre*, *Filipendula ulmaria*, sedges and grasses. Mosses, sometimes *Sphagnum* spp., were present in most habitats. *Carorita paludosa* was also taken in a *Betula/Alnus* carr where the ground was lightly shaded. It occurs in Sweden and in Belgium (Decleer & Bosmans, 1989), in eutrophic conditions, mainly in the litter layer of *Phragmites*, *Phalaris* and *Carex acuta* Linn. in a former wet meadow and in *Glyceria maxima* with other fen plants.

It is interesting to compare *C. paludosa* with its congener *C. limnaea* (Crosby & Bishop) (RDB1), which was first discovered in Britain in 1962 (Duffey & Merrett, 1963) in the extensive *Sphagnum* carpets of a periglacial kettle-hole in Cheshire, with peat 3–6 m deep. It was abundant in the moss but less frequent where *Erica tetralix* Linn. and small pines were invading. Although peatbogs with *Sphagnum* are frequent in Cheshire and neighbouring Shropshire, it was 30 years before this species was found in a neighbouring location in spite of extensive searches. *Carorita limnaea* is now known from two localities in Ireland (P. Merrett, pers. comm.), several around Uppsala in Sweden (the late Å. Holm, pers. comm.) and elsewhere in Europe, all from *Sphagnum* or other mosses. Hänggi *et al*. (1995) describe the habitat of *C. limnaea* as ''raised bogs, hummock areas'' and that of *C. paludosa* as ''sedge swamps, reedbeds''. This associates *C. limnaea* with bogs and *C. paludosa* with fens. While this is probably true the former is strictly stenotopic, apparently throughout its known range, while *C. paludosa* is more tolerant of habitat change and perhaps should be described as only moderately stenotopic.

Hypomma fulvum (Na: Fig. 8) and *Entelecara omissa* (Na: Fig. 9) are mesotopic species rare in Britain outside East Anglia. They were widespread and common in Broadland and also recorded on several Breckland, Suffolk and ''Other'' fens. *Entelecara omissa* was the more widespread, occurring in most of the different types of wetland vegetation in East Anglia. *Hypomma fulvum* is more closely associated with the reedswamp habitat, but not exclusively. A small linyphiid spider, <3 mm in length, it is probably a good aeronaut although precise information is lacking. *Entelecara omissa* had colonised most of the Suffolk fens and *H. fulvum* was well-established in the extensive reedswamp of Westwood Marshes and on Dunwich Common.

In contrast the reedbed salticid *Marpissa radiata*, which is also common in Broadland, did not appear to have reached this extensive habitat on the Suffolk coast. It was not present in our collections from that area and no records are reported in Harvey *et al*. (2002). Its dispersal abilities are not known but it is common at Wicken Fen and Redgrave and Lopham Fens as well as several Breckland fens. It is considerably larger than the two linyphiids and probably disperses in the immature stages. Is there a difference in the condition of the Suffolk Coastal reedbeds which makes them unsuitable or is the dispersal ability of *M. radiata* less effective?

Suffolk

The 10 fens in this region did not record any species of RDB status. Nevertheless they have a rich fauna totalling 138 species, including 9 Notable (4 Na, 5 Nb) and more *Walckenaeria* species than the other regions. Lott *et al*. (2002) visited only Walberswick NNR on the Suffolk coast, but the other coastal fens had not been previously studied by arachnologists except for Minsmere, where collections were made from 1994–97 in many different habitats from dry sandy heath to fens (R. Wilson, pers. comm.).

''Other Fens''

Two RDB species were recorded, *Dolomedes plantarius* (RDB1) at Redgrave and Lopham Fens, and *Baryphyma gowerense* (RDB2) at East Ruston Fen. The former has been known at the Redgrave/Lopham site for over 50 years, during which time the small population was threatened with extinction by desiccation of the fen by borehole abstraction for the public water supply. Eventually a system was installed to maintain an artificial water supply to the peat excavations where it was found. This probably saved *D. plantarius* from extinction until the borehole was removed in 1999. Since then there has been little evidence of a strong recovery in spite of the improved water level. Smith (2000) points out that summer water levels are sometimes too low and also refers to vegetation changes possibly caused by pollution, notably the increase of reed (*Phragmites australis*) and decrease of *Cladium mariscus*. The spider is known to avoid pools where reed is common.

The *D. plantarius* habitat in the three known sites in Britain consists of small ponds (old peat excavations) at Redgrave/Lopham, an extensive dyke system in cattle-grazed grassland at Pevensey Levels, and a canal in Wales. On the continent of Europe, in Sweden (T. Kronestedt, pers. comm.), Czech Republic (Růžička & Holec, 1998; Duffey & Holec, 2003), Switzerland and France (Duffey, 1995), the Netherlands (Van Helsdingen, 2006) and Belgium (personal visit), this species occurs amongst aquatic vegetation in larger permanent water surfaces. It may be that the British habitats are marginal in quality and larger populations cannot develop because of frequent poor years.

Baryphyma gowerense was first recorded in Britain as new to science in 1964 (Locket, 1965) and was taken on the upper saltmarsh at Whiteford Dunes in South Wales. Later it was found on several coastal saltmarshes along the south Welsh coastline and north to Anglesey (Harvey *et al*., 2002). In June 1974 our party collected 11 specimens at East Ruston in east Norfolk, a small valley fen which had a rich flora and spider fauna (Duffey,

2007) but has now been converted into a lake. This was the first record from a freshwater site but *B. gowerense* has since been found in similar habitats in Sweden, so is tolerant of both freshwater marsh and saltmarsh. At present its only known site in England is from the Broadland records of Lott *et al.* (2002), assuming it is extinct at East Ruston. The conservation quality assessment of RDB2 is provisional as not enough is known about the distribution, habitat tolerance and ecology of this species.

Conclusion

From this short review of East Anglian rare species there seems little doubt that the main cause of rarity is habitat compression. The destruction of fenland habitats by drainage or conversion to other uses during the last 200 years has been severe, resulting in increased isolation. Rare species are particularly vulnerable. Their populations are low, their distribution is very localised, they require specialised habitats in which to survive and reproduce, and there is increasing evidence that even less rare species which are more habitat-tolerant have been made artificially scarce by destruction or degradation of their preferred biotope.

In spite of the growth of research on the ecology of arachnids these problems still await attention. However, a thorough investigation of how butterflies are affected was made by Webb & Thomas (1994) in Dorset and may indicate how arachnological studies could proceed. The silver-studded blue butterfly (*Plebejus argus* L.) is a sedentary species of heathland where the vegetation is very short. In Dorset where much of this heathland survives, 85% of the area has been lost during the last 150 years and is now fragmented into numerous isolated small units. Detailed studies of the exacting habitat requirements of *P. argus* provide a precise definition of its needs. Not all heathland is suitable and in 1978 40% of surviving sites were in an unfavourable condition. The sedentary nature of this species means that if the nearest suitable habitat is only 1 km distant the establishment of a new colony is unlikely. In this case isolation and heathland management to preserve the best conditions are the main problems, and the knowledge is available to tackle them. Precise information of this sort is not known for any of the vulnerable British spiders but will become increasingly necessary as habitat loss and isolation continue in the future.

Conservation ecology

Studies on spider populations to understand their ecology and translate this into action to conserve rich faunas require accurate comparisons between sites and regions. This must be based on reliable collecting techniques and include habitat characteristics as well as a consideration of the influences which have modified them in the past. Wildlife habitats are constantly changing both by natural succession of the vegetation and by human interference, both of which are inevitable and should be taken into account for conservation management.

This survey shows that each regional group has a distinctive fauna and that, irrespective of the distribution of notable rarities, protected areas are needed everywhere to preserve arachnid biodiversity and facilitate future research. We need to know more about the habitats of vulnerable species, the resources they need for growth and reproduction, and how effective they are in dispersing to new areas. Because so many spiders live on or close to the ground the structure, depth and quality of the litter layer is of special importance. Hatley & MacMahon (1980) describe research in which simple and complex artificial structures were used as spider habitats in the field and their colonisation studied. Uetz (1991) describes work in which different depths of natural and artificial litter layers were colonised by spiders, and in each of these two experiments spiders were most numerous in the more complex environments. Although Uetz (1991) believed that habitat structure is probably most important, research is also needed on the microclimate characteristics of simple and complex habitats and how they influence environmental choice.

If we could define the preferred habitat of *Carorita paludosa* in Britain it would include: mainly short vegetation with grasses and sedges; a well-formed litter layer, not shaded or only slightly; and a permanent high water table at or near ground level. This would also apply to *Centromerus semiater* except that this species seems to tolerate shade. These conditions are widespread in Broadland but scarce in Suffolk, where the extensive fens are dominated by reed, and rare in Breckland, where the water table fluctuates with season. This seems to explain why these two species were not recorded outside Broadland, but to define habitat characteristics for more common species and relate them to distribution would be much more difficult.

East Anglia has a greater range of fens than comparable regions in Britain, but it is clear from the first Ordnance Survey carried out between 1810 and 1840 that the surviving fens today are only a very small part of the fen habitats present 200 years ago. An examination of the survivors shows that the Broadland region has by far the largest area and a stable water regime which has probably not fluctuated very much since the 15th century (Lambert *et al.*, 1965). Broadland has the advantage of National Park status and all the important areas are National Nature Reserves or owned by the Norfolk Wildlife Trust. The three largest areas are 851, 769 and 735 ha respectively (George, 1992).

On the Suffolk coast the Walberswick Marshes NNR and Minsmere RSPB reserves are now included in a single SSSI of 2326 ha, which should provide protection for the areas surrounding the main nature reserves. Benacre and Easton Broads are privately owned and thought to be in good condition, but precise information is lacking. Dunwich Common is protected by the National Trust. Butley Creek is the head of a narrow estuary and unchanged, but there is no information on the remaining two sites, which are small and less important. The 7 ''Other Fens'' in north and central Norfolk are relatively unchanged (information from local

residents and the Natural England website), apart from Redgrave and Lopham Fens, Suffolk, where the management regime has changed. The effect on the spider fauna is not known except for *Dolomedes plantarius*, which has been monitored during and since the period of desiccation.

The sad history of some of the Breckland fens has been described and is summarised in Table 7. The most important group (after Chippenham Fen) includes the pingo fens of Thompson, Foulden and East Walton Commons. The first is a Norfolk Wildlife Trust property and is in the best condition. The other two are SSSIs and show signs of neglect but are recoverable. The Chippenham Fen fauna needs more study to identify the specific habitats and status of its rarities. Wicken Fen shares (or used to share) most of the rarities found at Chippenham but may have lost several species during the last 100 years (Duffey, 2008).

The total of 220 species (231 with casual collections) recorded from the 44 sites in 1969–74 contrasts with the 182 species from 87 fens from pitfalls, water traps and casual collecting (1988–90) by Lott *et al.* (2002). The difference between the two surveys can probably be attributed to the different collecting techniques and possibly to the 20 years' interval between them if some of the sites had deteriorated.

The results of this survey based on comparative numbers of species and spiders related to timed hand-collection provide base-line data on the fauna for the period 1969–74. Future surveys following the same technique could assess evidence for population change and decline or increase in the status of species of special conservation interest.

In the past Natural England has had very few data on the arachnid fauna of East Anglian fens on which to base conservation assessments and future management. The two fens denotified as SSSIs, Stoke Ferry and Caldecote, especially the former, should be reassessed to find out whether the two rarities *Hygrolycosa rubrofasciata* and *Maso gallicus*, which were well-established in 1969–74, are still present. A reassessment of the arachnid fauna of East Ruston Fen is also needed to find out whether *Baryphyma gowerense* and other rarities have survived.

Fen	1969–74	2007
Sugar Fen, Norfolk* SSSI	Deteriorated but still with a fen fauna.	Very little fen vegetation seen. Intensively grazed by cattle and horses.
Stoke Ferry Fen, Norfolk* Former SSSI	Deteriorated as fen areas overgrown by bushes. Some fen rarities recorded.	Denotified as SSSI. Overgrown by bushes and trees. An assessment needed to see whether recoverable.
Borough Fen, Norfolk	In poor condition due to agricultural use.	Converted to agricultural use. No longer a fen.
Caldecote Fen, Norfolk* Former SSSI	Deterioration due to neglect and drainage causing spread of bush growth but open fen still present. Fen rarities found.	Denotified as SSSI by Natural England. Dense bush growth making entry impossible to examine in September 2007.
Pashford Fen, Suffolk SSSI	Small area (12 ha). Too much cattle grazing but some fen vegetation still present and interesting fauna found.	Condition unfavourable (Natural England). Grazed by cattle, drainage.
Icklingham Poor's Fen, Suffolk* Former SSSI	In good condition with excellent fen flora and high water table fed by springs. A rich fauna.	Drained and completely disappeared. Not in SSSI list but surrounding area of sandy heath is a new SSSI.
East Walton Common, Norfolk* SSSI	A pingo fen in an interesting and good condition. An excellent fauna.	Some pingo fens overgrown by trees and bushes. Recoverable if fen areas cleared.
Tuddenham Fen, Suffolk NNR	Part of the Cavenham Heath NNR. Fen area hydrology deteriorating by deepening of adjacent River Lark.	Lack of surface water appears to be more serious. Natural England staff trying to resolve problem.
Foulden Common, Norfolk* SSSI	In good condition with outstanding fauna.	In good condition. More of the pingoes should be cleared of woody growth which is suppressing fen vegetation.
East Wretham Heath, Norfolk	In good condition.	Unchanged.
Thompson Common, Norfolk SSSI NWT	In good condition.	In good condition as far as information is available.
Cranberry Rough, Norfolk SSSI NWT	In good condition.	In good condition as far as information is available.
East Winch Common, Norfolk* SSSI NWT	In good condition.	In good condition.
Chippenham Fen, Cambridgeshire NNR	In good condition with outstanding fauna.	In good condition.

Table 7: A comparison of the conservation status of the 14 Breckland fens in 1969–74 and in 2007.
Sources of information: The 1969–74 descriptions were made at the time of the survey visits. Site information for 2007 was obtained by visits to 7 Breckland Edge fens in September 2007; from data downloaded from the Natural England website; from colleagues resident in the two counties and Natural England staff. The comments in the third column are my own. *Site visited in September 2007. NNR = National Nature Reserve; SSSI = Site of Special Scientific Interest; NWT = Norfolk Wildlife Trust.

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Appendix 1

Species and numbers recorded from the three regions and "Other Fens". The total of 231 species includes 220 from timed collections and 11(*) from casual collections. The figures include only adults. The many immature stages have not been included as accurate identification is not always possible. The only exception is *Thanatus striatus*, as many subadults were taken in the Breckland September survey. Nomenclature follows Harvey *et al*. (2002).

Species	Breck	Broads	Suff.	Other
Achaearanea lunata (Clerck)	1	0	0	0
Agroeca inopina (O.P.-Camb.)	0	0	3	0
Agroeca proxima (O.P.-Camb.)	1	1	20	0
Agyneta conigera (O.P.-Camb.)	2	0	0	1
Agyneta decora (O.P.-Camb.)	0	1	0	20
Agyneta ramosa Jackson	1	0	0	1
Agyneta subtilis (O.P.-Camb.)	2	0	0	0
Allomengea scopigera (Grube)	0	1	5	0
Allomengea vidua (L. Koch)	1	214	246	0
Antistea elegans (Blackwall)	10	156	565	0
Aphileta misera (O.P.-Camb.)	62	41	0	70
Araeoncus crassiceps (Westring)	9	0	0	0
Araeoncus humilis (Blackwall)	0	0	1	0
Araneus diadematus Clerck	2	0	2	0
Araneus marmoreus Clerck	3	1	0	0
Araneus quadratus Clerck	0	1	1	0
Araniella cucurbitina (Clerck)	*1	0	0	0
Argyroneta aquatica (Clerck)	*1	0	0	0
Baryphyma gowerense (Locket)	0	0	0	11
Baryphyma pratense (Blackwall)	3	0	0	3
Baryphyma trifrons (O.P.-Camb.)	16	3	4	2
Bathyphantes approximatus (O.P.-C.)	84	663	98	12
Bathyphantes gracilis (Blackwall)	55	168	233	57
Bathyphantes nigrinus (Westring)	4	79	114	1
Bathyphantes parvulus (Westring)	120	2	9	122
Carorita paludosa Duffey	0	204	0	0
Centromerus dilutus (O.P.-Camb.)	50	0	26	16
Centromerus semiater (L. Koch)	0	31	0	0
Centromerus serratus (O.P.-Camb.)	0	0	1	0
Centromerus sylvaticus (Blackwall)	8	9	26	0
Ceratinella brevipes (Westring)	2	3	1	3
Ceratinella brevis (Wider)	3	7	0	1
Ceratinella scabrosa (O.P.-Camb.)	2	0	0	0
Cercidia prominens (Westring)	12	0	1	1
Clubiona brevipes Blackwall	3	0	1	0
Clubiona comta C.L. Koch	1	0	2	0
Clubiona diversa O.P.-Camb.	26	4	1	1
Clubiona juvenis Simon	0	5	0	0
Clubiona lutescens Westring	33	3	1	3
Clubiona neglecta O.P.-Camb.	1	0	0	0
Clubiona pallidula (Clerck)	0	0	2	0
Clubiona phragmitis C.L. Koch	46	72	87	32
Clubiona reclusa O.P.-Camb.	37	0	0	5
Clubiona rosserae Locket	4	0	0	0
Clubiona stagnatilis Kulczyński	54	29	21	18
Clubiona subtilis L. Koch	131	106	116	64
Clubiona terrestris Westring	21	0	1	0
Clubiona trivialis C.L. Koch	1	0	0	0
Cnephalocotes obscurus (Blackwall)	12	8	3	22
Crustulina guttata (Wider)	21	0	4	1
Crustulina sticta (O.P.-Camb.)	52	0	5	1
Dictyna arundinacea (Linn.)	28	0	0	1
Dictyna latens (Fabricius)	*1	0	0	0
Dictyna pusilla Thorell	1	0	0	0
Dictyna uncinata Thorell	0	*1	0	*1
Dicymbium nigrum (Blackwall)	5	64	0	1
Diplocephalus cristatus (Blackwall)	*2	0	0	0
Diplocephalus latifrons (O.P.-Camb.)	*1	0	0	1
Diplocephalus permixtus (O.P.-C.)	40	42	0	5
Dismodicus bifrons (Blackwall)	34	0	4	7
Dolomedes plantarius (Clerck)	0	0	0	1
Donacochara speciosa (Thorell)	0	8	4	0
Drapetisca socialis (Sundevall)	0	0	12	0
Drepanotylus uncatus (O.P.-Camb.)	2	69	17	0
Entelecara acuminata (Wider)	0	0	1	0
Entelecara erythropus (Westring)	0	0	0	1
Entelecara flavipes (Blackwall)	*3	0	0	0
Entelecara omissa O.P.-Camb.	20	13	42	67
Enoplognatha ovata (Clerck)	5	0	0	0
Episinus angulatus (Blackwall)	5	0	0	1
Erigone atra Blackwall	15	8	4	1
Erigone dentipalpis (Wider)	3	1	1	1
Erigonella hiemalis (Blackwall)	3	0	0	0
Erigonella ignobilis (O.P.-Camb.)	51	14	7	1
Ero cambridgei Kulczyński	21	18	98	18
Ero furcata (Villers)	4	1	4	0
Ero tuberculata (De Geer)	0	1	2	0
Euophrys frontalis (Walck.)	6	3	3	13
Floronia bucculenta (Clerck)	0	48	70	0
Glyphesis servulus (Simon)	16	0	0	0
Gnathonarium dentatum (Wider)	79	93	10	13
Gonatium rubellum (Blackwall)	2	0	30	0
Gonatium rubens (Blackwall)	6	2	3	2
Gongylidiellum latebricola (O.P.-C.)	0	0	0	19
Gongylidiellum murcidum Simon	13	3	0	3
Gongylidiellum vivum (O.P.-Camb.)	57	16	142	8
Gongylidium rufipes (Linn.)	3	5	1	1
Hahnia helveola Simon	0	0	8	1
Hahnia montana (Blackwall)	17	0	6	0
Hahnia nava (Blackwall)	0	0	1	0
Haplodrassus signifer (C.L. Koch)	1	0	0	0
Harpactea hombergi (Scopoli)	12	0	0	0
Hygrolycosa rubrofasciata (Ohlert)	99	0	0	0
Hylyphantes graminicola (Sundevall)	0	1	0	0
Hypomma bituberculatum (Wider)	85	14	5	25
Hypomma cornutum (Blackwall)	3	1	0	0
Hypomma fulvum (Bösenberg)	0	6	4	0
Hypselistes jacksoni (O.P.-Camb.)	0	1	6	11
Hypsosinga pygmaea (Sundevall)	0	0	*1	1
Kaestneria dorsalis (Wider)	5	7	0	0
Kaestneria pullata (O.P.-Camb.)	341	59	50	124
Larinioides cornutus (Clerck)	5	10	1	1

Species	Breck	Broads	Suff.	Other
Lathys humilis (Blackwall)	0	0	*1	0
Latithorax faustus (O.P.-Camb.)	1	0	0	0
Lepthyphantes alacris (Blackwall)	9	0	5	0
Lepthyphantes cristatus (Menge)	1	0	15	0
Lepthyphantes ericaeus (Blackwall)	91	18	92	41
Lepthyphantes flavipes (Blackwall)	2	1	1	0
Lepthyphantes mengei Kulczyński	69	10	22	6
Lepthyphantes minutus (Blackwall)	1	0	3	0
Lepthyphantes obscurus (Blackwall)	*1	0	*1	0
Lepthyphantes pallidus (O.P.-Camb.)	27	1	5	1
Lepthyphantes tenuis (Blackwall)	26	46	67	2
Lepthyphantes zimmermanni Bertkau	13	11	496	0
Leptorhoptrum robustum (Westring)	4	23	6	4
Linyphia triangularis (Clerck)	1	5	58	0
Lophomma punctatum (Blackwall)	46	151	163	4
Macrargus rufus (Wider)	0	0	2	0
Marpissa radiata (Grube)	2	0	*1	1
Maso gallicus Simon	141	0	0	0
Maso sundevalli (Westring)	51	18	15	2
Meioneta beata (O.P.-Camb.)	1	0	0	0
Meioneta rurestris (C.L. Koch)	2	1	3	0
Meioneta saxatilis (Blackwall)	52	3	0	2
Metellina mengei (Blackwall)	6	0	3	1
Metellina merianae (Scopoli)	1	6	1	0
Metellina segmentata (Clerck)	3	37	22	0
Metopobactrus prominulus (O.P.-C.)	0	0	0	10
Micaria pulicaria (Sundevall)	2	0	0	0
Micrargus herbigradus (Blackwall)	41	36	369	11
Microlinyphia impigra (O.P.-Camb.)	47	1	3	5
Microlinyphia pusilla (Sundevall)	30	2	0	5
Microneta viaria (Blackwall)	6	2	8	1
Minyriolus pusillus (Wider)	3	0	1	0
Monocephalus fuscipes (Blackwall)	5	0	1	2
Neon reticulatus (Blackwall)	43	1	4	68
Neon valentulus Falconer	20	0	0	1
Neoscona adianta (Walck.)	0	0	*1	0
Neottiura bimaculata (Linn.)	58	2	3	85
Neriene clathrata (Sundevall)	72	23	35	3
Neriene montana (Clerck)	7	0	1	0
Notioscopus sarcinatus (O.P.-C.)	2	0	0	28
Oedothorax agrestis (Blackwall)	1	0	0	0
Oedothorax fuscus (Blackwall)	3	5	2	0
Oedothorax gibbosus (Blackwall)	280	45	101	274
Oedothorax retusus (Westring)	16	5	0	2
Ostearius melanopygius (O.P.-C.)	0	0	*1	0
Ozyptila atomaria (Panzer)	2	0	0	0
Ozyptila brevipes (Hahn)	8	2	8	2
Ozyptila praticola (C.L. Koch)	0	0	0	1
Ozyptila sanctuaria (O.P.-Camb.)	0	0	0	1
Ozyptila trux (Blackwall)	32	17	3	18
Pachygnatha clercki Sundevall	51	181	84	8
Pachygnatha degeeri Sundevall	6	13	7	0
Pachygnatha listeri Sundevall	0	0	1	0
Paidiscura pallens (Blackwall)	2	1	0	1
Pardosa amentata (Clerck)	2	0	0	0
Pardosa hortensis (Thorell)	1	0	0	0
Pardosa nigriceps (Thorell)	5	*1	6	40
Pardosa prativaga (L. Koch)	10	0	1	1
Pardosa proxima (C.L. Koch)	1	0	0	0
Pardosa pullata (Clerck)	17	2	0	10
Pelecopsis parallela (Wider)	3	0	1	0
Peponocranium ludicrum (O.P.-C.)	3	1	0	3
Philodromus cespitum (Walck.)	1	1	0	0
Philodromus dispar Walck.	1	0	0	0
Pholcomma gibbum (Westring)	16	17	62	3
Pirata hygrophilus Thorell	343	39	1	295
Pirata latitans (Blackwall)	35	6	5	14
Pirata piraticus (Clerck)	90	18	11	38
Pirata piscatorius (Clerck)	27	0	0	4
Pirata tenuitarsis Simon	2	0	0	0
Pirata uliginosus (Thorell)	0	0	8	0
Pisaura mirabilis (Clerck)	4	1	0	0
Pocadicnemis juncea Lock. & Mill.	50	1	9	67
Pocadicnemis pumila (Blackwall)	203	1	46	249
Poeciloneta variegata (Blackwall)	2	0	0	0
Porrhomma egeria Simon	0	1	0	0
Porrhomma pallidum Jackson	1	0	9	3
Porrhomma pygmaeum (Blackwall)	129	277	40	1
Robertus arundineti (O.P.-Camb.)	0	19	0	5
Robertus lividus (Blackwall)	13	15	20	5
Rugathodes instabilis (O.P.-Camb.)	86	5	21	15
Saaristoa abnormis (Blackwall)	6	*2	4	5
Saaristoa firma (O.P.-Camb.)	1	0	9	0
Saloca diceros (O.P.-Camb.)	3	0	2	1
Savignia frontata Blackwall	4	23	0	1
Silometopus ambiguus (O.P.-Camb.)	0	0	0	7
Silometopus elegans (O.P.-Camb.)	12	1	0	33
Simitidion simile (C.L. Koch)	1	0	0	0
Sitticus caricis (Westring)	13	36	0	25
Stemonyphantes lineatus (Linn.)	2	0	2	0
Tallusia experta (O.P.-Camb.)	22	128	109	1
Tapinocyba insecta (L. Koch)	2	2	0	0
Tapinopa longidens (Wider)	1	*2	10	0
Taranucnus setosus (O.P.-Camb.)	64	22	105	36
Tetragnatha extensa (Linn.)	9	0	0	0
Tetragnatha montana Simon	8	0	0	0
Tetragnatha pinicola L. Koch	2	0	0	0
Thanatus striatus C.L. Koch	41	0	1	4
Theonoe minutissima (O.P.-Camb.)	2	0	0	70
Theridion pictum (Walck.)	2	1	0	0
Theridion sisyphium (Clerck)	2	0	0	0
Theridiosoma gemmosum (L. Koch)	3	1	*1	1
Thyreosthenius parasiticus (Westr.)	*2	0	0	0
Tibellus maritimus (Menge)	19	0	0	2
Tibellus oblongus (Walck.)	7	1	0	5
Tmeticus affinis (Blackwall)	0	1	0	0
Trichopterna thorelli (Westring)	0	0	0	2
Trochosa ruricola (De Geer)	2	1	1	0
Trochosa spinipalpis (F.O.P.-Camb.)	1	19	4	11
Trochosa terricola Thorell	4	3	7	5
Walckenaeria acuminata Blackwall	13	5	29	4
Walckenaeria antica (Wider)	5	124	0	11
Walckenaeria atrotibialis (O.P.-C.)	9	2	2	7
Walckenaeria corniculans (O.P.-C.)	0	0	1	0
Walckenaeria cucullata (C.L. Koch)	0	0	2	1
Walckenaeria cuspidata Blackwall	0	0	1	0
Walckenaeria furcillata (Menge)	0	0	1	0
Walckenaeria incisa (O.P.-Camb.)	0	0	1	0
Walckenaeria kochi (O.P.-Camb.)	3	17	30	1
Walckenaeria monoceros (Wider)	2	0	1	0
Walckenaeria nodosa O.P.-Camb.	5	37	5	2
Walckenaeria nudipalpis (Westring)	7	18	24	2
Walckenaeria unicornis O.P.-Camb.	6	11	41	7
Walckenaeria vigilax (Blackwall)	24	0	0	7
Xysticus cristatus (Clerck)	3	*1	1	1
Xysticus ulmi (Hahn)	21	1	0	13
Zelotes latreillei (Simon)	10	0	1	0
Zora spinimana (Sundevall)	94	56	196	0
Zygiella atrica (C.L. Koch)	0	0	1	0