Fen Raft Spider Recovery Project:
2009 Summary Report for Redgrave & Lopham Fen

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Summary

1 This report describes the results from the nineteenth year of systematic monitoring of the nationally endangered fen raft spider (*Dolomedes plantarius*) at Redgrave & Lopham Fen National Nature Reserve, Norfolk. This work was undertaken as part of Natural England's Species Recovery and BAP programmes in 2009. Habitat survey and management work and measurements of surface water levels are also documented and discussed in relation to spider population trends.

2 Throughout the 19-year census the population was very small and its range was restricted to two small and spatially separated areas, on Little Fen and Middle Fen.

3 Desiccation of the fen by artesian abstraction, thought to be responsible for the decline in this semi-aquatic species, ended in 1999 with relocation of a borehole that had drained the fen. This, in combination with higher than average rainfall in the following two years, resulted in rapid hydrological recovery.

4 An annual index of population size that allowed statistical comparison between years showed that the census data were best described by a model in which population size varied substantially and sometimes significantly between years with no evidence of a sustained upward or downward trend.

5 Modelling of the data sets for both the Little and Middle Fen sub-populations showed that there was a significant difference between them in the pattern of annual variation. In 2009 the index for Middle Fen was slightly higher, and that for Little fen slightly lower, than in 2008 but both were well within the range of values for the previous 18 years.

6 An increase in range occupied by *D. plantarius* on Middle Fen that began in 2006 was sustained although not increased in 2009. Spiders were found along a linear series of ponds, extending over 120m beyond the area in which they had previously been recorded since 1993. This is the first range expansion during this period.

7 Numbers of breeding females on both Little and Middle Fen were amongst the highest recorded. However, a severe drought between August and October curtailed the breeding season.

8 On Little Fen a large stand of *Cladium mariscus* within the core area for *D. plantarius* was cut in late July. No *C. mariscus* was cut on Middle Fen in 2009. Grazing stock had access to both areas.

9 After an exceptionally wet July, 2009 saw the most severe drought on the fen since closure of the bore-hole in 1999. Almost no standing water remained on the fen by September.

10 An excavator was used to deepen some of the ponds in the core *D. plantarius* areas by removing sediment from their centres in October: the pond margins were left undisturbed.

11 Twenty new turf ponds were excavated immediately east of the core *D. plantarius* area on Middle Fen. This area retained scattered clumps of *C. mariscus* but lacked turf ponds deep enough to hold water through most summers. It is hoped that targeted habitat management of this kind will allow a natural expansion in range.

12 Translocation is expected to be the primary means of achieving the BAP target of an increase in the number of sustainable populations of *D. plantarius* across the UK. At Redgrave & Lopham Fen, the 2009 monitoring data provide further support for the conclusion of recent years that translocation will also be required to meet the BAP target of a substantial increase in the occupied area at this site.

Contents

1 Introduction

This report summarises monitoring and management work undertaken as part of the Fen Raft Spider (*Dolomedes plantarius*) Recovery Project at Redgrave & Lopham Fen National Nature Reserve (NNR) in 2009, the nineteenth year of monitoring and targeted management for *D. plantarius* at this site. Redgrave & Lopham Fen remains one of only three UK sites for this Schedule 5 species. The recovery project was initiated in 1991 (under English Nature's Species Recovery Programme) to prevent extinction of this population. Desiccation of the site resulting from artesian abstraction since 1960, compounded by droughts in the 1980s and 1990s, reduced the spider population to very low levels (Smith 2000). By the late 1980s, the remnant population had become restricted to turf ponds on two separate parts of the NNR. Throughout the 1990s, despite targeted habitat management, monitoring showed that there was no significant increase in the size of the population and that its range was continuing to contract. Between 1991 and 1999, irrigation of the ponds inhabited by the spiders appeared to be the key factor in their persistence (Smith 2000).

Abstraction of water from the aquifer underlying the fen ended 1999 and resulted in rapid hydrological recovery (Harding 2000). This was expected to result in a rapid increase in *D. plantarius*, which has very high potential fecundity. This expectation was encapsulated in the original *D. plantarius* Species Action Plan targets for this site (U.K. Biodiversity Steering Group 1999), of a sustained increase in density per pond to the maximum recorded during the 1990s and a ten-fold increase in range.

By the time of the 2005 BAP Review, the *D. plantarius* population still showed no sign of sustained or significant recovery (Smith 2006). It was clear both that any recovery would be slow and that the wetness of the fen was not the only factor required to trigger it. Revised BAP targets (BARS 2008) for the increase in range on Redgrave & Lopham Fen were for occupancy of 13 Ha in three years out of every five by 2010, and 65 Ha by 2020. Nationally, a reduction in the risk of stochastic extinction was to be achieved by the establishment of six more new, sustainable populations in the UK by 2010. By 2020 the total number of sites with sustainable populations should be increased to 12.

A small increase in range of the Middle Fen population began in 2006 - the first since systematic monitoring began in 1991 and eight years after restoration of the fen's hydrology. Although this range expansion involved such small numbers that it was not reflected in the annual index of population size, it was the first indication that habitat conditions beyond the core range of this sub-population were becoming suitable for the spiders. By 2008 the spiders had recolonised one extremity of a series of turf ponds last occupied in the mid-1980s.

This report presents the 2009 results from the standardised annual census of *D. plantarius* at Redgrave & Lopham Fen and examines the progress of this range expansion as well as changes in population size and breeding success. These results are discussed in the context of the previous eighteen years' monitoring data and are used to assess progress towards the BAP targets for this site. The influence of habitat management on distribution of *D. plantarius* is discussed and measures that may be required to ensure that BAP targets are met are discussed. This report also describes the results of regular monitoring of water levels in the census ponds and summarises ground water and rainfall data collected the Suffolk Wildlife Trust (SWT), the NNR managers.

More detailed analyses of the census data to examine the effects of water levels and of vegetation management on the long-term trends in numbers are beyond the scope of this report but will be published in the scientific literature. Further background to the project, and details of previous years' work, are given by Duffey (1991) and Smith (1992, 1993, 1994, 1995, 1996, 1997, 1998, 2000, 2001 2005, 2006, 2007, 2008, 2009a).

2 Methods

2.1 Annual census

The annual census of *D. plantarius* followed the methodology adopted in 1993 and described by Smith (1993, 2000, 2009). The three replicate counts were made at 29 turf ponds on Little Fen (Fig. 1) and 30 on Middle Fen (Fig. 2) in late July. Whenever consistent and favourable weather conditions allowed, the counts for each fen were made on consecutive days (Table 1).

In 2000 and 2001 very high water levels made it impossible to census Little Fen during the summer. From 2002 onwards, two Little Fen ponds included in the original scheme had to be excluded from the census because they had been substantially infilled with spoil during the fen restoration operations (Harding 2000). Counts at two other Little Fen ponds were made from the bank because the depth of sediment made work in the water unsafe (L31 and L33: Fig. 1). By 2004 two of the three replicate counts at a further pond (L36) also had to be made from the bank; in subsequent years all counts at this pond were made from the bank.

Table 1 Census dates for 1994-2009

Year	July (& /Aug.) Census dates	
	Little Fen	Middle Fen
1994	26-29	9-18/08
1995	20-25	27-1/08
1996	18-21	22-26
1997	24-21	22-26
1998	18-21	21-24
1999	17-19	21-26
2000	-	17-20
2001	-	17-20
2002	14-18	19-21
2003	18-22	23-27
2004	21-27	12-24
2005	21-05/08	18-21
2006	13-17	17-20
2007	31-11/08	19-31
2008	24-28	21-23
2009	13-20	23-28

2.2 Analyses of annual census data

The annual census data are expressed as an index derived from analyses of population trends carried out using generalised linear models, with the maximum count for each pond in July as the response variable (Smith 1995, 2000). Log-linear Poisson regression models were fitted to the systematic data collected since 1991 (excluding Little Fen in 2000 and 2001,when it was deeply inundated)**,** as implemented in program TRIM (Pannekoek & van Strien, 1998). TRIM allows the data to be split into different strata: in this context Little and Middle Fens form separate co-variate strata. The model also allows sites to be censused in some years and not others and so both the data from the set of ponds censused at the outset of the project (1991-1995), and those from the set of ponds censused from 1993 onwards, could be utilised (see Smith 1995).

The program fits five standard models: (i) no time (year) effects; (ii) linear trend (in log numbers); (iii) linear trends within covariate strata (linear trends differ between Little and Middle Fen); (iv) time effects (separate effects for each year); (v) time-effects within covariate strata (year effects differ between Little and Middle Fen.

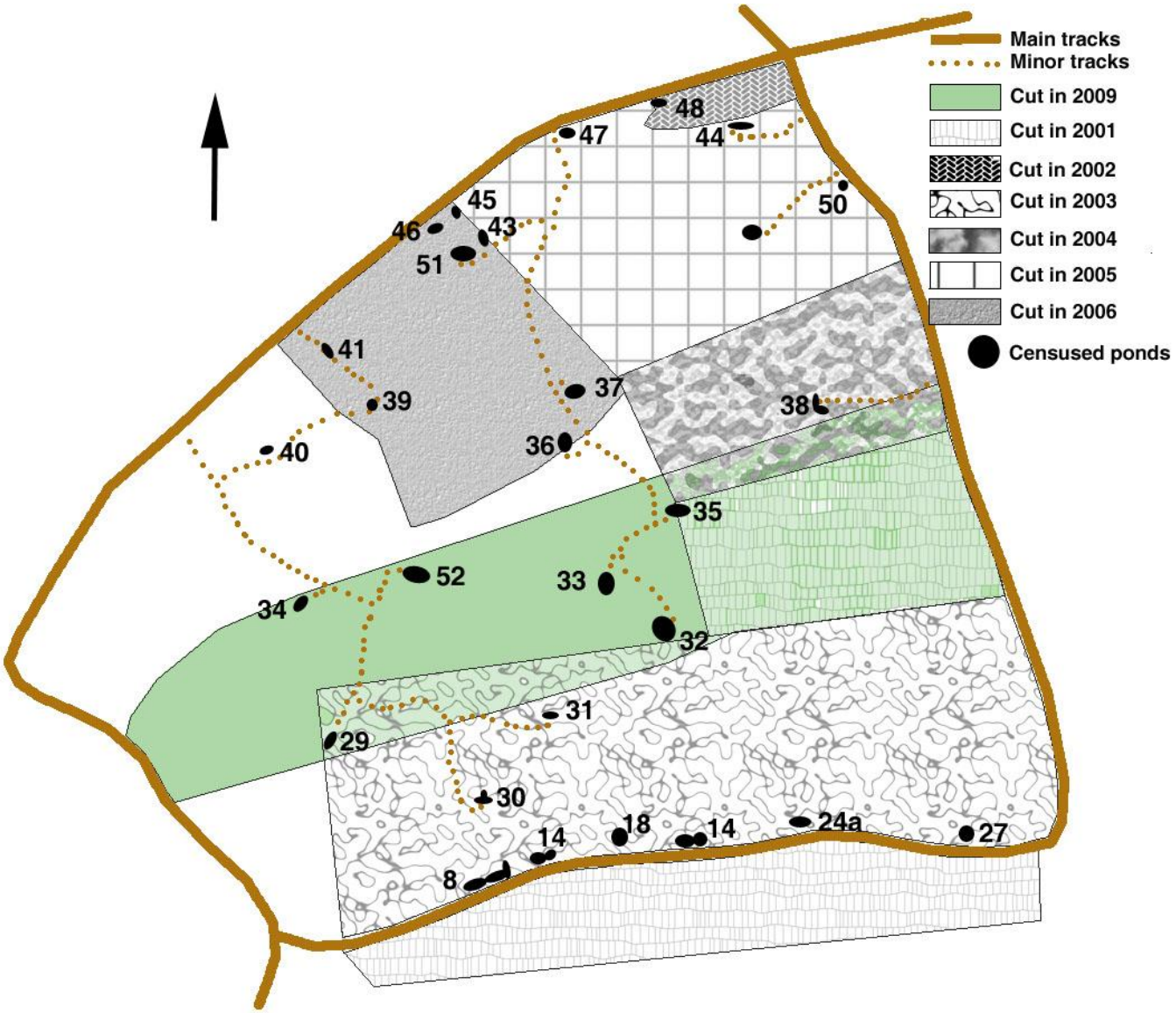


Fig. 1 The Little Fen census area showing ponds included in the census. Shading shows areas where vegetation was cut and removed in July/August each year.

2.3 Breeding indicators

Very limited but comparable quantitative information on breeding success each year is derived from the counts of adult females and of nursery webs during the annual census (above). Additional information is derived from casual records and from sedge-cutting management but this cannot be used for quantitative comparison between years.

2.4 Water levels

Routine water level measurements against posts in the census ponds on Little and Middle Fens, and in the ponds dug on Great Fen in 1998 (Smith 2000, 1998), were carried out at approximately monthly intervals. The levels in the Little and Middle Fen ponds are expressed relative to an arbitrary datum established in April 1992. The heights of the measuring posts in the Great Fen ponds were levelled and so the measurements are expressed relative to Ordnance Datum.

Ground water levels on the Fen have been monitored by the Suffolk Wildlife Trust (SWT) since 1976 using a network of 54 piezometer tubes (Smith 2000). Most of these monitor near-surface hydrology: eight are sunk into the underlying chalk. The data presented in this report are the highest monthly mean recorded from all of these tubes between November and April (winter maximum) and the lowest monthly mean recorded between May and September (summer minimum) each year. Although this is a coarse measure, it gives a good picture of differences between years over the 33-year recording period. Monthly rainfall data measured by the SWT at a gauge on the fen since 2001 are also presented.

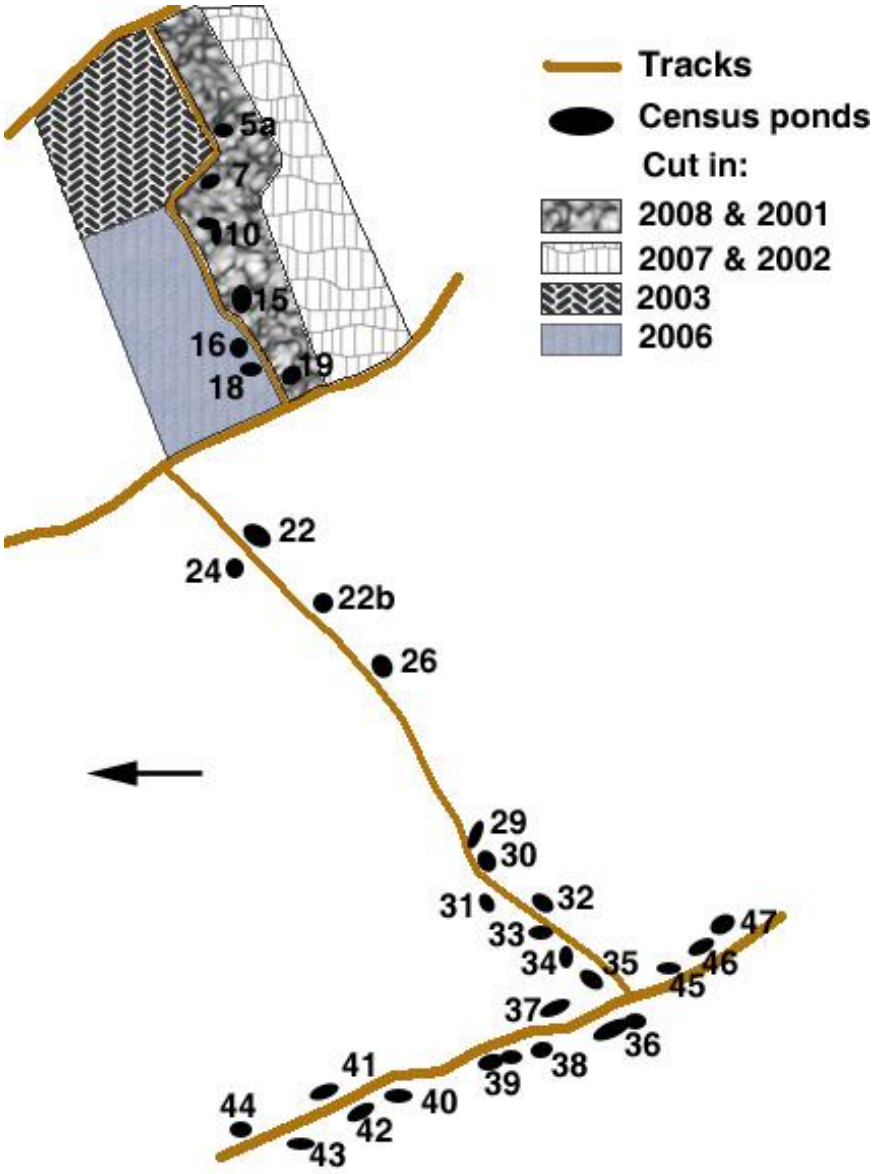


Fig. 2 The Middle Fen census area showing ponds included in the census. Shading shows areas where vegetation was cut and removed in July/August each year.

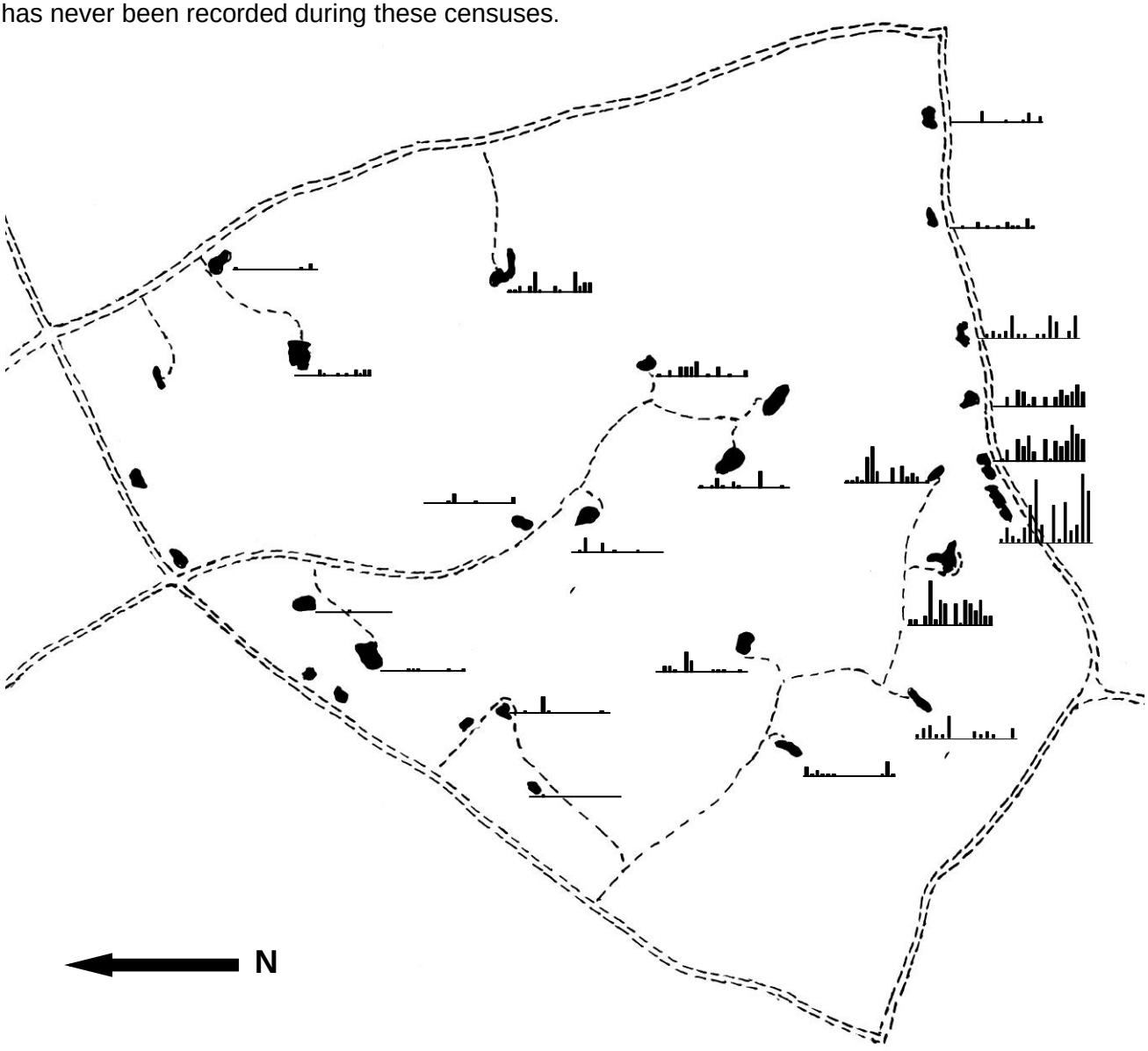
3 Results

3.1 Distribution

On **Little Fen** the number of census ponds on which *D. plantarius* was recorded was slightly lower than in 2008 but still above the average since 1993, with no change in the pattern of occupancy (Table 2). Since closure of the artesian borehole in 1999, *D. plantarius* has been found predominantly in the southern part of the census area (Fig. 3). This area also held the core of the population during the 1990s when it was irrigated with a piped water supply to maintain summer water levels in the ponds. In most

years spiders have also occurred in a band of ponds stretching north from this core area but records outside this zone are sporadic.

Fig. 3 Little Fen census area showing relative numbers of *D. plantarius* recorded at each pond in late July between 1993 and 2009. Bars represent maximum counts for consecutive years (highest count=24 :no July data were collected in 2000 and 2001). Where ponds have no chart, *D. plantarius* has never been recorded during these censuses.



On **Middle Fen** *D. plantarius* was recorded in the same number of ponds as in 2008, with occupancy remaining higher than at any time since the present census was established in 1993 (Table 2). This was because, for the third successive year, spiders were found in ponds up to *c*a 120m from their previous maximum western limit (Fig. 4). However, there was no additional extension in range in 2009. Although the only records in this area during the July census were of adults on only three ponds, sub-adults were seen on two other ponds in the area in April.

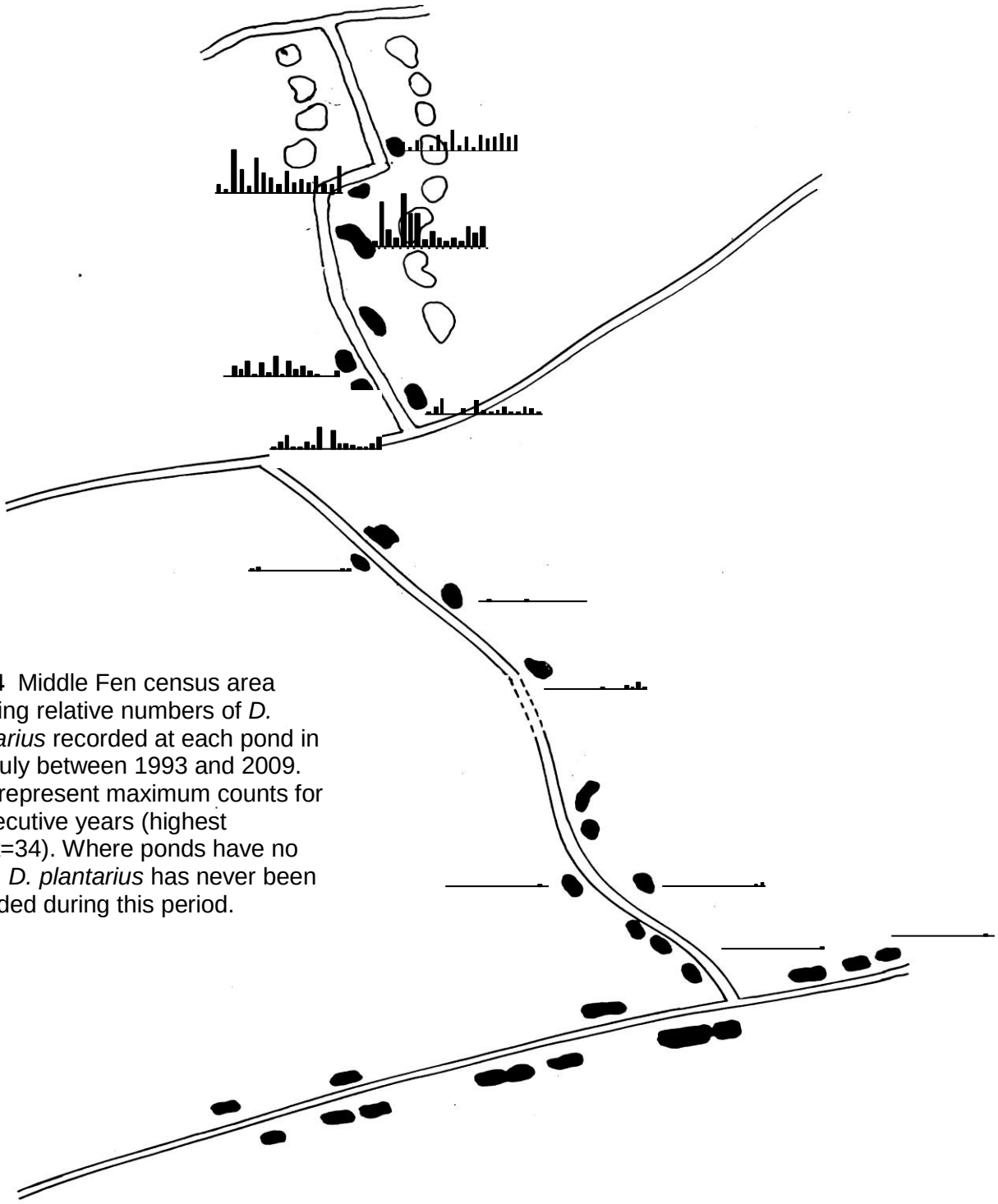


Fig. 4 Middle Fen census area showing relative numbers of *D. plantarius* recorded at each pond in late July between 1993 and 2009. Bars represent maximum counts for consecutive years (highest count=34). Where ponds have no chart, *D. plantarius* has never been recorded during this period.

Table 2 Numbers of census ponds on which *D. plantarius* was recorded in July each year. Numbers are given separately for ponds that were and were not influenced by the irrigation supplied between 1993 and 1999. The 2000 data for Little Fen are based on two, rather than three replicate counts, made in September rather than July: no data were collected on Little Fen in 2001 (see Smith 2005)

Year	**'93**	**'94**	**'95**	**'96**	**'97**	**'98**	**'99**	**'00**	**'01**	**'02**	**'03**	**'04**	**'05**	**'06**	**'07**	**'08**	**'09**
Little Fen																	
'Irrigated' n=15[1]	8	8	12	9	12	14	11	-	-	12	6	12	11	9	8	12	11
'Unirrigated' n=14[1]	2	2	4	0	1	6	4	-	-	2	1	2	0	4	2	4	3
Total	**10**	**10**	**12**	**9**	**13**	**20**	**15**	**(11)`**	**-**	**14**	**7**	**15**	**11**	**13**	**10**	**16**	**14**
Middle Fen																	
'Irrigated' n=7	6	7	7	5	6	7	6	7	6	7	7	7	7	7	6	6	7
'Unirrigated' n=23	2	3	0	0	0	0	1	2	0	2	1	0	0	1	2	6	5
Total	**8**	**10**	**7**	**5**	**6**	**7**	**7**	**9**	**6**	**9**	**8**	**7**	**7**	**8**	**8**	**12**	**12**

[1] Prior to 2003, n=16 irrigated and 15 unirrigated ponds respectively

Table 3. Proportions of *D. plantarius* in different size classes, and maximum counts of all individuals, adult females and nursery webs, in the standard annual census ponds on Little and Middle Fen at the July census from 1993 to 2009. * The number of adult females given is based on identification of individuals and may be a higher figure than the maximum count of spiders in the large size category.

	1993	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Little Fen																	
% Large	36	21	20	65	30	5	8	-	-	9	29	4	10	14	18	11	45
% Medium	57	37	66	15	41	50	53	-	-	57	43	68	88	45	73	68	34
% Small	7	42	15	20	29	45	39	-	-	34	28	28	2	41	9	21	21
Max. spider count	**14**	**19**	**41**	**20**	**66**	**94**	**62**	**-**	**-**	**53**	**7**	**68**	**40**	**42**	**66**	**75**	**47**
Adult females*	0	1	6	6	16	4	4	-	-	4	2	3	4	7	10	10	15
Nursery web count	0	2	0	0	9	0	4	-	-	0	0	1	2	4	4	0	3
Middle Fen																	
% Large	29	30	3	17	47	5	15	6	20	6	10	5	13	10	19	12	16
% Medium	33	48	62	34	53	32	46	49	30	55	48	50	45	63	50	46	58
% Small	38	22	35	49	0	63	39	45	50	39	42	45	42	27	31	40	26
Max.spider count	**21**	**44**	**102**	**41**	**15**	**99**	**52**	**112**	**20**	**72**	**29**	**42**	**31**	**30**	**54**	**56**	**70**
Adult females*	0	8	1	5	6	5	7	7	0	2	2	1	4	3	8	5	9
Nursery web count	1	3	1	0	0	0	7	0	0	0	0	0	3	1	2	1	2

3.2 Abundance

Since census work began in 1991, the size of the *D. plantarius* sub-populations on both Little and Middle Fens has varied substantially, and in some cases significantly, between the years but at no time has there been any evidence of sustained or significant recovery (Table 3, Fig. 5). In 2009 numbers were well within the range of variation since 1993, with a slight increase on Middle Fen and decrease on Little Fen since 2008.

Separate analysis of the 19 year data set for the Little and the Middle Fen sub-populations shows that, in both cases, the annual time effects models gave a better description of the data (lowest AIC values) than either the linear-trend or no-time-effects models. For Little Fen this model had an AIC value of -175.77 (Wald test for significance of deviation from linear trend: 103.09, $p<0.001$, df=15). Linear-trend and no-time-effects models had AIC values of –0.71 and 39.73 respectively. For Middle Fen this model had an AIC value of –122.84 (Wald test for significance of deviation from linear trend: 178.06, $p<0.001$, df=17). Linear-trend and no-time-effects models had AIC values of 192.29 and 195.9 respectively.

Inclusion in the population models of the data for both fens showed that, as in previous years when such comparison was possible, there was a highly significant difference in the annual pattern of variation between Little and Middle Fen (analysis of data for 1991-'99 and 2002-'09: Wald test for difference between fens: 89.73, $p<0.001$, df=16).

3.3 Breeding indicators

On **Little Fen** the number of adult females encountered during the July census was higher than in 2008 and second only to that recorded in the peak year of 1997 (Table 3). Of three nurseries encountered, females were only found with two of them. Nine of the females encountered were carrying egg sacs. A further 13 nurseries were recorded as casual observations on Little Fen.

On **Middle Fen** nine adult females were recorded during the census, one more than in any previous year (Table 2). Of these, two had nurseries, three had eggs sacs and one was clearly gravid. Both of the nurseries and one of the females carrying an egg sac were on ponds in the western spur of the population that had developed since 2006 (Smith 2009). The nurseries were on the same ponds, in the same sedge clumps, as the two found in this area on 2007. Only two other nurseries were recorded on Middle Fen as a result of casual recording but the recording effort was much lower than on Little Fen.

No new nurseries were seen on either fen after the second week of August, when water levels in the ponds started to fall rapidly (Section 3.4).

3.4 Water Levels

High winter water levels (Figs. 6 & 7) were followed by below average levels in early summer and then a very wet July (Fig. 6). A severe drought set in during the second half of August and lasted until early October (Fig. 6). The mean summer minimum recorded in the dipwells was similar to that in the previous two drought years of 2006 and 2003 (Fig. 7). Levels recorded in the turf ponds on both Little and Middle Fen were lower than in both of those years (Figs. 8 & 9), although only a small number of ponds retained water and contributed to these figures. A higher proportion of ponds were either dry at the measuring post or had no standing water, than in either the 2003 or 2006 drought (Fig. 10). All of the ponds on dug on Great Fen in 1988 (Smith 1988) had dried out by mid-August (Fig. 11).

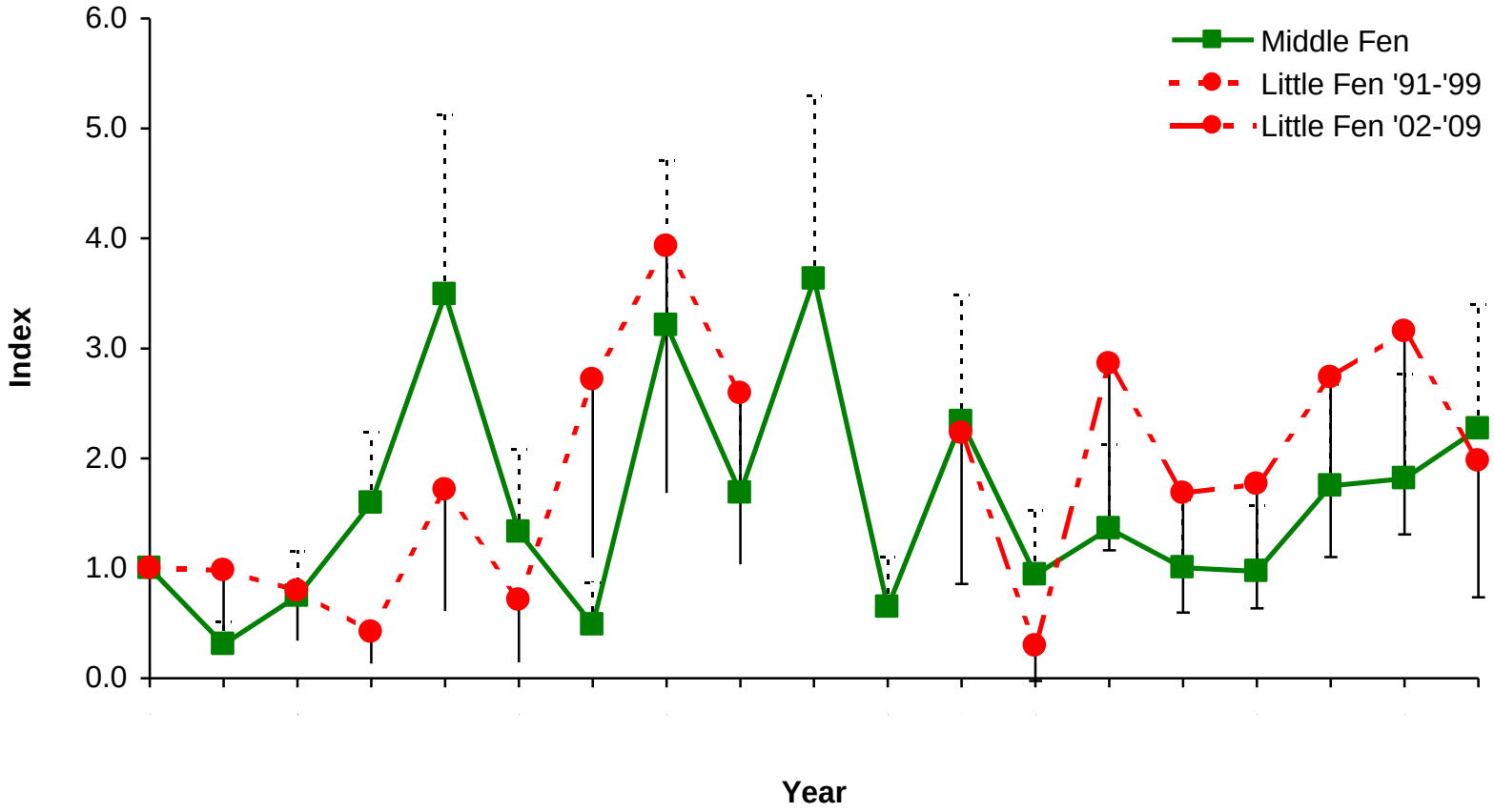


Fig. 5 Annual population indices for *D. plantarius* on Middle and Little Fens in July 1991-2009, generated by a log-linear Poisson regression model and plotted on a linear scale. See text for missing data on Little Fen. 2SEs shown by positive vertical bars for Middle Fen and negative bars for Little Fen.

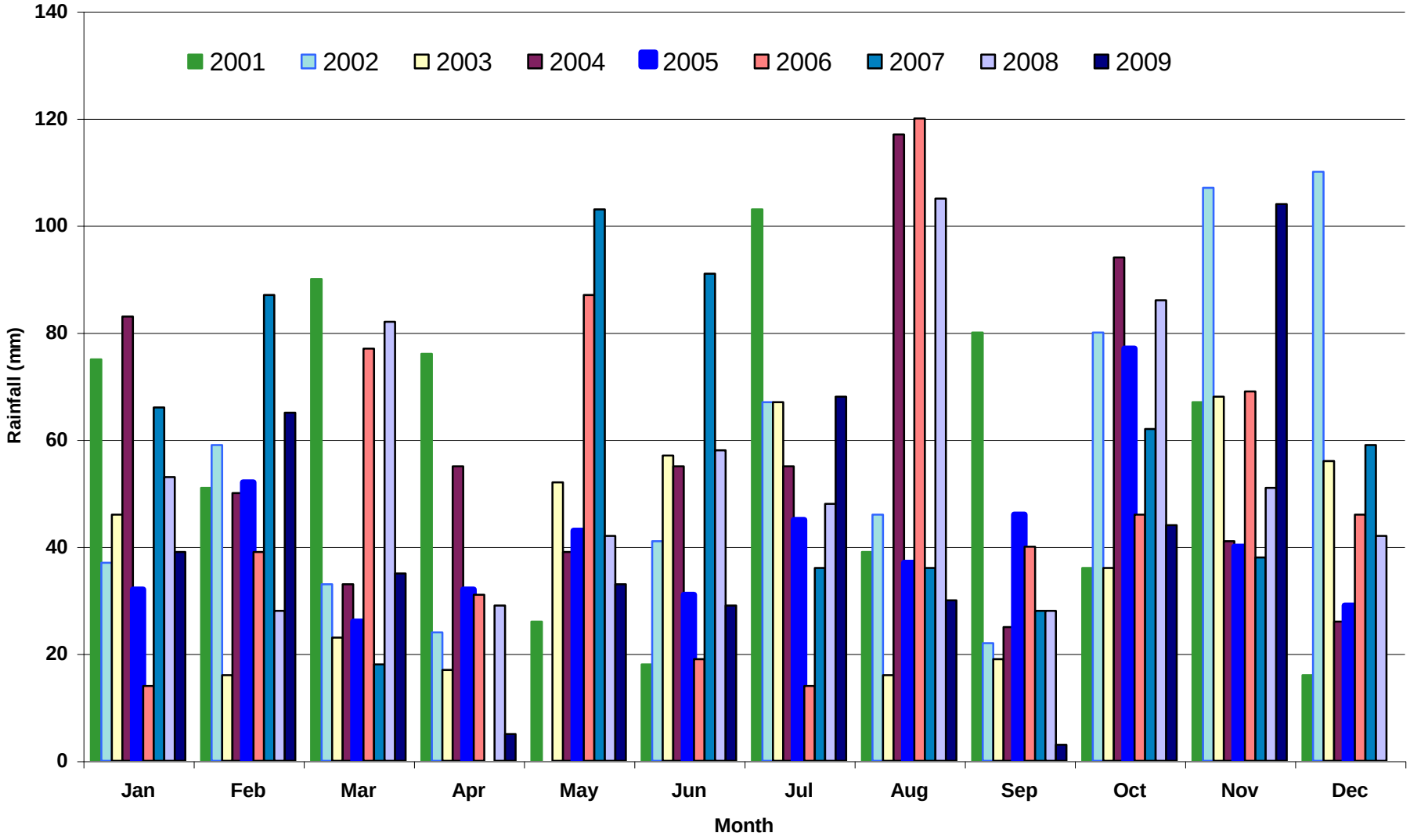


Fig. 6 Monthly rainfall totals for Redgrave & Lopham Fen NNR 2001- Jan 2010

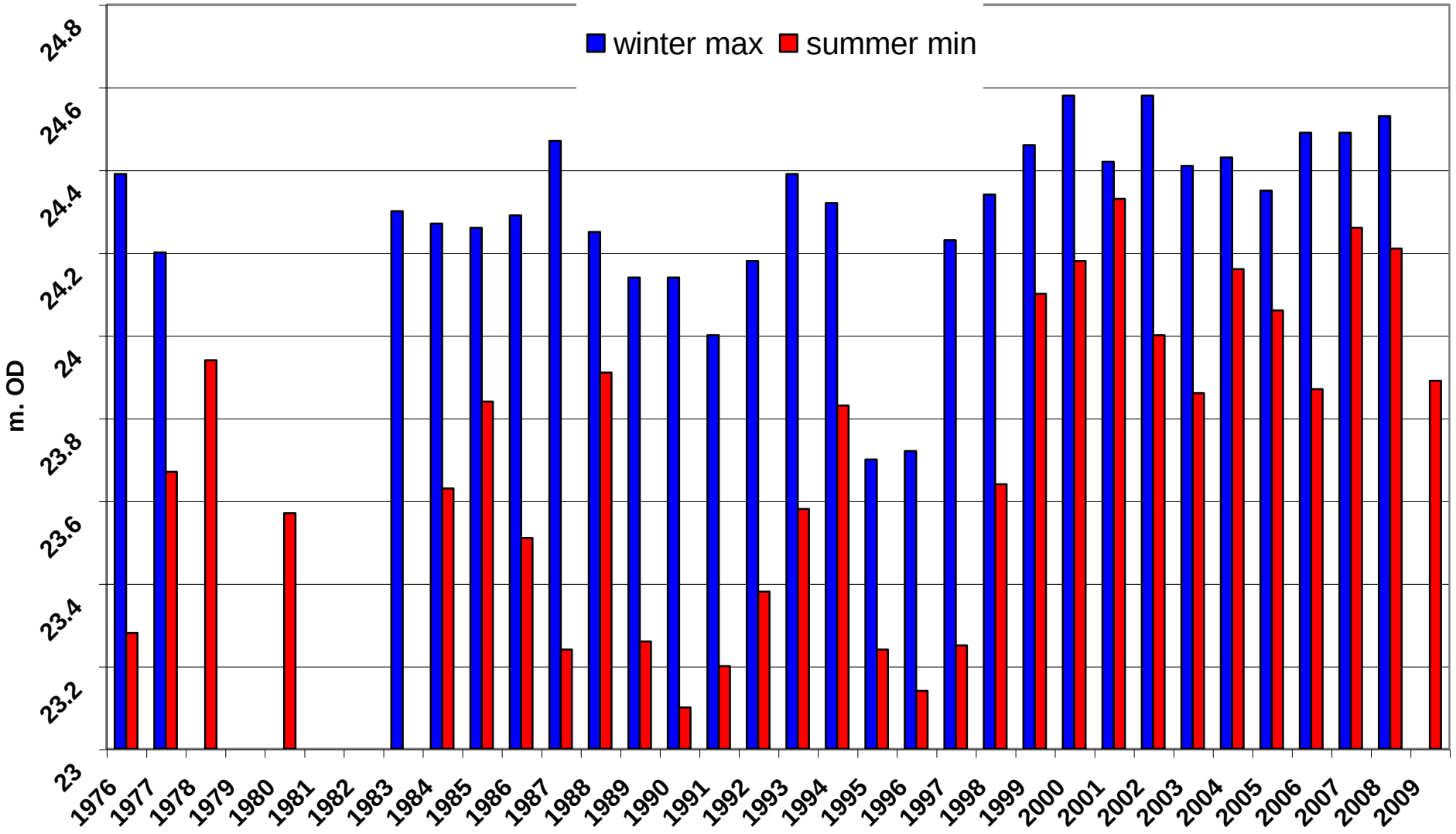


Fig. 7 Mean winter maximum and summer minimum water levels in piezometers on Redgrave & Lopham Fen NNR, 1976-2009

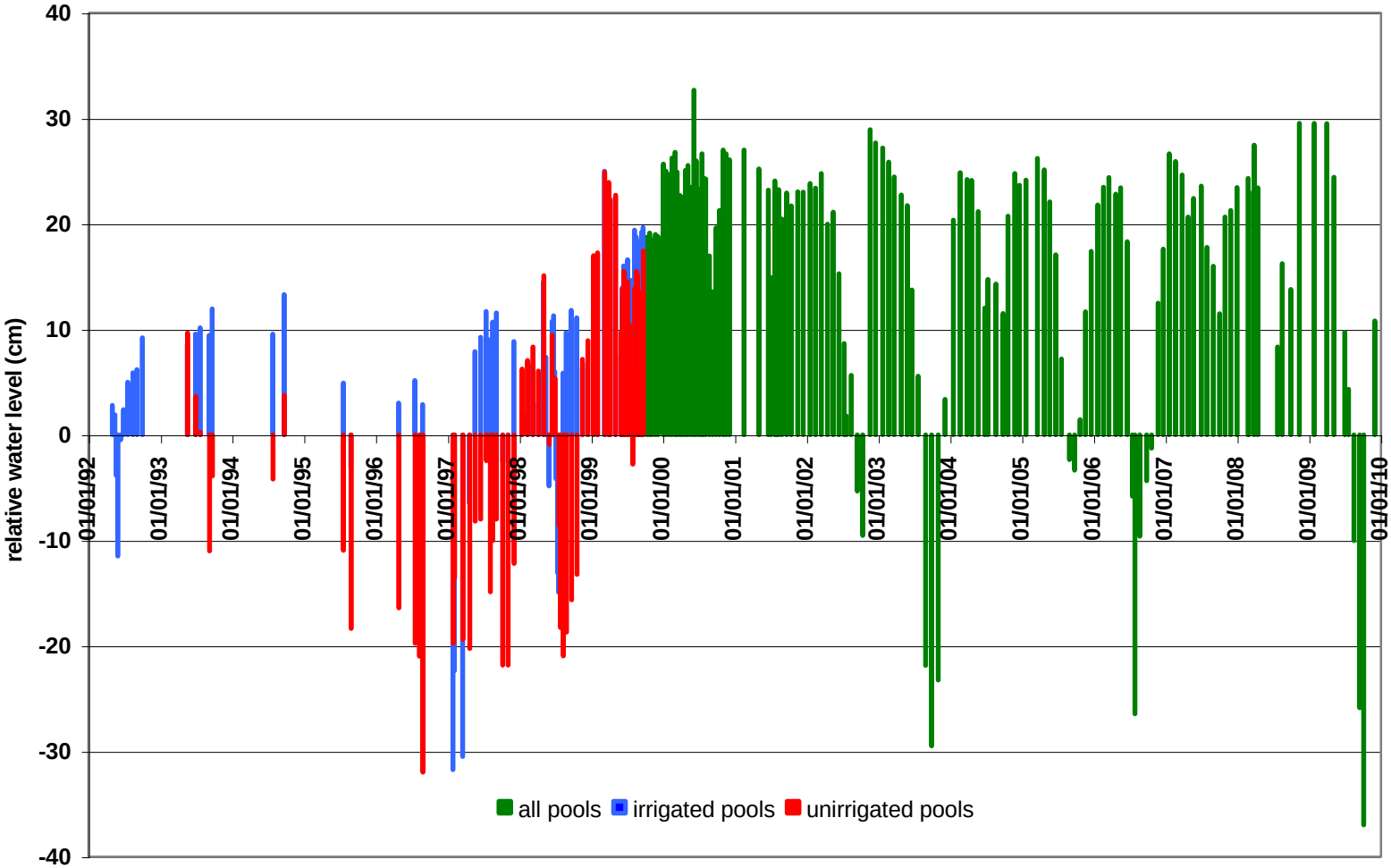


Fig. 8 Water levels in Little Fen ponds 1992-2009. Horizontal line represents the April 1992 datum. Blue and red lines represent mean levels in irrigated and unirrigated ponds respectively : summer irrigation stopped in 1999 (see text).

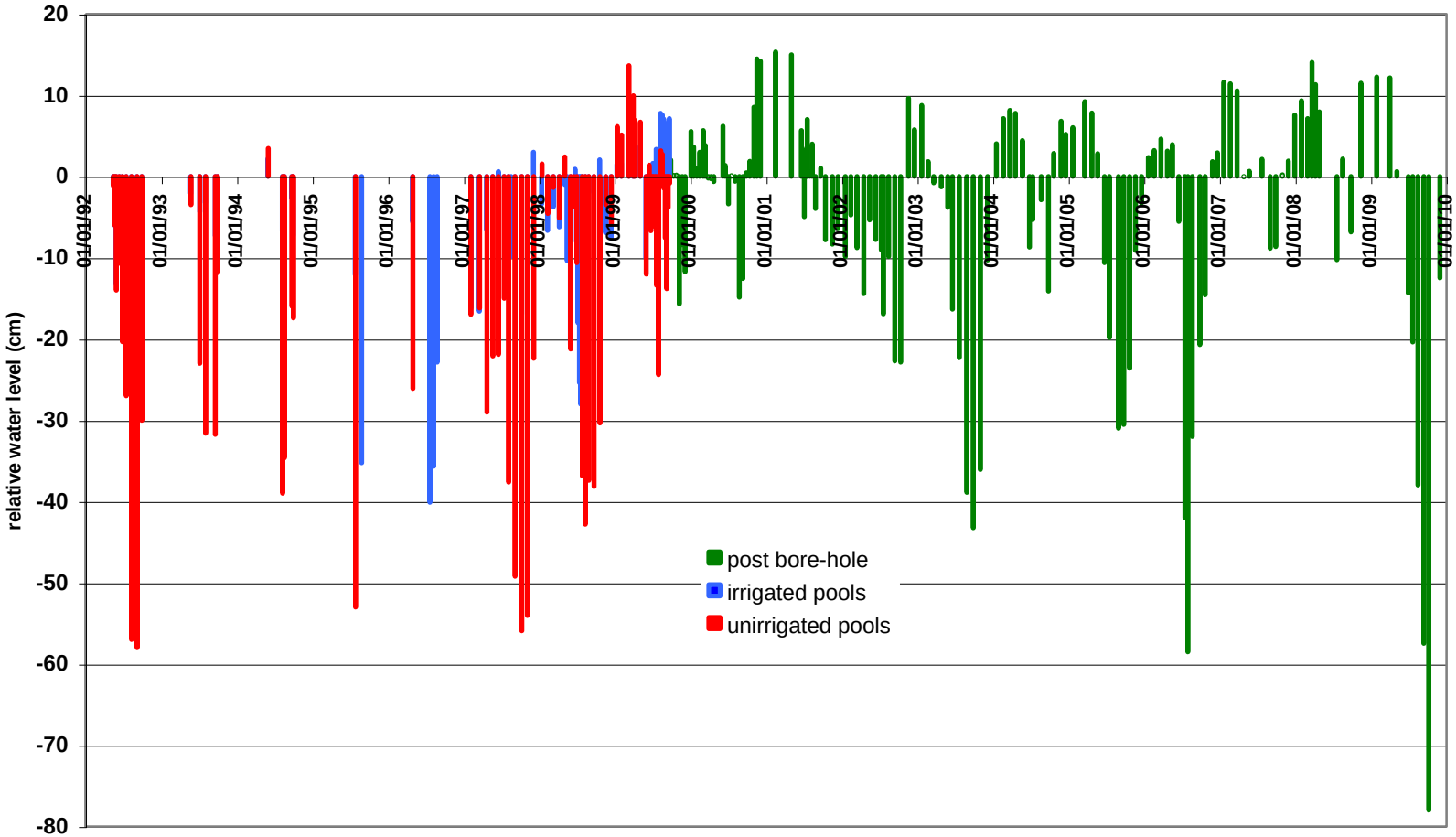


Fig. 9 Water levels in Middle Fen ponds 1992-2009. Horizontal line represents the April 1992 datum. Blue and red lines represent mean levels in irrigated and unirrigated ponds respectively: summer irrigation stopped in 1999 (see text).

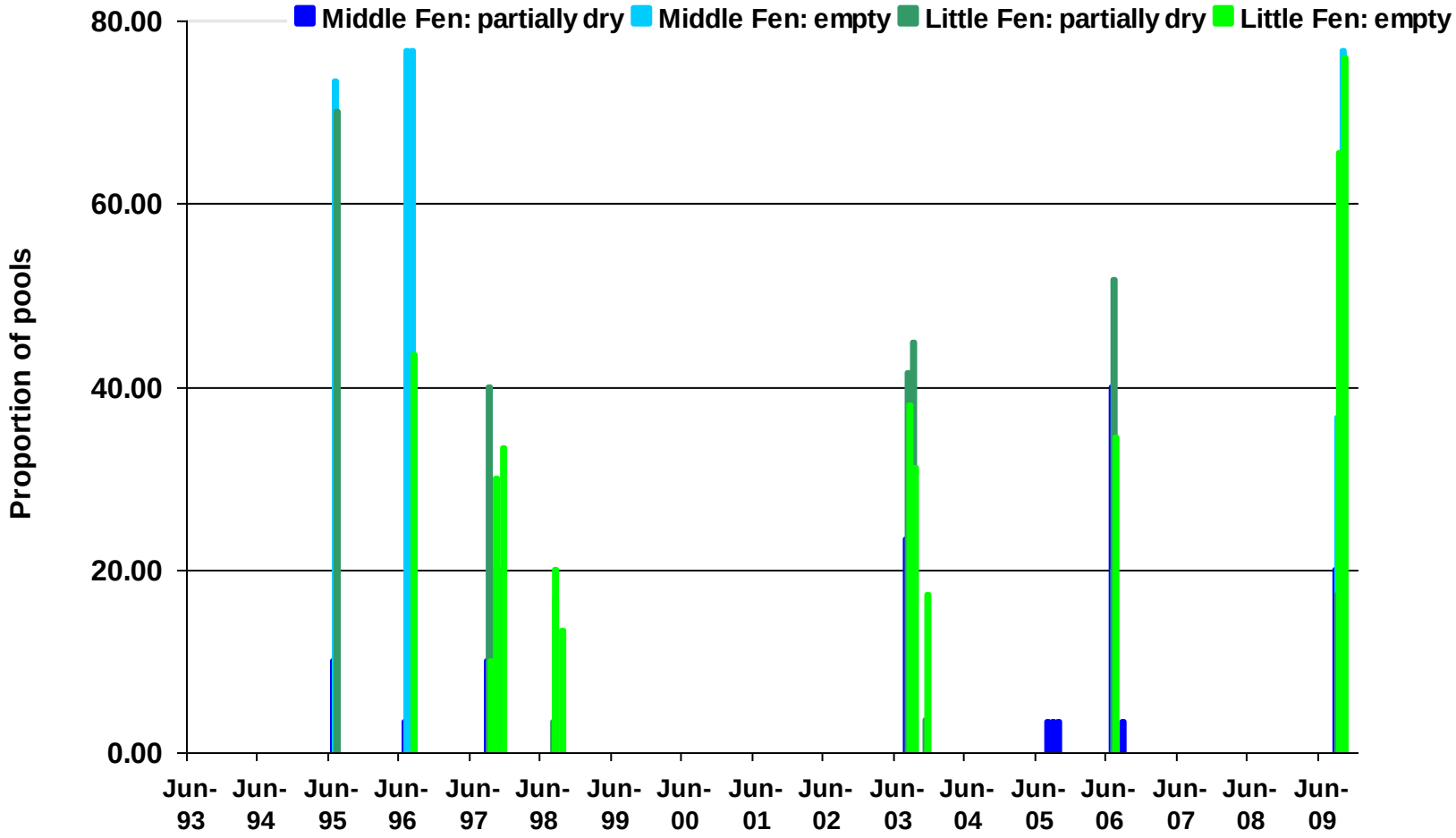


Fig. 10 Proportions of ponds in the Little and Middle Fen census sample that were either partially or completely lacking in standing water in drought summers between 1993 and 2009

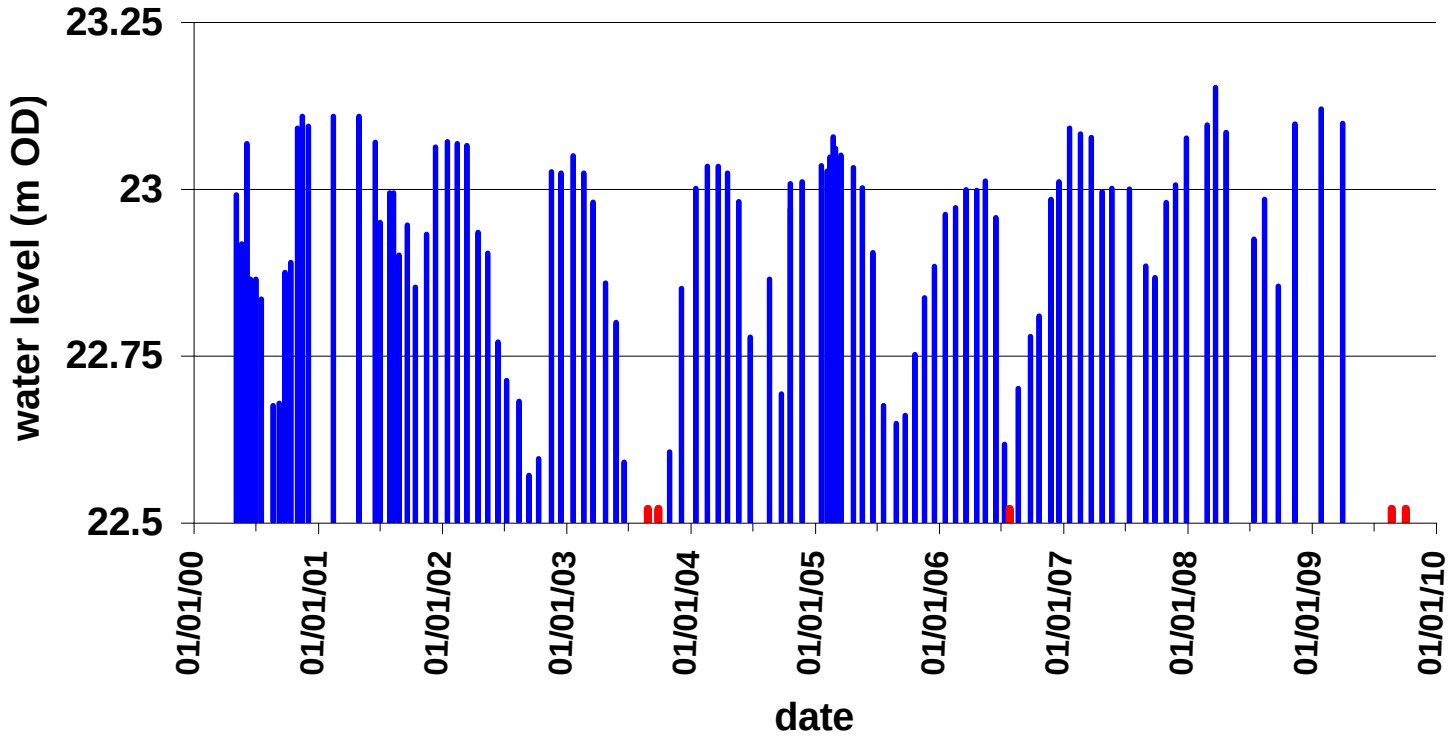


Fig. 11 Water levels in ponds excavated on Great Fen in 1998. Broken line denotes level below which most ponds are dry. Red indicates dates on which all ponds were completely dry (no data were collected in other 'blank' months)

4 Habitat management

4.1 Rotational mowing of *Cladium mariscus*

The *C. mariscus* cutting rotation initiated in 1998 (Smith 1998) in stands surrounding the ponds that supported the highest density of *D. plantarius* (Figs. 1 and 2) was abandoned after 2003. In 2004 the fences around these areas were removed to allow stock to enter (Smith 2005). However, because of failure of the stock to graze much of the wetter fen, from 2004 onwards the SWT initiated limited cutting of stands judged to be in most need of management, both within and beyond the core area for *D. plantarius*.

In 2009, on Little Fen, an east-west strip of *C. mariscus* was cut in the second week of August. This incorporated, and extended west, the southern part of the block last cut in 2001 and northern part of the block last cut in 2003 (Fig.1). As in previous years, occasional clumps of emergent and marginal *C.mariscus* were left uncut around the turf ponds to provide shelter for the spiders and support for nursery webs.

No *C. mariscus* was cut on Middle Fen in 2009 (Fig. 2). The block that was cut on Middle Fen in 2008 (Fig. 2) showed unusually poor recovery, with substantial die-back both at the pond margins and between the ponds. This was exacerbated by trampling by stock during the summer.

4.2 Grazing

On **Middle Fen** the grazing management of areas occupied by *D. plantarius* was more successful than on Little Fen (full records of stock types, rates and movements are maintained by the SWT). However, stock rarely entered areas of tall, dense mature sedge unless they were recently cut (Fig.2).

In the western part of the census area, away from the dense *C. mariscus* beds that dominate the core range for *D. plantarius,* the grazing regime initiated in 2001 continued to have a substantial and positive impact on the vegetation. Tall dense reed, which formerly resulted in deep shading of many of the pools, has been largely replaced by shorter, more open, more mixed associations, with *C. mariscus* thriving, particularly around the margins of the turf ponds.

On **Little Fen**, as in previous years, the stock made relatively few incursions into the areas occupied by *D. plantarius* and had relatively little effect on the vegetation (e.g. Smith 2007). The late summer drought encouraged more access, particularly to the newly cut area (Section 4.1).

4.3 Deepening of turf ponds

In the third week of September a mini-excavator was used to deepen and remove solid plumes of rotting Charophytes from 20 turf ponds on Little Fen and 12 on Middle Fen. The excavated ponds were all within the core spider areas but included ponds that are not part of the standard census sample. Their selection was a compromise between the need to provide more open and deep water, and avoidance of disturbance to spiders when they were likely to be aestivating during a drought period. For this reason, adjacent ponds were rarely excavated. On Little Fen an attempt was made to access and deepen some of the old turf ponds away from the paths. However, despite the very dry conditions, the surface could not support the excavator. In most ponds only one or two buckets of sediment were removed, deepening the centre of the without affecting the margins. On Little Fen three ponds close to the track were substantially enlarged.

4.4 Excavation of new turf ponds on Middle Fen

At the same time, twenty new turf ponds were excavated on Middle Fen in an area immediately east of the core area for *D. plantarius* (Fig. 12). This area was identified in 2008 as having suitable vegetation but no ponds deep enough to support expansion of the population (Smith 2009b). The new ponds were profiled to encourage growth of emergent *C. mariscus*, particularly on their south-facing banks. Their maximum depth was between 1 and 1.2m - slightly below the water table during this drought period.

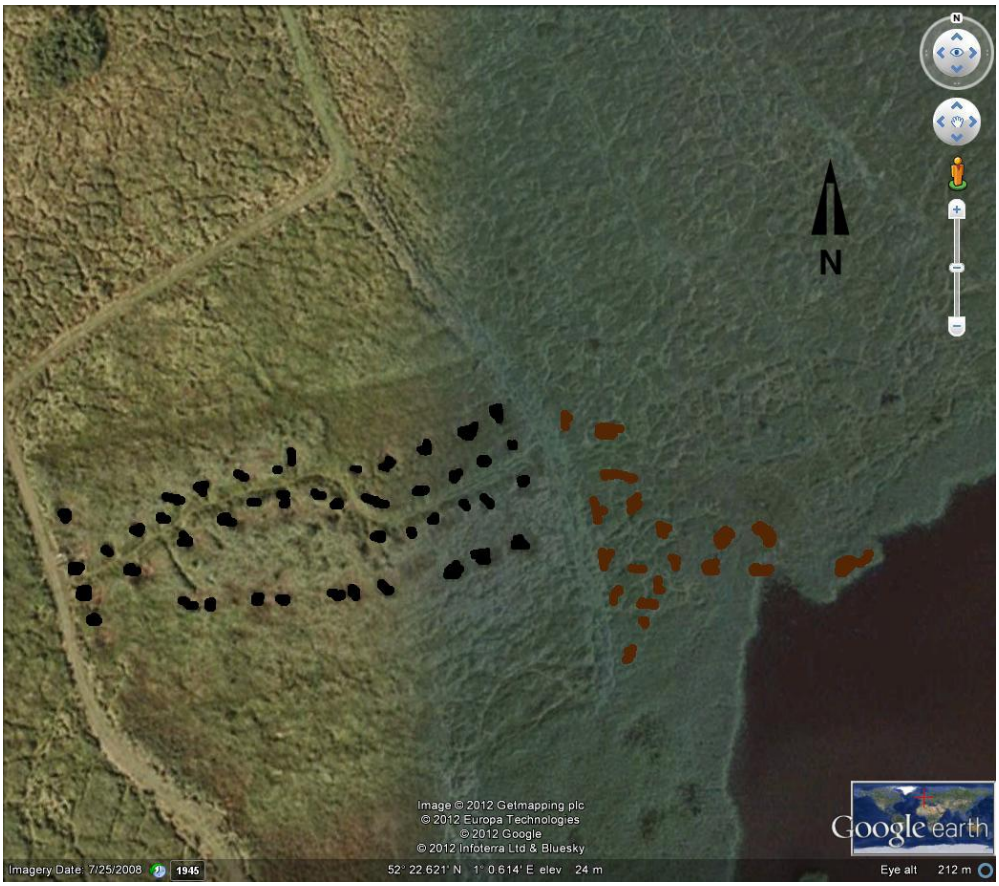


Fig. 12 New ponds excavated on Middle Fen in September 2009 (brown). Pools marked in black are those at the eastern end of the standard census area (see Fig. 4).

5 Discussion

In 2009, ten years after hydrological restoration of Redgrave & Lopham Fen NNR, the *D. plantarius* population remained small and confined to two spatially separate areas of the reserve. The annual population index showed no evidence of any sustained or significant change, remaining well within the range recorded over the previous nineteen years since systematic monitoring began.

Although successful maintenance of summer water tables and evidence of high numbers of both adult females and nurseries in both 2007 and 2008 (Smith 2008, 2009a) provided the potential for significant population growth, no such increase was detected. Breeding numbers were again above average in 2009 but the serious late summer drought curtailed the breeding season. As well as preventing any late breeding attempts, including second broods, such droughts affect growth rates and potential fecundity in the following year (Pearson 2008, Smith 2007). These results highlight once again the need to understand the complex effects of water level on population size, the likely importance of other factors in the population recovery, and the vulnerability of this population in dry summers.

In most years water levels on the Fen have been much higher since artesian abstraction ended in 1999, but because the spider population remains small it is still extremely vulnerable to drought. During the droughts of the 1990s the population was buffered from their worst impacts by irrigation of the core areas of ponds with water piped from the artesian bore-hole. This capacity is no longer available and so, although the effects of droughts are generally less protracted, they can be as severe as, or worse than, those in the 1990s for short periods. For over a month in 2009, despite the sluice systems on the river (Smith 2008), there was almost no standing water anywhere on the Fen complex.

The 2009 results support the conclusions of recent years that, whilst an increasing area of the fen complex has suitable vegetation to support *D. plantarius* (Smith 2009), re-colonisation is limited either by lack of suitable, deep turf ponds or by distance. The very slow rate of spread of the new spur of the population on Middle Fen supports research evidence that this population has a very low propensity and ability to disperse (Pearson 2008). Funding from the Higher Level Stewardship (HLS) scheme allowed the SWT to start to address this problem in 2009 with the excavation of a new series of ponds linking the core *D. plantarius* area on Middle Fen with a large shallow scrape created in the mid-1990s (Harding 2000). Although this scrape is still largely reed fringed, *C. mariscus* has recently started to colonise the fringes of other scrapes of the same period (Smith 2009b). A further chain of new turf ponds, again radiating out from the core areas of the spider population, will be excavated in 2010. The expectation is that *D. plantarius* will eventually colonise these ponds naturally. If improvements in the vegetation quality on the fen continue, it is estimated that natural recolonisation by *D. plantarius* could eventually be stimulated over an area of approximately 20ha in this way. Although this will go some way towards meeting the BAP target for range expansion at this site, the only means of ensuring colonisation of suitable areas that are further from the core spider areas is likely to be by translocation. Translocations within Redgrave & Lopham Fen are proposed as part of the national translocation programme for *D. plantarius,* expected to start in 2010.

The vulnerability of this site to drought - a problem that is likely to worsen in the future – presents problems for the translocation proposal. Even the large scrapes created during the 1990's as part of the restoration operations, dried out in 2009 (Fig. 13). These scrapes are likely to be the focus of new *D. plantarius* populations established by translocation. Ongoing attention is needed to ensure the maintenance of adequate depth in existing turf ponds and the creation both of new, deep ponds and of areas of deeper water near the *C. mariscus*-fringed margins of the larger scrapes.

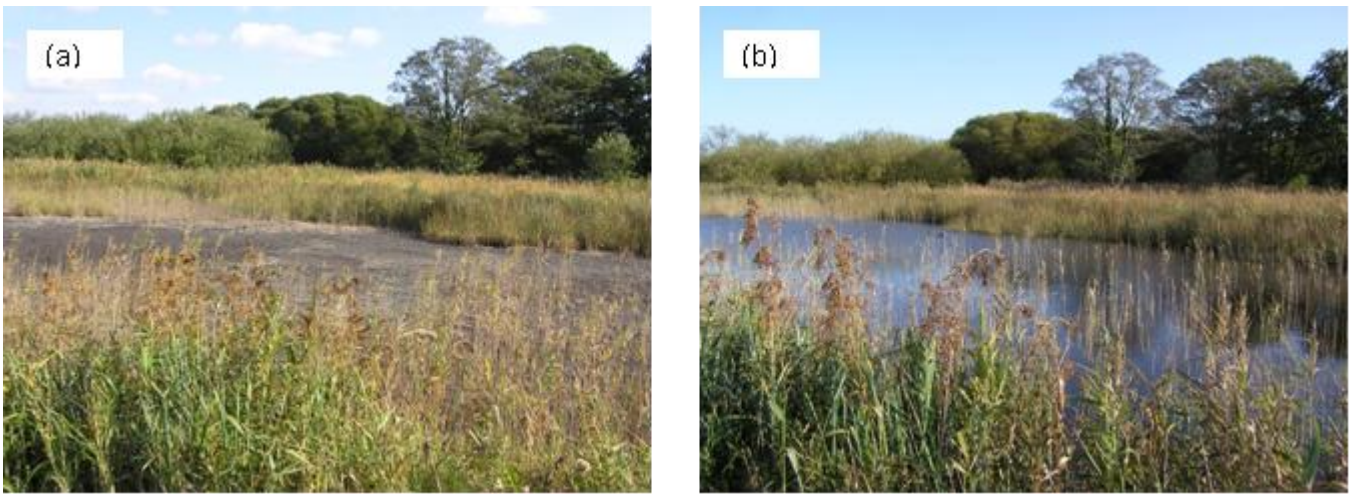


Fig. 13 Scrape at the south-east corner of Middle Fen, with *Cladium mariscus* colonisating the margins, in September of (a) 2009 and (b) 2008

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