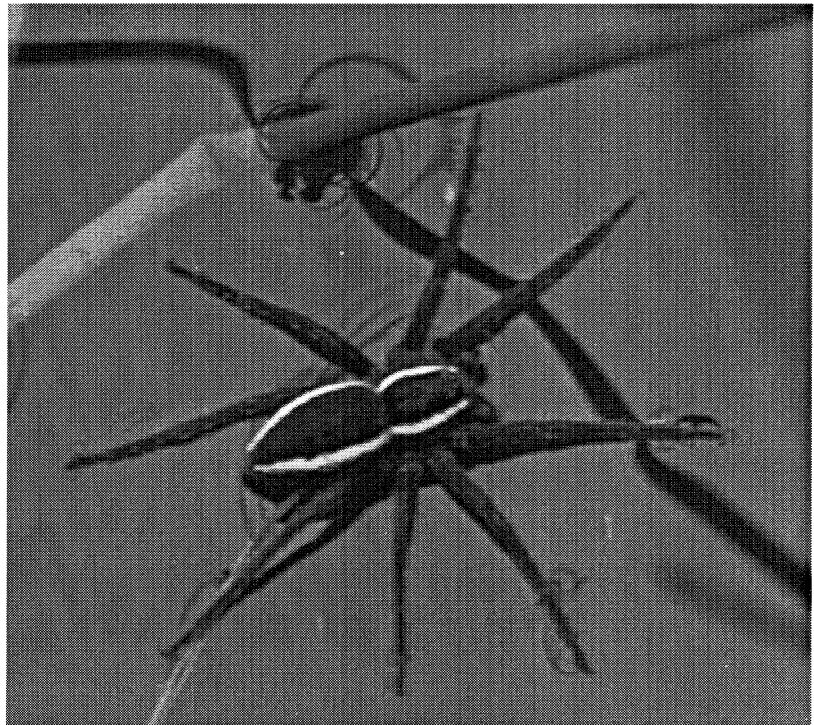


Fen raft spider project: interim summary report for 1998

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**Fen Raft Spider Project:
Interim Summary Report for 1998**

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This report summarises the results of monitoring and management work completed as part of the Fen Raft Spider (*Dolomedes plantarius*) Recovery Project at Redgrave and Lopham Fen NNR in 1998. The work was jointly funded by EN and the SWT. The background to the work is detailed by Smith (1992, 1993, 1994, 1995, 1996, 1997).

Water Levels

Little Fen

The 1997 irrigation supply to the core spider pools was turned off for the winter on 12 December. High rainfall later in the winter resulted in water levels higher than at any time since the 1994. These levels were maintained until early May (Figure 1). Although they fell during May they recovered in June before dropping sharply during July and August. A slow began recovery in late August and accelerated in late October, rapidly restoring levels to those reached in early spring. Because of legal problems over the supply of irrigation water, 1998 saw the lowest water levels in the irrigated pools during the peak of the breeding season than at any time since the project was initiated in 1991. A brief period of irrigation in June coincided with high rainfall and had little impact on the irrigated relative to the unirrigated pools (Figure 1). During the next month several normally irrigated pools held no standing water: more of the census pools were either dry at their gauges or empty than in the much drier summer of 1997 (Table 1). A small irrigation supply was reinstated on 23 July but it was not until 27 July that sufficient volume was supplied to reverse the decline and bring about a full recovery in levels. Cessation of the supply in late October resulted in a fall to early-spring levels in the irrigated pools.

Middle Fen

Water levels in the Middle Fen pools followed a very similar pattern, with high late winter water levels maintained until early May and a recovery in June (Figure 2). As in previous years, the loss of water from the unirrigated pools during July and August was more severe than on Little Fen and, until October, the autumn recovery was slower. Although the failure of the irrigation supply during July resulted in very low levels in many normally irrigated pools, the greater depth of these pools than of those on Little fen prevented any from drying out completely (Table 1). The restoration of the irrigation supply resulted in a recovery in the irrigated pools in August and September.

On 27 July water levels in the pools excavated in the hinterland of the irrigated pools in 1996 (Smith 1996, 1997) were 28.8 cm below the April 1992 datum and 30.3 cm lower than at the same time last year.

The distribution and abundance of *D. plantarius*

Little Fen

The wet spring allowed a further increase, over that in 1997 (Smith 1997), in the numbers of pools and the area of Compartment 5 occupied by *D. plantarius* in July. (Table 2, Figure 3). Spiders reoccupied much of the maximum area in which they have been recorded since the present census began in 1993. They were present in pools at both the eastern end of the irrigated series, and towards the northern and western edges of Compartment 5, from which they have been absent since 1993 and 1996 respectively.

Maximum numbers recorded also showed a continuing recovery since 1996, with the highest totals since the present census began in 1993 (Table 3). Densities of spiders recorded on both irrigated and unirrigated pools were also higher than at any time in the last five

years, and were significantly higher than in 1996 (Table 5). It is notable that a very high proportion of the population comprised small and medium sized spiders, reflecting the high relatively high numbers of adult females and of successful breeding attempts in 1997 (Table 3 & 6). Some of the spiders in the small size category are likely to represent successful breeding attempts relatively early this summer (see below).

The annual population index, which allows comparison with data from the previous census scheme, in 1991 and 1992 (Smith 1996), was the highest ever recorded on Little Fen (Table 4) and was significantly higher than the indices for 1996 and 1994. As in previous years, neither linear trend nor null models provided adequate descriptions of annual variations in numbers (see Smith 1996).

Middle Fen

1998 was the fourth consecutive year in which *D. plantarius* was confined to pools in the irrigated area (Figure 4). Within this area, however, the spiders showed a very substantial recovery from 1997 (Smith 1997). Numbers and densities were the second highest recorded in the last six years (Tables 3 and 5). As on Little Fen, the increase was in the medium and small size categories, reflecting what was thought to have been a very successful breeding season in 1997 (Smith 1997). The annual population index, allowing comparison with the last eight years data, was the second highest recorded and was significantly higher than that for 1997 (Table 4). As on Little Fen, there was no evidence of any linear trend in the annual indices and, as in previous years, the pattern of annual variation on Little and Middle Fens differed significantly.

Breeding success

Although total numbers of spiders on Little Fen were high, number of adults were much lower than in the previous two years (Table 3). Low adult numbers, in combination with low water levels in July and August, resulted in a poor breeding season. No nursery webs were found during the July census and the two females with egg sacs at that time failed to breed on the pools where they held 'territory', because of the rapidly falling water levels (Table 6). There were only three observations of breeding spiders on pools not included in the census: one empty and one occupied web were found in July and a female with an egg sac was seen on 30 September. However, the presence of very small spiders and of two post-partum females on the census pools in July suggests that the wet spring and early summer allowed some breeding attempts to be completed successfully in June.

On Middle Fen adults again comprised only a small proportion of the total population (Table 3) and it seems likely that, here too, 1998 was a poor breeding season. Although there were five records of breeding females at the time of census (Table 6) there were no additional casual records from these or other pools. On the pools excavated in 1996, on five of which breeding was recorded in 1997, only one adult female (with egg sac) was seen. Water levels on these pools in July and August were so low that few suitable breeding sites remained.

***Stratiotes aloides* (water soldier) introduction**

All of the *S. aloides* plants in the Middle Fen pools looked very unhealthy. Most were heavily red-pigmented, as in 1997. None had emergent green leaves and many rosettes remained on the bottoms of the pools throughout the summer, making accurate counting of rosettes very difficult. Submerged rosettes were often obscured by Charophytes and submergent macrophytes. No plants could be seen in six of the 15 pools. The mean of 6.2 (range 0-20) rosettes per pool represents a substantial decrease since last year (mean 19.5, range 10-46). In view of the failure of the introduced *S. aloides* to establish healthy growth over two years, it seems likely that it will continue to decline and will fail to provide emergent foliage that can be utilised for breeding by *D. plantarius*.

Management work

1. **Sedge cutting** was the only management work carried out around the spider pools in 1998. Approximate boundaries of blocks cut on Little and Middle Fens are shown on Figures 3 and 4, together with cutting dates.

On Little Fen the cutting had two purposes. The first was to reduce the vigour of the increasingly dense stand of *Phragmites australis*, which surrounds and overshadows the most westerly irrigated pools, by cutting in early August. This area was last cut in April 1997 but this early cutting date appears to have increased the dominance *P. australis* at the expense of *Cladium mariscus*. The second was to cut *C. mariscus* between the irrigated pools and along the edges fronting the path. These areas were left uncut when the backs of the pools were cut as part of the main sedge rotation, in the summers of 1997 and 1996.

On Middle Fen, tall, dense *C. mariscus* was cut as part of the main sedge rotation, in late July. The south east and west margins of the pools excavated in 1996 were cut but the northern edges, together with a narrow band of sedge between these pools and those bordering the path, were left uncut (Figure 4).

2. **Scrub removal from around Middle Fen pools**, as recommended in 1997 (Smith 1997) was undertaken during autumn 1997.
3. **Excavation of new pools on Great Fen**, in preparation for the proposed future introduction of spiders to this area, was done between 3 and 5 November. Twenty-five pools were dug in two staggered rows, approximately 100m long, on an approximate north/south axis, *ca* 15 m west of one of the main bunds through the centre of Great Fen. The pools dimensions were between 1.5-5m by 5-10m, with a maximum depth of 50-75 cm. Outlines and orientations were varied but in general a high bank length:water surface ratio was achieved by creating long, thin pools or pools with lobed outlines. The sides were gently graded, with distances of one to five metres between pools. The vegetation in the area is dominated by *C. mariscus* but the stand is less pure than that in the core areas on Little and Middle Fens. Clumps of *C.*

mariscus removed during excavation were replanted around the shallow margins of the pools.

4. **Semi-permanent electric fencing to exclude grazing stock** was erected around the core pools on Middle Fen and adjacent prime sedge beds. The enclosure included all of the irrigated pools and the pools excavated in 1996, and stretched approximately 25 m to the north and 30 m to the south of the path between the pools.

A semi-permanent electric fence will be erected around the core pools and prime sedge beds on Little Fen during November.

Recommendations

1. **Water Levels:** The capacity to irrigate pools in the core areas must be retained until recovery of the water table gives adequate summer levels.
2. **Management of prime sedge beds in core areas:** All of the grazing enclosure on Middle Fen should be managed by mowing on a four-year rotation, with four blocks being mown in successive years. On Little Fen, where the sedge-beds are more extensive than on Middle Fen, part of the enclosure will be managed by mowing on a four-year rotation and the remainder by grazing on the same rotation. Proposals for the rotations for Little and Middle Fens are given in Figures 5 and 6 respectively. The proposed regimes are designed to give continuity with the rotational mowing of recent years and will become progressively simpler as pool margins, which have been managed separately in the past, become incorporated into the main mowing blocks (see below). As in recent years, mowing should be done in July and August with care being taken wherever possible to avoid nursery webs. Some marginal and island clumps of *C. mariscus* should be left around the pools to provide cover. On both fens the poorer quality sedge beds outside the enclosures will be managed by non-rotational grazing.

The SWT currently favours using extensive grazing over a period of months, rather than intensive grazing for a few weeks, to treat these areas in the allocated year. The effects of this should be reviewed after the first season to ensure that this results in satisfactory break-up of litter and re-juvenation of the sedge.

Unless the grazing regime has obvious deleterious effects on the spiders, either directly through trampling or indirectly through undesirable changes in the vegetation, it should be pursued through one complete cycle and reviewed in 2002. This should comprise a comparison of its impact compared with that of mowing and of extensive non-rotational grazing. It would be highly desirable to make this comparison on an experimental basis. However, the large size of the plots that would be required to accommodate both edge effects and the heterogeneous grazing habits of horses, together with the need for adequate replication make it unlikely that this will be feasible within the relatively small areas concerned.

3. **Emergent reed removal from Middle Fen pools**, by removing sediment and roots from the bottoms of the pools, as recommended in 1997 (Smith 1977), should be carried out this winter. To avoid excessive disturbance, half of the irrigated pools, and half of the unirrigated pools along the east-west path through Compartment 3 should be cleaned out this winter and the other half during winter 1998/99. Removal of reed from the deeper pools along the former board walk should be delayed until the effects on the reed of the higher water levels, following bore-hole closure, reed can be assessed.
4. **Monitoring:** Provision has been made to continue the standard summer census in 1999. It was originally planned that the SRP would continue to fund the census for at least two years after bore-hole closure. However, because closure will not now take place until spring 1999 at the earliest, nearly two years later than scheduled, consideration must now be given to extending the present project until it is clear that there is a significant expansion in the spider population following bore-hole closure. During this period, I recommend that a second monitoring scheme is initiated, based on counts of nursery webs. The present and new schemes should be run in parallel until it is clear (1) that there is a significant expansion in the population and (2) that sufficient nursery webs are being produced to give a data set large enough to analyze (which is not the case at present). At this point the new scheme should be run annually and the frequency of the present census reduced. The proposed new scheme has the advantages that it is much safer and requires less expertise, and so monitoring can be undertaken by volunteers.

Regular monitoring of water levels (usually monthly, but more frequent in times of rapid change) in the census pools, currently undertaken by volunteers, should continue (1) as a basis for making decisions about the irrigation strategy and (2) to help interpret changes in spider numbers. Water levels in a sub-sample of the new pools in Great Fen should be monitored to assess their suitability for the proposed spider introduction. After a year, it should be possible to reduce this to a very small number of these pools if it is clear that variation between them is small or has a consistent linear gradient.
5. **Levelling of a sub-set of the spider pool depth gauges**, on Little, Middle and Great Fens, as part of the end-of project levelling survey would enable the surface water measurements to be related to the piezometer measurements, rather than to an arbitrary relative datum as at present.
6. **Marking new pools:** The newly dug pools on Great Fen need numbered oak marker posts installed in preparation for monitoring water levels (see 6. above) and, eventually, the introduced spiders.
7. **Autecological work.** As ever (Smith 1996, 1995, 1994, 1993).

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Table 1 Numbers of pools which were either completely dry or were dry at their measuring gauges during 1998. Equivalent numbers are given for 1997 and 1996 where data are available for similar dates.

Date	Little Fen						Middle Fen					
	No. dry			No. dry at gauge			No. dry			No. dry at gauge		
	96	97	98	96	97	98	96	97	98	96	97	98
mid-Jan	16	5	0	11	0	0	0	0	0	0	0	0
mid March	-	3	0	-	2	0	-	0	0	-	0	0
early April	-	5	0	-	2	0	-	0	0	-	0	0
early May	-	-	0	-	-	0	-	0	0	-	0	0
mid-May	-	0	0	-	0	0	0	0	0	0	0	0
mid-June	-	0	0	-	0	0	-	0	0	-	0	0
mid-July	10	0	1	4	0	1	18	0	0	3	0	0
early Aug	-	0	1	-	0	6	-	0	0	-	0	0
end-Aug	-	0	0	-	13	5	-	0	0	-	3	0

Table 2 Numbers of census pools on which *D. plantarius* was recorded in July 1993-1998

Year:	1993	1994	1995	1996	1997	1998
Little Fen	11	10	16	9	13	20
Middle Fen	8	10	7	5	6	7

Table 3 Maximum numbers of *D. plantarius* counted in Little and Middle Fen census areas in July 1993 - 1998

	1993	1994	1995	1996	1997	1998
<u>Little Fen</u>						
Large	5	4	8	13	20	5
Medium	8	7	27	3	27	47
Small	1	8	6	4	19	42
Total	14	19	41	20	66	94
<u>Middle Fen</u>						
Large	6	13	3	7	7	5
Medium	7	21	63	14	8	32
Small	8	10	36	20	0	62
Total	21	44	102	41	15	99

Table 4 Multiplicative annual indices for *D. plantarius* on Little and Middle Fens in July 1991-1998, generated by a poisson regression model (TRIM).

Year	Little Fen		Middle Fen	
	Annual index	Std.err.	Annual index	Std.err.
1991	1.000	0.000	1.000	0.000
1992	2.809	0.744	1.485	0.3236
1993	0.579	0.198	0.535	0.150
1994	0.394	0.151	1.655	0.357
1995	1.321	0.381	3.234	0.639
1996	0.657	0.289	1.261	0.370
1997	2.543	0.817	0.519	0.167
1998	3.621	1.110	3.046	0.723

Table 5 Mean numbers of *D. plantarius* on irrigated and unirrigated pools within the census area in July 1993 - 1998. Data are means of the maximum count for each census period (no spring or autumn census after 1994). Two S.Es. of the mean are given in parentheses for the July counts. There were 25 unirrigated and 7 irrigated pools on Little Fen and 23 unirrigated and 7 irrigated pools on Middle Fen.

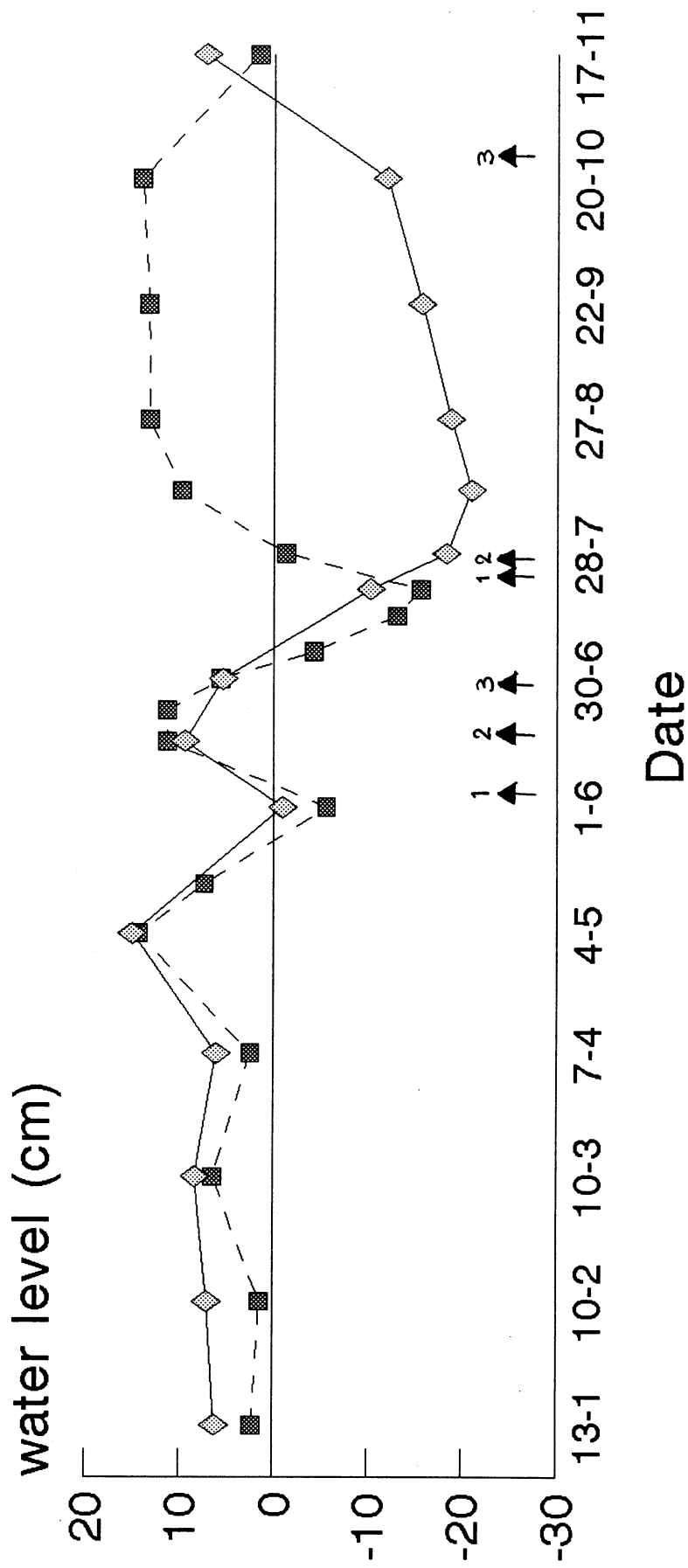
		Little Fen										
Census period	Unirrigated				Irrigated							
	1993	1994	1995	1996	1997	1998	1993	1994	1995	1996	1997	1998
Spring	0.32	-	-	-	-	-	1.57	-	-	-	-	-
Summer	0.48	0.33	1.00	0.46	1.50	2.17	0.29	0.86	1.71	0.29	2.29	4.86
	(0.31)	(0.23)	(0.57)	(0.36)	(1.32)	(1.32)	(0.37)	(1.11)	(1.13)	(0.37)	(1.84)	(3.19)
Autumn	0.60	0.96	-	-	-	-	1.71	0.86	-	-	-	-

		Middle Fen										
Census period	Unirrigated				Irrigated							
	1993	1994	1995	1996	1997	1998	1993	1994	1995	1996	1997	1998
Spring	0.09	0.04	-	-	-	-	1.78	1.71	-	-	-	-
Summer	0.13	0.35	0.00	0.00	0.00	0.00	2.00	3.71	14.3	5.57	2.14	12.43
	(0.19)	(0.41)	(0.00)	(0.00)	(0.00)	(0.00)	(1.07)	(1.21)	(7.64)	(4.07)	(1.54)	(9.01)
Autumn	0.00	0.17	-	-	-	-	2.86	2.71	-	-	-	-

Table 6 Numbers of adult females at different stages of the breeding cycle in the Little and Middle Fen census areas during the July census 1993 - 1998 (individuals recorded at more than one stage are listed for the most advanced stage only)

	1993	1994	1995	1996	1997	1998
<u>Little Fen</u>						
Pregnant	2	0	3	2	0	0
with egg sacs	3	0	3	3	7	2
with webs	0	2	0	0	9	0
post-partum	0	0	2	0	0	2
Total	5	2	8	5	16	4
<u>Middle Fen</u>						
pregnant	1	1	0	1	0	0
with egg sacs	1	5	1	4	6	4
with webs	1	3	1	0	0	0
post-partum	1	2	1	0	0	1
Total	4	11	3	5	6	5

Figure 1 Mean water levels in pools censused on Little Fen in 1998

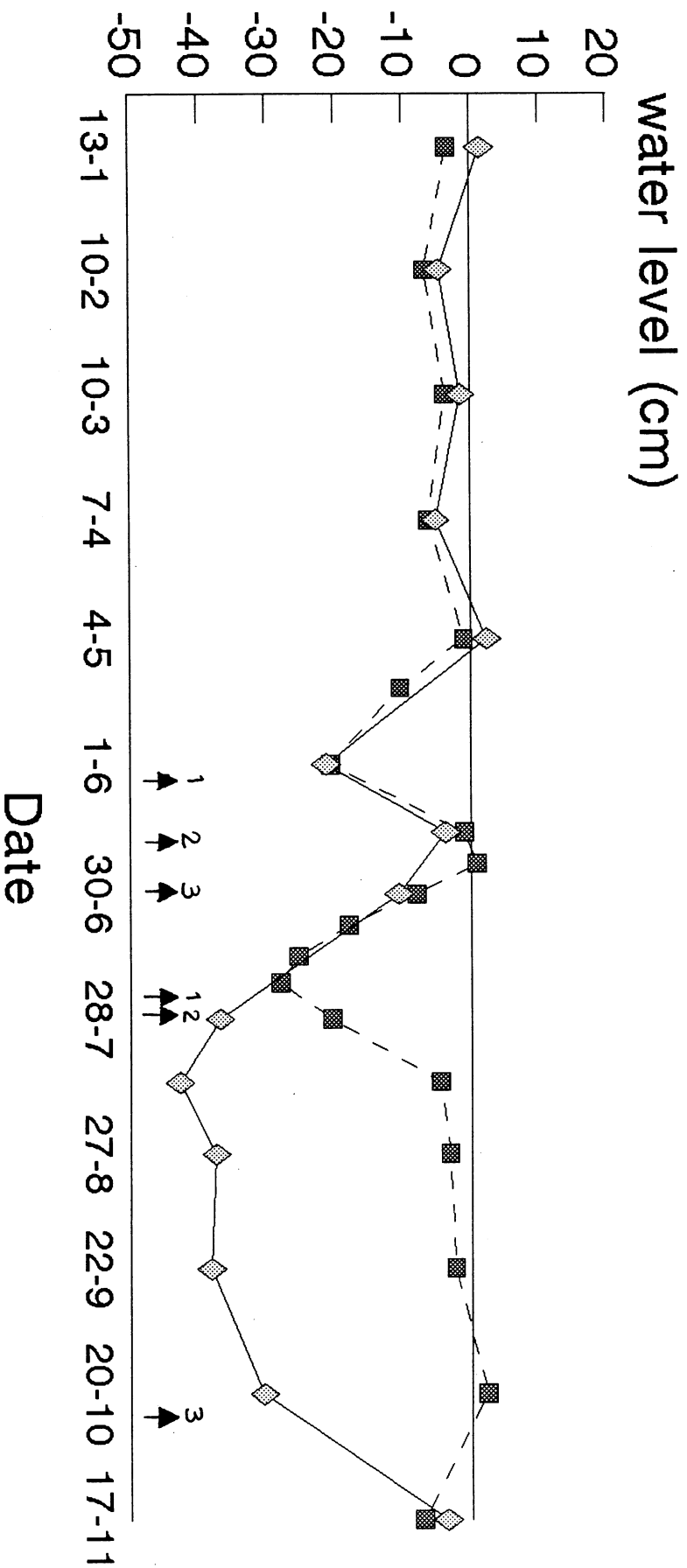


◆ unirrigated' 98 ■ irrigated '98

Horizontal line represents the April 1992 datum (Smith 1992)

Vertical arrows show (1) start of irrigation (2) increase in supply (3) end of supply

Figure 2 Mean water levels in pools censused on Middle Fen in 1998

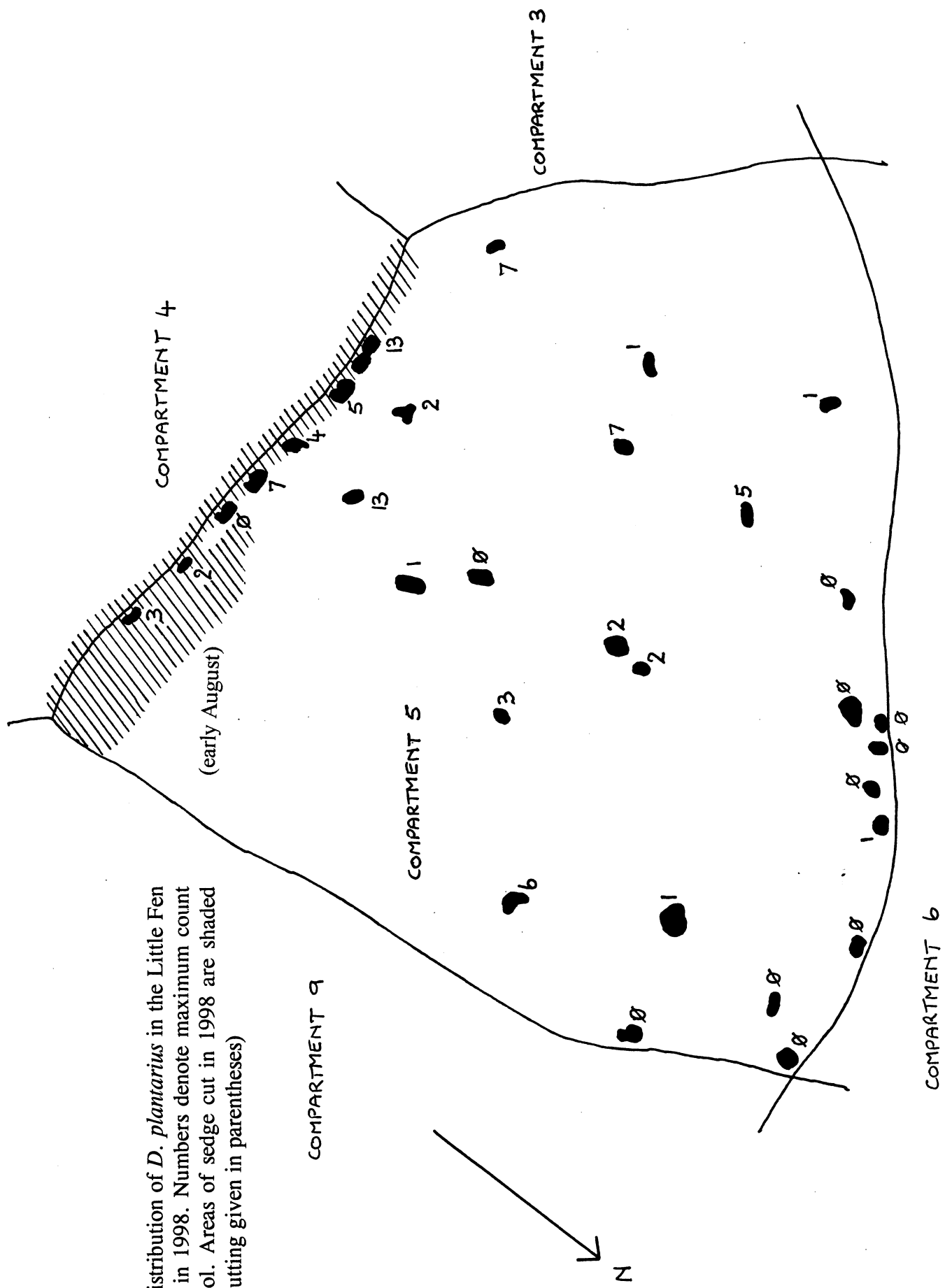


◇ unirrigated '98 ■ irrigated '98

Horizontal line represents the April 1992 datum (Smith 1992)

Vertical arrows show (1) start of irrigation (2) increase in supply
(3) end of supply

Figure 3 Distribution of *D. plantarius* in the Little Fen census area in 1998. Numbers denote maximum count for each pool. Areas of sedge cut in 1998 are shaded (timing of cutting given in parentheses)



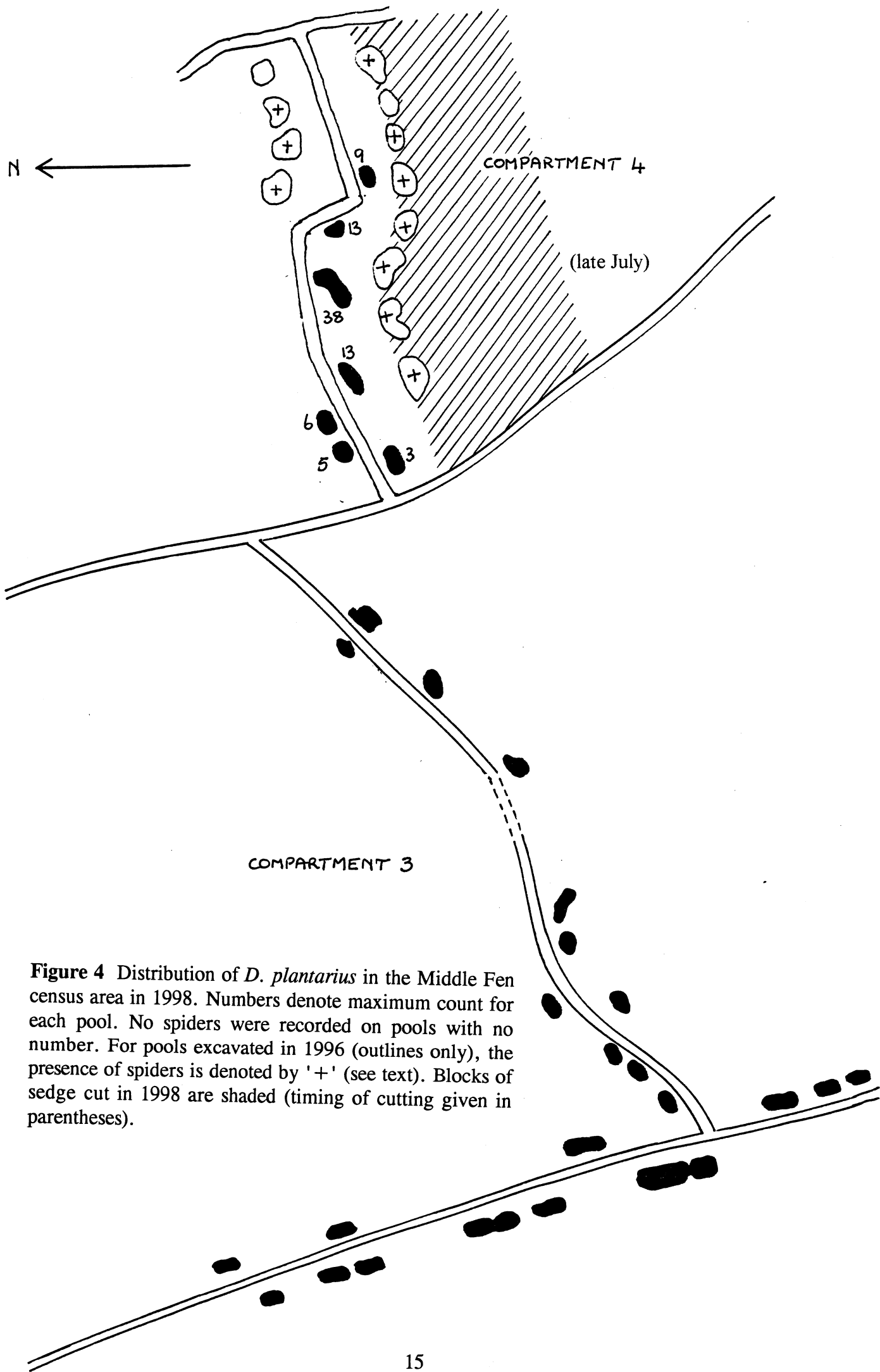


Figure 4 Distribution of *D. plantarius* in the Middle Fen census area in 1998. Numbers denote maximum count for each pool. No spiders were recorded on pools with no number. For pools excavated in 1996 (outlines only), the presence of spiders is denoted by '+' (see text). Blocks of sedge cut in 1998 are shaded (timing of cutting given in parentheses).

Figure 5 Proposed rotational management of *Cladium mariscus* beds in core areas for *D. plantarius* on Little Fen. Note that suggested boundaries of blocks are very approximate. Rotational management to be confined to shaded areas. Hatching denotes different blocks. Dotted areas are grazed as opposed to mown.

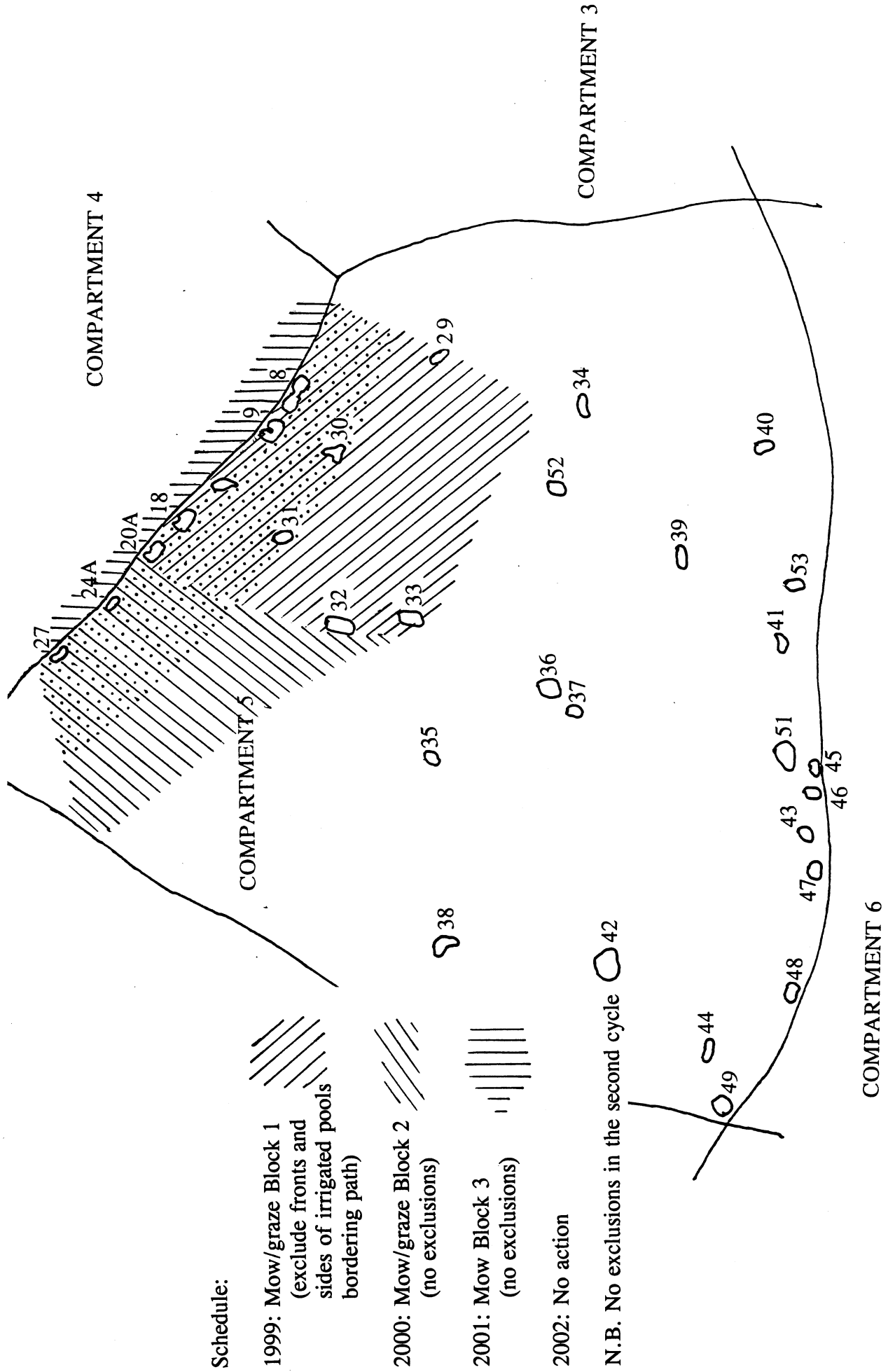
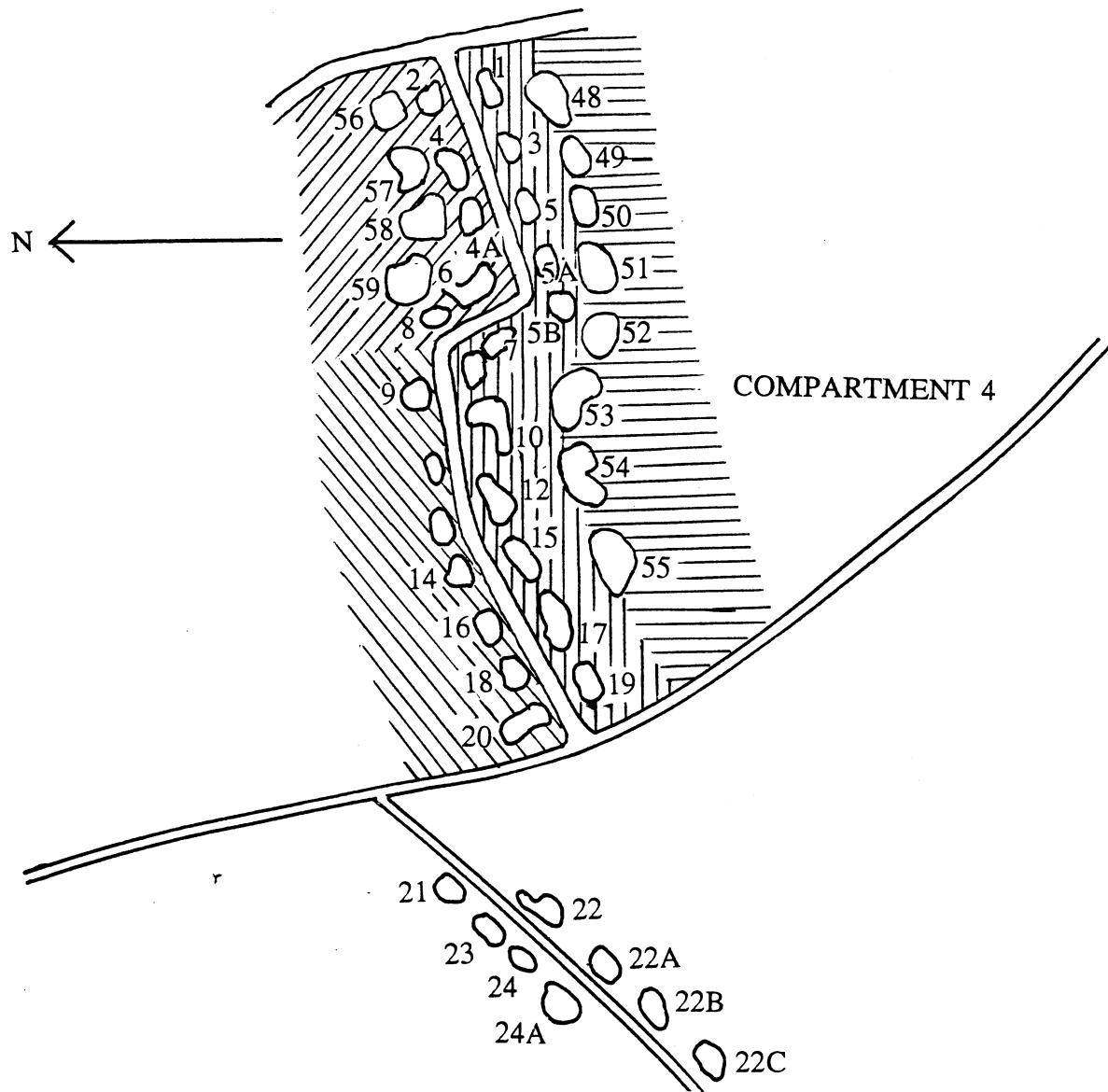





Figure 6 Proposed rotational mowing of *Cladium mariscus* beds in core areas for *D. plantarius* on Middle Fen. Note that suggested boundaries of blocks are very approximate. Rotational management to be confined to shaded areas. Hatching denotes different blocks.

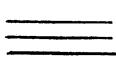


Schedule:

1999: Block 1 
 (exclude fronts of pools bordering path but include sides and backs)

2000: Block 2 
 (no exclusions)

2001: Block 3 
 (no exclusions)

2002: Block 4 
 (no exclusions)

N.B. No exclusions in the second cycle