

OAK BREEDING SEEDLING ORCHARDS 2003 research report

This report summarises progress to date in establishing BIHIP's eight oak breeding seedling orchards. After a short explanation of trial design the report highlights progress and presents a financial report and summary. Estimated costs of a further two years of supporting work are presented.

SUMMARY

The oak BSO project initiated by the Oxford Forestry Institute (Peter Savill, Jason Hubert *et al.*) and the BIHIP Oak Group of is now managed and co-ordinated by the Northmoor Trust (NMT). The aim of the research is to establish seed orchards of oak (*Quercus robur*, *Q. petraea* and hybrids) in the UK and Eire from seeds collected from plus trees in the UK, Eire and northern continental Europe (Appendix 1). The orchards are situated on eight sites: Northmoor Trust in Oxfordshire, Shakenhurst in Worcestershire, Belmont Park Estate in Kent, Sotterley Hall in Suffolk, Dalkeith in Scotland, Newton Rigg in Cumbria, Carmarthenshire in Wales and County Cork in Eire.

UPDATE ON PROGRESS

The sites were surveyed by NMT staff (except Eire & Wales) and planted, either by the site owners or by contractors, during March/April 2003. In total 19,499 trees, excluding the two surrounding guard rows per site, were established across eight sites (Table 1). The breeding seedling orchard design adopted was common to all sites but there was variation between sites both for number of families and replicates. All families within a trial were represented as single tree plots in each block and distributed randomly within the block at planting time. The total number of families available with sufficient trees and the area presented at each site dictated the number of blocks within a trial. Detailed layouts for each site are presented in Appendix 3.

Table 1 The eight P2003 BIHIP oak breeding seedling orchard experiments.

	Suffolk	Oxon	Cork	Carmarthen	Cumbria	Kent	Midlothian	Worcestersh	Total plants
<i>families per site</i>	61	56	46	44	40	34	31	21	19,499
<i>reps per site</i>	50	39	48	53	63	71	85	100	
<i>trees per site</i>	3,050	2,240	2,208	2,332	2,520	2,414	2,635	2,100	
<i>ha per site</i>	1.22	0.90	0.88	0.93	1.01	0.97	1.05	0.84	

At the planning stage, each trial was balanced in that all families within a trial were represented in each unit by one tree. Owing to some inevitable incorrect sorting by the nursery there were either duplicates or missing families within several blocks at most sites. This factor combined with mortality and, in all probability insufficient beat-up numbers, will make the experiments slightly unbalanced. However, the large within-site replication at many sites may allow consolidation within sites to keep these site balanced.



The newly planted oak BSO at the Oxon site, Northmoor Trust, April 2003.

All trials have adequate protection from pests, either in the form of fencing, treeshelters or spiral guards. Five out of the eight sites have now been mapped (Table 2) and data entry into Genstat spreadsheets for these sites is ongoing. Each site has had at least one visit by NMT personnel (Table 2) and beat ups for all sites are being held in a lining-out bed at the Oxon site (Appendix 2).

At the Oxon site seven replicates were removed from the experiment and the constituent 392 (7 × 56) trees lined out by family in a *demonstration plot* neighbouring the BSO (Appendix 1).

Table 2 Summary of activities and data entry for the eight BSO sites, as of July 2003

SITE	VISITS	MAPPED	DATA INPUTTED	SURVIVAL COUNT
OXON	frequent	✓	✓	×
WORCESTERSHIRE	3	✓	×	×
KENT	3	×	×	×
SUFFOLK	2	✓	✓	×
CUMBRIA	2	✓	✓	×
MIDLOTHIAN	3	✓	×	×
CARMARTHENSHIRE	1	✓	×	×
CORK	0	✓	×	×

Clonal hedges have been established at four sites, three of which are also BSO hosts whilst one further site hedge is with Horticulture Research International in East Malling, Kent (Appendix 3). Some of the material in the clonal hedges is not present in the BSOs as, although collected from selected parent trees, insufficient seeds or transplants were available for use in the BSOs (Appendix 4).

FINANCIAL REPORT

All funds relating to the oak BSOs are presently held and managed by the Northmoor Trust.

The trees were raised by Forest Research at Roslin and were charged to the BIHIP oak group at £0.50 per plant. Site owners were required to pay £0.35 per plant plus delivery costs, leaving a deficit of £0.15 per plant. The BIHIP oak group was to meet this deficit.

The total number of trees supplied by Roslin was 19,891 plus unspecified numbers of beat-ups. The site owners (Table 3) have met the net cost of **£7,000.21** plus delivery (at cost) and the oak group have covered the remainder of the invoiced tree cost from Roslin, which is **£3,000.09**. Some payments are still outstanding as of July 2003, as summarised in Table 3.

Table 3 Payments for trees and delivery charges.

SITE	£ trees	£ delivery	£ total (net)	£ owed
OXON	943.56	678.17	1,599.37	--
WORCESTERSHIRE	735.00	234.87	969.87	234.87
KENT	844.90	298.49	1,143.39	1,143.39
SUFFOLK	1,076.50	124.84	1,192.34	--
CUMBRIA	882.00	--	882.00	882.00
MIDLOTHIAN	929.25	--	1,083.64	--
CARMARTHENSHIRE	816.20	365.03	1,181.23	--
CORK	772.80	127.71	900.51	900.51
	7,000.21			

The project costs were initially met by donations to cover travel to and from the sites for Northmoor Trust staff. These donations are summarised in Table 4.

Table 4 Oak B.S.O. project profit/loss summary.

Activity	£ amount
Income	
Woodland Heritage	1,000.00
Oxford Forest Institute held funds transferred to NMT	8,618.68
site owner payments for trees	7,000.21
site owner payments for delivery of trees	1,650.00
sub total	18,268.89
Outgoings	
Supply of trees from Roslin (raising and allocation per site)	10,030.50
Delivery of trees to sites	1,829.11
NMT staff travel to all sites during 2002/03 (subsistence, petrol and accommodation)	1,305
sub total	13,164.61
Total	5,104.28

FUTURE WORK

The balance of **£5,104.28** remaining in oak group funds will be used in support of the activities listed in Table 5. A further £2,295.72 is required for work costed for completion during 2003 and an additional £8100 for completion of work during

2004. It is crucial that funding for this work is secured as the long-term viability of the project will rely on sufficient tree establishment and collation of early tree height data for use as a covariate in future statistical analyses.

Table 5 Estimated costs to complete establishment and data entry for 2003 and 2004.

Date	Action	£ cost	Who
September 2003	Travel and subsistence costs - visiting each of the eight sites during autumn 2003.	1,600	NMT
	16 man days labour - field assessments of survival and completion of mapping	3,200	NMT
October 2003	4 man days labour - identification of missing, duplicated and dead trees and preparation of detailed instructions for beating-up for site owners.	800	NMT
early November 2003	Courier dispatch - NMT-held beat-up trees will be dispatched directly to the sites during the winter of 2003/04.	800 (at cost)	NMT
November 2003 – March 2004	Beating-up/correction of trees within blocks at each site	--	site owners
constant during 2003	5 man days labour - production of reports, record management and data entry.	1,000	NMT
Total to end 2003		7,400	
September 2004	Travel and subsistence costs - visiting each of the eight sites.	2,300	NMT
	24 man days labour - field assessments of survival and tree height measurement	4,800	NMT
constant during 2004	5 man days labour - production of reports, record management and data entry.	1,000	NMT
Total to end 2004		8,100	

CONCLUSIONS

After some initial teething problems the oak BSOs are now established on eight sites and the data input for tree positions is ongoing (to be completed by October 2003). Many site owners report satisfactory survival of around 80-90 % by casual observation (*e.g.* Oxon, Suffolk and Worc.) except Kent (estimated 50 %). Full assessment of survival at each site is planned during autumn 2003. The Oxon site was one of the last planted and therefore can act as a bench mark against which others may be compared. Lower survival rates at other sites may indicate poor planting and/or tree handling, after due consideration of site or climatic effects.

Additional funding must be sought as a priority.

Appendix 1 Oak BSO database highlighting plus tree locations, BSO site and clonal archive details.

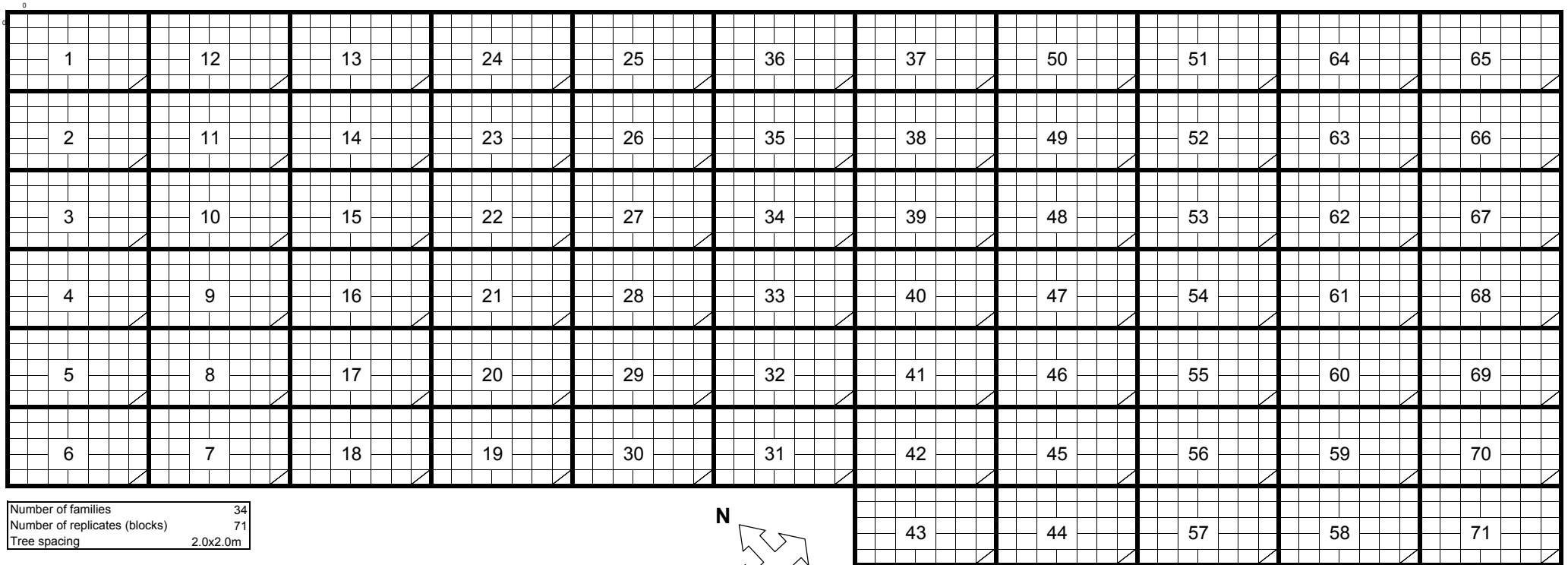
Family code	Plus tree locations			Breeding seedling Orchard sites								Clonal archive					
	Country	Region	Grid reference	SUFFOLK	OXON	CORK	CARMARTMAN	CUMBRIA	KENT	MIDLOTHIAN	WORCESTERSH	number of sites	OXON	CORK	SUFFOLK		EAST MALLING
Alice Holt	England	Surrey		1	1	1	1	1	1	1	0	7	*	*	*	*	Alice Holt
BOR001	Scotland	Borders	NT 68597 32949	1	1	1	1	1	0	0	0	5	*	*	*	*	BOR001
BOR002	Scotland	Borders	NT 69128 33455	1	1	1	1	1	1	1	1	8	*	*	*	*	BOR002
BRC001	France	Sarthe	461.83 2311.45 (LZ2)	1	1	1	1	1	0	0	0	5	2	2	1	0	BRC001
BRC002	France	Sarthe	461.78 2311.30 (LZ2)	1	1	1	1	1	1	1	1	8	2	2	2	3	BRC002
CUM001	England	Cumbria	SD 33229 92401	1	1	1	1	1	0	0	0	5	*	*	*	*	CUM001
D&G003	Scotland	Dumfries & Galway	NX 66330 67768	1	1	1	1	1	1	1	1	8	1	1	1	1	D&G003
ELT004	Scotland	East Lothian	NT 515 722	1	1	1	1	1	1	1	0	7	2	3	3	2	ELT004
ELT005	Scotland	East Lothian	NT 516 714	1	1	1	1	1	1	1	1	8	2	2	2	2	ELT005
Fontainbleau	France	Seine et Marne		1	0	0	0	0	0	0	0	1	*	*	*	*	Fontainbleau
GLS012	England	Gloucestershire	SO 66123 09347	1	1	1	0	0	0	0	0	3	2	2	2	2	GLS012
GLS014	England	Gloucestershire	SO 65504 08584	1	1	0	0	0	0	0	0	2	*	*	*	*	GLS014
GLS016	England	Gloucestershire	SO 65778 07450	1	1	1	1	0	0	0	0	4	*	*	*	*	GLS016
GLS022	England	Gloucestershire	SO 622 130	1	1	1	1	1	0	0	0	5	1	1	1	2	GLS022
GLS025	England	Gloucestershire	SO 537 043	1	1	1	1	1	1	1	0	7	*	*	*	*	GLS025
HAM004	England	Hampshire	SU 235 126	1	1	1	1	1	1	1	1	8	*	*	*	*	HAM004
HAM006	England	Hampshire	SU 28104 09939	1	1	0	0	0	0	0	0	2	*	*	*	*	HAM006
HAM007	England	Hampshire	SU 268 053	1	1	0	0	0	0	0	0	2	2	3	2	2	HAM007
HAM011	England	Hampshire	SU 72396 08977	1	0	0	0	0	0	0	0	1	*	*	*	*	HAM011
HAM012	England	Hampshire	SU 32688 04140	1	1	1	1	1	1	1	0	7	*	*	*	*	HAM012
HAM013	England	Hampshire	SU 301 279	1	1	1	1	1	1	1	1	8	1	1	0	1	HAM013
HAM014	England	Hampshire	SU 31528 28754	1	1	1	1	1	1	1	1	8	*	*	*	*	HAM014
HGH001	Scotland	Highlands	NN 1040 5905	1	1	1	1	1	0	0	0	5	*	*	*	*	HGH001
HRF004	England	Herefordshire	SO 51971 33097	1	1	0	0	0	0	0	0	2	1	3	2	3	HRF004
HRF006	England	Herefordshire	SO 38948 36874	1	1	1	1	0	0	0	0	4	3	2	1	2	HRF006
HRF008	England	Herefordshire	SO 46792 63010	1	1	0	0	0	0	0	0	2	*	*	*	*	HRF008
HRF013	England	Herefordshire	SO 64466 29055	1	1	1	1	1	1	1	0	7	3	3	2	2	HRF013
HRF017	England	Worcestershire	SO 719 585	1	1	1	1	1	1	1	0	7	*	*	*	*	HRF017
LEI001	England	Leicestershire	SK 39412 18885	1	1	1	1	1	1	1	1	7	*	*	*	*	LEI001
LNC001	England	Lincolnshire	TF 037 216	1	1	0	0	0	0	0	0	2	2	2	2	3	LNC001
LND003	N. Ireland	Londonderry	55 03 32.6 N: 6 54 30.1 W	1	0	0	0	0	0	0	0	1	*	*	*	*	LND003
NHP002	England	Northamptonshire	SP 93698 80585	1	1	1	1	0	0	0	0	4	*	*	*	*	NHP002
NHP006	England	Northamptonshire	SP 91787 81870	1	1	0	0	0	0	0	0	2	*	2	1	2	NHP006
NHP008	England	Northamptonshire	SP 8775 8225	0	1	0	0	0	0	0	0	1	*	*	*	*	NHP008
NHP009	England	Northamptonshire	SP 64490 43355	1	1	1	1	1	1	1	1	8	*	*	*	*	NHP009
NMB001	England	Northumberland	NZ 06816 96165	1	1	1	0	0	0	0	0	3	1	2	2	2	NMB001
NOR005	England	Norfolk	TG 096 115	1	1	1	1	1	1	1	1	8	3	3	3	2	NOR005
NOR007	England	Norfolk	TM 215 920	1	1	0	0	0	0	0	0	2	*	*	*	*	NOR007
OFL002	Eire	Offaly	GIS unavailable	1	1	1	1	1	1	1	1	8	2	2	1	1	OFL002
REN001	France	Normandy	477.23 1093.95 (LZ1)	1	1	1	1	1	1	1	1	8	*	*	*	*	REN001
REN003	France	Normandy	477.23 1093.95 (LZ1)	1	1	1	1	1	1	1	1	8	*	*	*	*	REN003
SEN002	France	Chartres	502.65 1097.80 (LZ1)	1	1	1	1	1	1	1	1	8	*	*	*	*	SEN002
SHP005	England	Shropshire	SO 711 756	1	0	0	0	0	0	0	0	1	*	*	*	*	SHP005
SOM002	England	Somerset	ST 05540 37884	1	1	1	1	1	1	1	1	8	*	*	*	*	SOM002
SOM003	England	Somerset	ST 055 366	1	1	1	1	1	1	1	0	7	*	*	*	*	SOM003
SUF001	England	Suffolk	TM 46197 85384	1	1	1	1	1	1	0	0	6	*	*	*	*	SUF001
SUF003	England	Suffolk	TM 46683 85074	1	1	1	1	1	1	0	0	6	*	*	*	*	SUF003
SUF004	England	Suffolk	TL 964 699	1	1	1	1	1	1	1	0	7	*	*	*	*	SUF004
WIK003	Eire	Wicklow	52 56 28.8 N: 6 14 26.2 W	1	1	1	1	0	0	0	0	4	*	*	*	*	WIK003
WOR003	England	Worcestershire	SO 71234 57809	1	0	0	0	0	0	0	0	1	*	*	*	*	WOR003
WOR007	England	Worcestershire	SO 6730 7295	1	1	1	1	1	1	1	1	8	*	*	*	*	WOR007
ZE11 -1	Holland	Gelderland	52 02 50.6 N: 5 34 35.9 E	1	1	1	1	1	1	1	1	8	2	2	1	2	ZE11 -1
ZE142-1	Holland	N. Brabant	51 29 02.1 N: 5 38 24.5 E	1	1	1	1	1	1	1	1	8	*	*	*	*	ZE142-1
ZE15 -1	Holland	Utrecht	147.1 468.7 (grid)	1	0	0	0	0	0	0	0	1	2	3	2	2	ZE15 -1
ZE23 -2	Holland	Gelderland	52 13 51.9 N: 6 02 03.3 E	1	1	1	1	1	1	1	1	8	*	*	*	*	ZE23 -2
ZE34-1	Holland	Gelderland	201.5 488.3 (grid)	1	1	1	1	1	1	1	0	7	1	2	1	1	ZE34-1
ZE46-1	Holland	N. Brabant	51 40 55.3 N: 5 49 26.5 E	1	1	1	1	1	1	1	1	8	*	*	*	*	ZE46-1
ZE47-2	Holland	N. Brabant	51 37 16.5 N: 5 52 11.4 E	1	1	1	1	1	1	1	1	8	2	2	2	3	ZE47-2
ZE58 -2	Holland	N. Brabant	51 28 24.1 N: 5 32 34.0 E	1	1	1	1	1	0	0	0	5	*	*	*	*	ZE58 -2
ZE64 -1	Holland	N. Brabant	51 29 56.6 N: 5 16 19.7 E	1	1	1	1	0	0	0	0	4	*	*	*	*	ZE64 -1
ZE80 -1	Holland	Mid Brabant	51 41 02.6 N: 5 05 20.5 E	1	1	0	0	0	0	0	0	2	1	1	1	1	ZE80 -1
ZE82 -1	Holland	Brabant	51 25 27.6 N: 5 32 45.3 E	1	1	1	1	1	1	1	1	8	2	2	2	2	ZE82 -1

Appendix 2**Beat-up numbers for families available in 2003/04**

FAMILY	NUMBER OF BEAT UPS
ALICE HOLT	35
BOR001	35
BOR002	35
BRC001	35
BRC002	35
CUM001	35
D&G003	50
ELT005	35
GLS012	60
GLS014	35
GLS016	35
GLS022	35
GLS025	35
HAM002	35
HAM004	35
HAM006	35
HAM007	35
HAM011	35
HAM012	35
HAM013	35
HAM014	35
HGH001	35
HRF004	35
HRF006	35
HRF017	35
LEI001	35
LNC001	35
LND003	35
NHP002	35
NHP006	35
NHP008	35
NHP009	35
NMB001	35
NOR005	35
NOR007	35
OFL002	35
REN001	35
REN003	35
SEN002	35
SHP005	35
SOM002	35
SOM003	35
STF002	35
SUF001	35
SUF003	35
SUF004	35
WIK003	35
WOR003	35
WOR007	35
ZE11-1	35
ZE82-1	35
ZE80-1	35
ZE64-1	35
ZE58-2	35
ZE47-2	35
ZE46-1	35
ZE34-1	35
ZE23-2	35

Appendix 3

Detailed site plans and tree positions within blocks for seven of the oak BSO sites. Details for the site in Wales will be available autumn 2003.

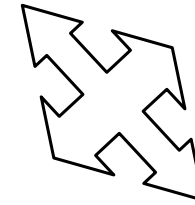


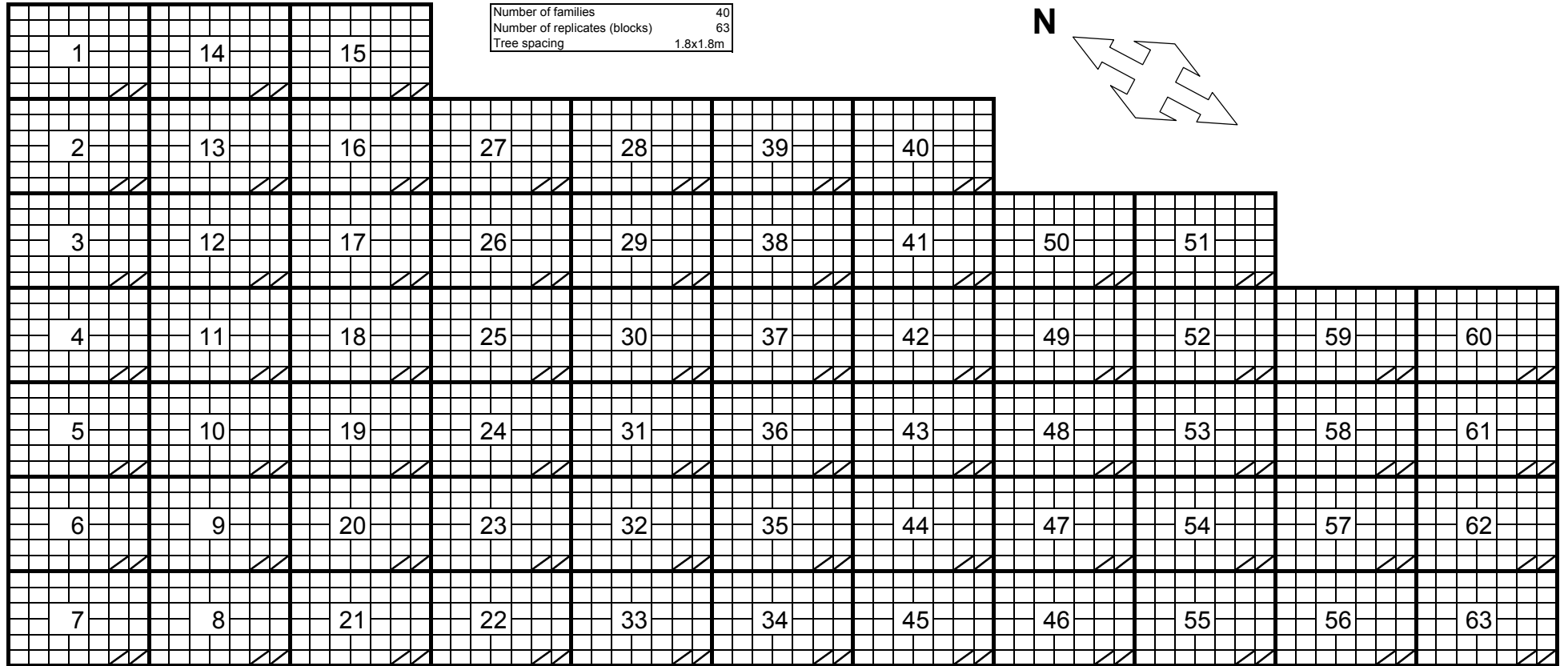
Kent oak BSO - Tree positions within blocks

Block:.....

1	10	11	20	21	30	31
2	9	12	19	22	29	32
3	8	13	18	23	28	33
4	7	14	17	24	27	34
5	6	15	16	25	26	

N

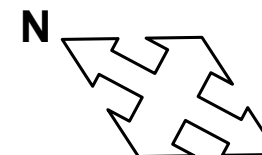




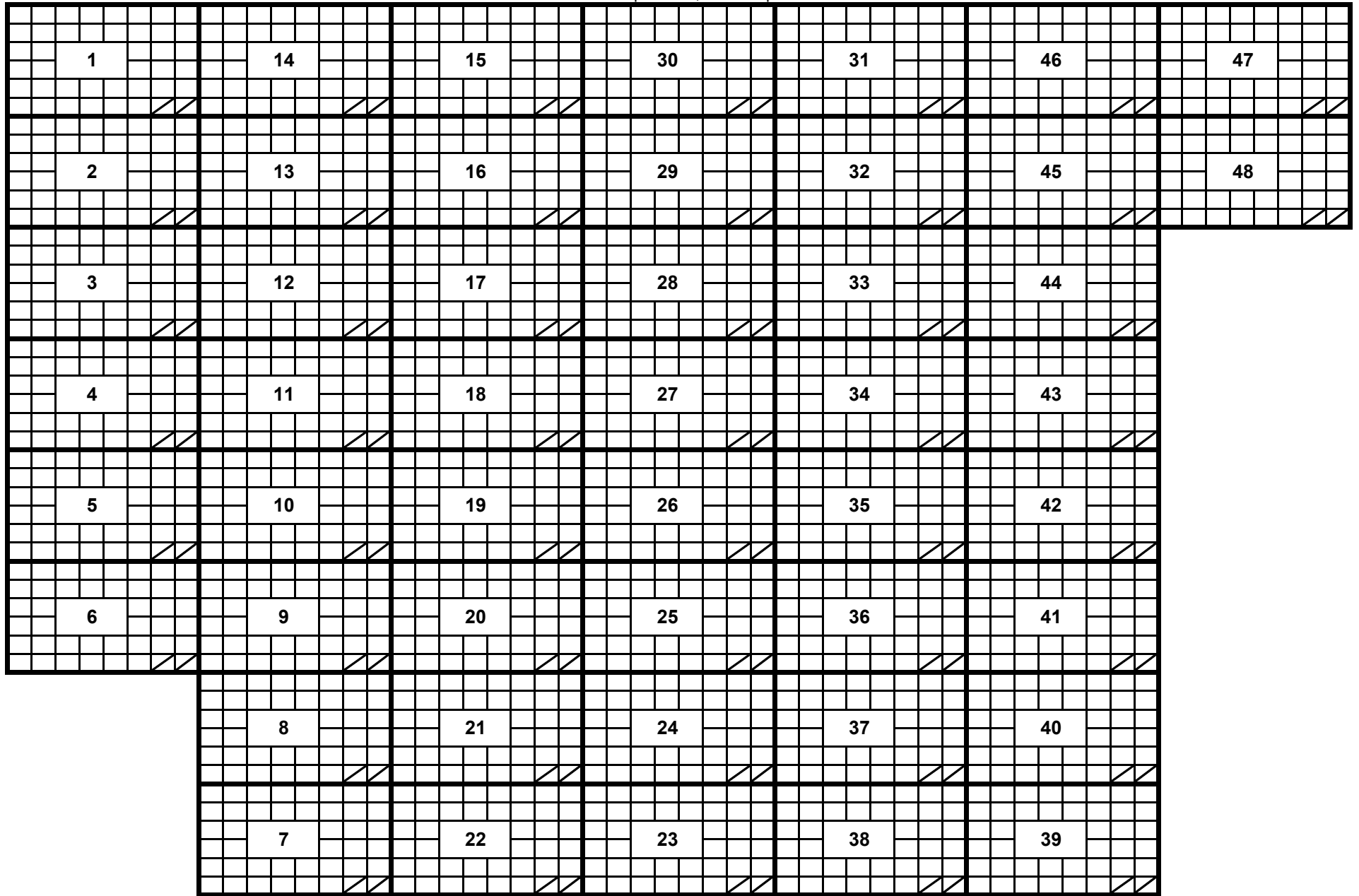
Cumbria oak BSO - Tree positions within blocks

Block:.....

1	12	13	24	25	35	36
2	11	14	23	26	34	37
3	10	15	22	27	33	38
4	9	16	21	28	32	39
5	8	17	20	29	31	40
6	7	18	19	30		



Oak BSO site plans.xls, Eire site plan



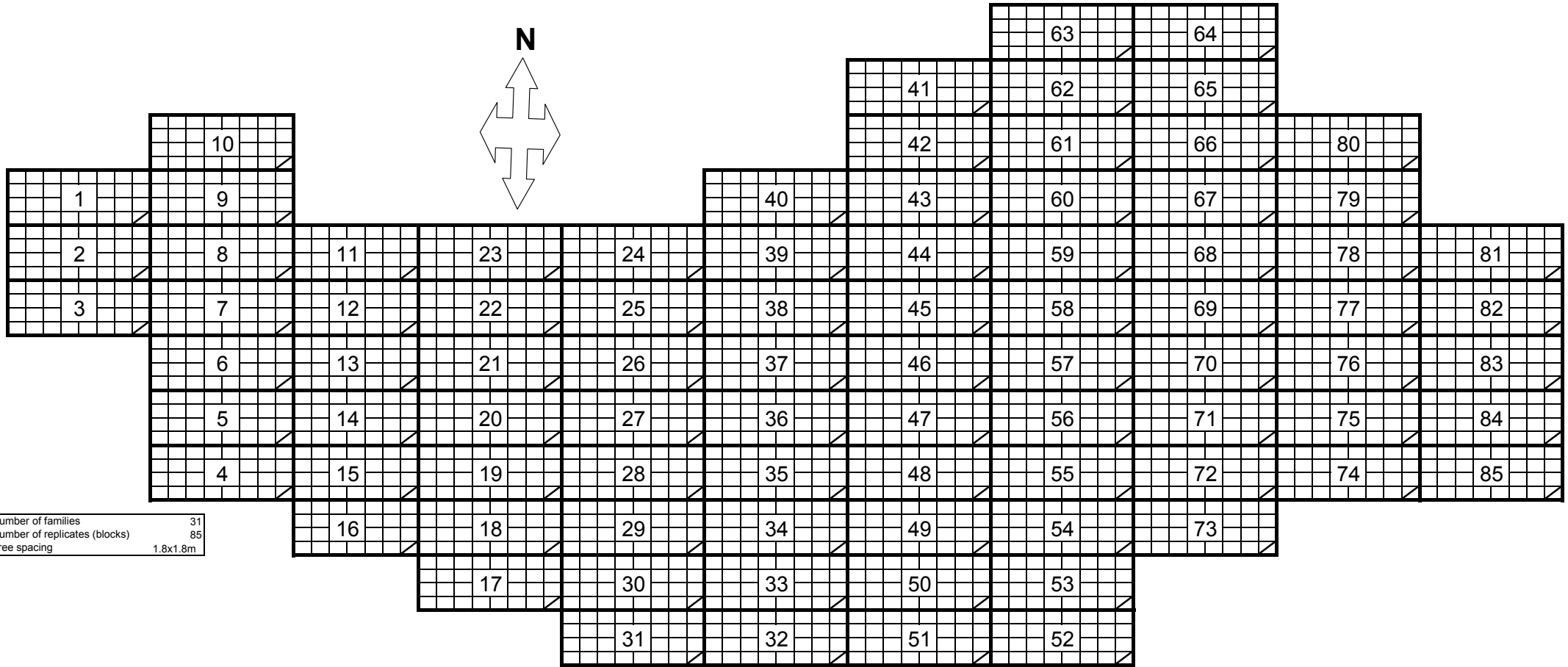
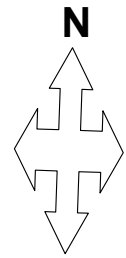
Number of families	46
Number of replicates (blocks)	48

Planted at 2x2 metres with 3m between plots

Eire oak BSO - Tree positions within blocks

1	12	13	24	25	36	37	46
2	11	14	23	26	35	38	45
3	10	15	22	27	34	39	44
4	9	16	21	28	33	40	43
5	8	17	20	29	32	41	42
6	7	18	19	30	31		

88

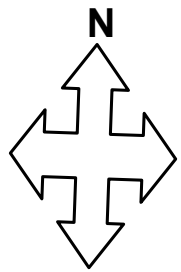


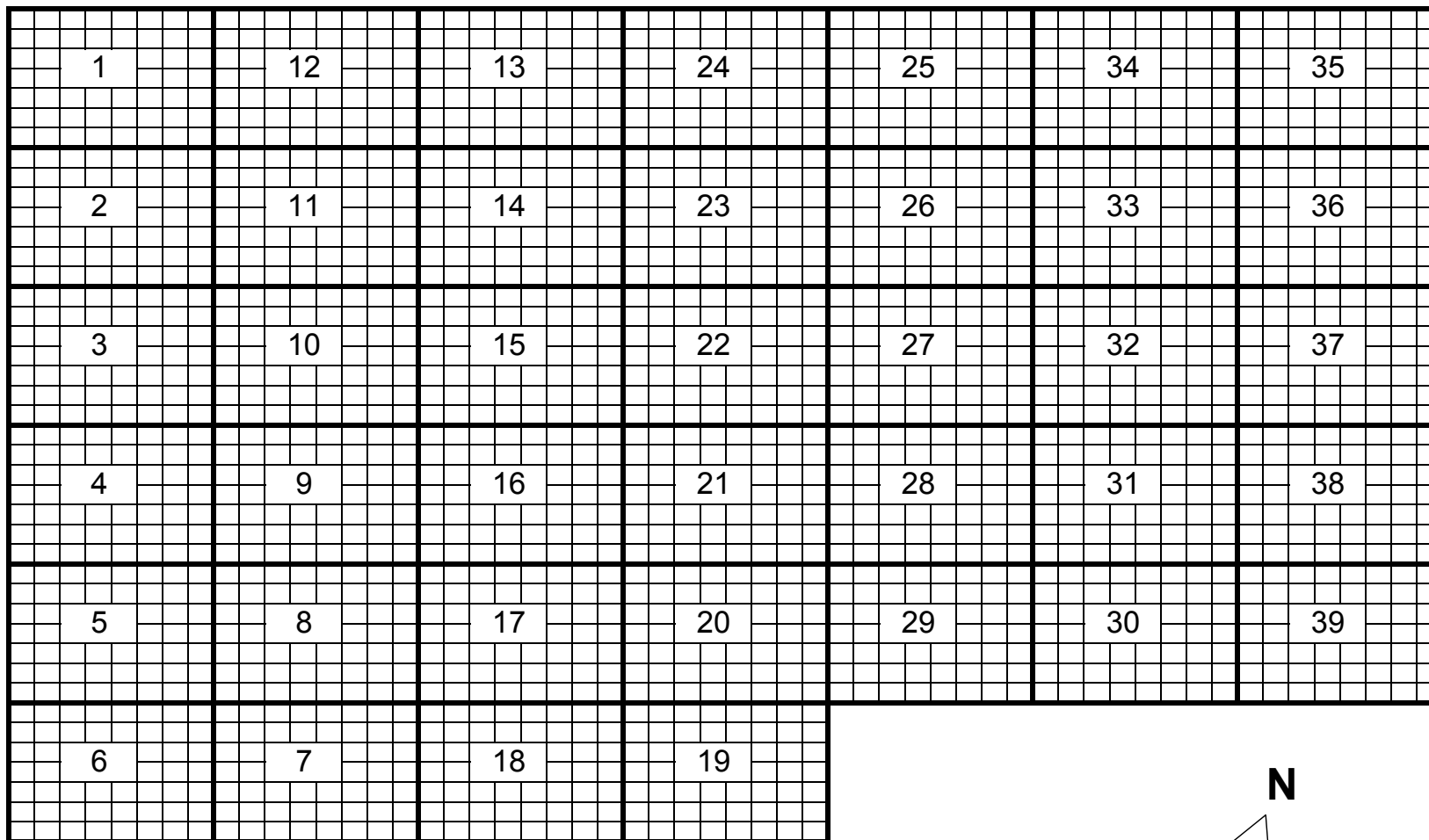
Number of families	31
Number of replicates (blocks)	85
Tree spacing	1.8x1.8m

Midlothian oak BSO - Tree positions within blocks

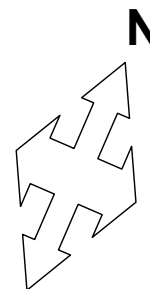
Block:.....

1	8	9	16	17	24	25	31
2	7	10	15	18	23	26	30
3	6	11	14	19	22	27	29
4	5	12	13	20	21	28	





Number of families	56
Number of replicates (blocks)	39
Tree spacing	2x2m



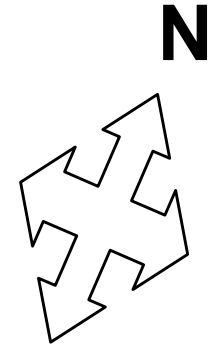
Demonstration plots

	Alice Holt
	BOR001
	BOR002
	BRC001
	BRC002
	CUM001
	D&G003
	ELT004
	ELT005
	GLS012
	GLS014
	GLS016
	GLS022
	GLS025
	HAM004
	HAM006
	HAM007
	HAM012
	HAM013
	HAM014
	HGH001
	HRF004
	HRF006
	HRF008
	HRF013
	HRF017
	LEI001
	LNC001
	NHP002
	NHP006
	NHP008
	NHP009
	NMB001
	NOR005
	NOR007
	OFL002
	REN001
	REN003
	SEN002
	SOM002
	SOM003
	SUF001
	SUF003
	SUF004
	WIK003
	WOR007
	ZE11 -1
	ZE23 -2
	ZE34-1
	ZE46-1
	ZE47-2
	ZE58 -2
	ZE64 -1
	ZE80 -1
	ZE82 -1
	ZE142-1

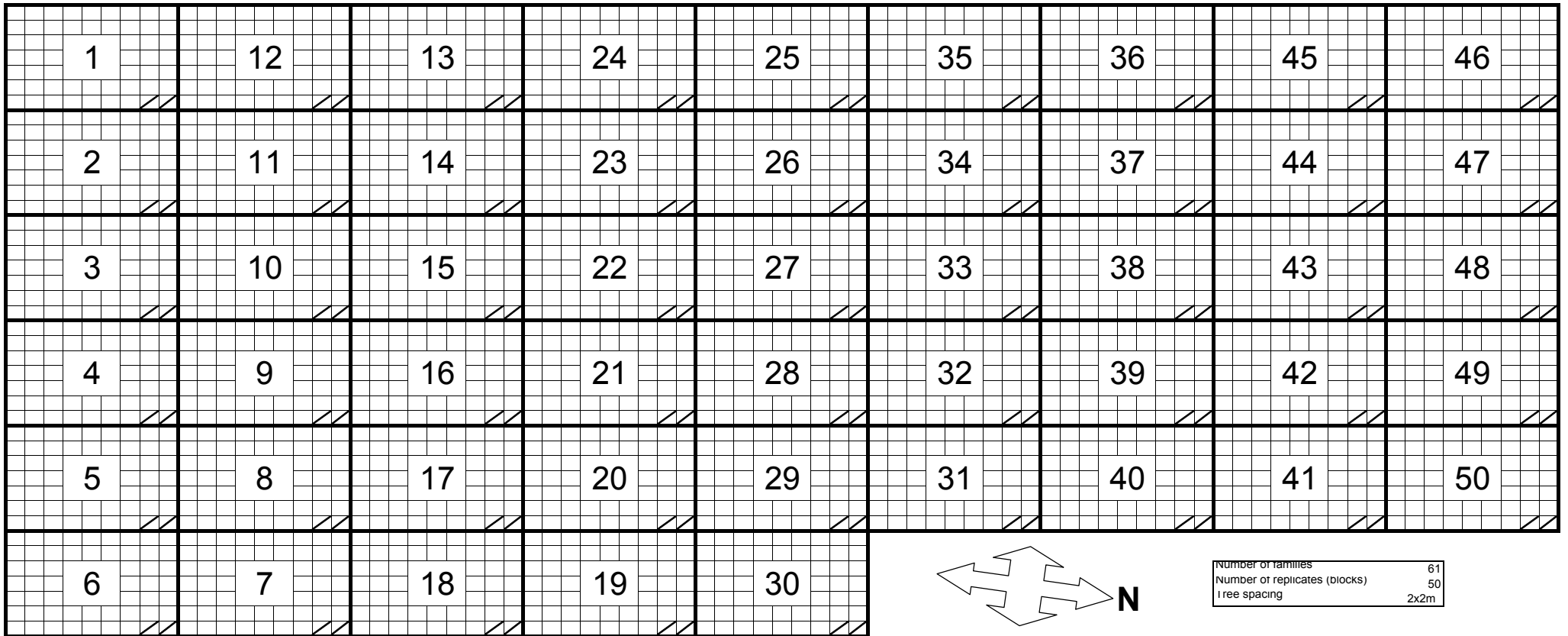
Oxon oak BSO - Tree positions within blocks

Block:.....

1	14	15	28	29	42	43	56
2	13	16	27	30	41	44	55
3	12	17	26	31	40	45	54
4	11	18	25	32	39	46	53
5	10	19	24	33	38	47	52
6	9	20	23	34	37	48	51
7	8	21	22	35	36	49	50



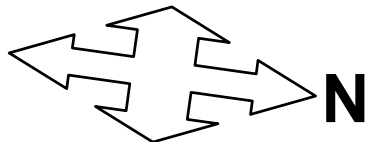
numbers in top left corner refer to tree positions within a block



Suffolk oak BSO - Tree positions within blocks

Block:.....

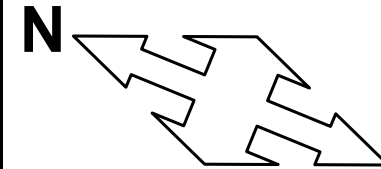
1	14	15	28	29	42	43	55	56
2	13	16	27	30	41	44	54	57
3	12	17	26	31	40	45	53	58
4	11	18	25	32	39	46	52	59
5	10	19	24	33	38	47	51	60
6	9	20	23	34	37	48	50	61
7	8	21	22	35	36	49		



Worcestershire oak BSO - Tree positions within blocks

Block:.....

1	6	7	12	13	18	19
2	5	8	11	14	17	20
3	4	9	10	15	16	21



Appendix 4

Material represented in the clonal hedges but not included in the BSOs due to insufficient seeds/transplants. Three of the sites also host a BSO.

		OXON BSO site	CORK BSO site	SUFFOLK BSO site	EAST MALLING
<i>Family code</i>	<i>Plus tree grid reference</i>	<i>Number of plants</i>			
BER002	SU 925 741	0	0	0	1
BUK001	SP 85512 02598	2	3	2	0
ELT001	NT 319 618	0	1	0	1
ELT006	NT 39719 65499	2	3	2	2
KIL001	53 20 46.2 N: 6 44 35.1 W	2	2	2	3
KLK003	52 27 09.6 N: 7 16 19.0 W	3	3	2	3
LND002	C925 150 (NI grid)	2	2	1	1
NMB002	NZ 208 237	1	1	1	2
NOR003	TG 0385 2830	0	1	0	1
POW002	SJ 21227 11829	0	1	0	1
SEN001	502.25 1097.84 (LZ1)	2	2	2	2
SOM005	SS 921 462	1	1	1	1
TIP001	52 40 33.6 N: 7 33 19.9 W	1	2	1	1
TIP002	52 39 48.2 N: 7 34 10.8 W	2	2	2	2
WIK001	52 59 38.1 N: 6 18 15.4 W	0	2	2	1
WIK005	52 45 57.6 N: 6 38 01.9 W	3	3	3	3
WOR004	SO 71314 57644	2	2	1	2