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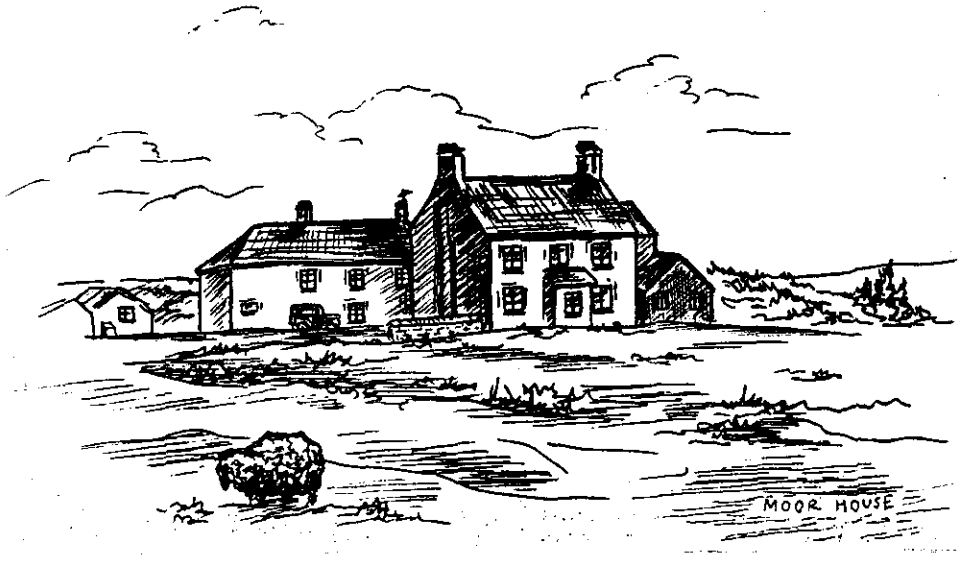

LONG-TERM STUDIES OF VEGETATION CHANGE AT MOOR HOUSE N N R: GUIDE TO RECORDING METHODS AND THE DATABASE

by

R H MARRS, M RAWES, J S ROBINSON & S D POPPITT

Institute of Terrestrial Ecology
Merlewood Research Station
Grange-over-Sands
Cumbria
England
LA11 6JU

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Summary

This report briefly reviews the history of the long-term studies of vegetation change at Moor House NNR, and describes 10 experiments which are being monitored on a regular basis. Detailed methods for sampling the vegetation, and a guide to the data, which has now been transferred to computer storage, are presented for each experiment.

Acknowledgements

As senior author (RHM) I would like to thank the other authors of this report: M. Rawes for his foresight in preparing the handover of the Moor House programme for an inexperienced newcomer, and for his meticulous record keeping; M Rawes and Mrs J S Robinson for help and cheerful company in the field, when the weather was none too pleasant (!); and Ms S D Poppitt who had the unenviable task of encoding and checking the bulk of the data during transfer to computer storage. In addition, help was given by many of my colleagues at Monks Wood Experimental Station: Mrs L Ling (data processing); Mrs B Stocker (typing), Ms S Ide and J Pattingale (cartography), and Ms A S Dickerson (frontspiece). This work was funded in part by Nature Conservancy Council funds.

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Authors addresses

MARRS, R H — NERC Institute of Terrestrial Ecology
Monks Wood Experimental Station
Abbots Ripton
Cambs PE17 2LS

*RAWES, R — Newlands, Ruckcroft, Armathwaite, Carlisle

+ROBINSON, J D — Dales Farm, Copphill, Wearhead

POPPITT S D — Department of Zoology, University of Aberdeen,
Tillydrone Avenue, Aberdeen AB9 2TN

* - formerly Senior Officer at Moor House Research Station
+ - formerly Scientific Assistant at Moor House Research Station

C O N T E N T S

1 INTRODUCTION

Moor House National Nature Reserve (Grid reference - NY 758328) is one of the largest nature reserves (c. 4000 ha) owned by the Nature Conservancy Council (NCC) in England. The reserve straddles the north Pennines (Figure 1.1), and is adjacent to Cross Fell, the highest point in the Pennine range. The reserve contains one of the largest areas of blanket bog-covered moorland in Great Britain (Heal & Smith 1978), as well as a range of grassland communities typical of upland land, which is of marginal value for agriculture, and is close to, or above, the treeline (c. 550 m). Although Moor House is owned by the NCC, the reserve is common land, and used for sheep grazing by various local farmers.

Moor House was bought by the Nature Conservancy in 1952 as a centre for scientific research on upland communities, and in 1965 was designated the main British site in the International Biological Programme (IBP) for studies on the productivity and ecology of moorlands. In the IBP study, Moor House was included in the Tundra Biome comparative study, reflecting the adverse climatic conditions found there (cool, wet and windy - Heal *et al*. 1975). The specific aims of IBP were to study: (1) the primary and secondary productivity, and (2) the main pathways of dry matter and nutrients, in the blanket bog communities (Heal & Perkins 1978). Most of the IBP work has been completed, and can be found in the literature (for example - Rawes & Welch 1969; Heal *et al*. 1975; Heal & Perkins 1976, 1978, *inter alia*). However, the IBP studies were done on sites or vegetation types which were part of ongoing long-term experiments designed to investigate:

(1) The long-term change in species composition, structure and function of a range of vegetation types, and

(2) The long-term effects of management by man (sheep grazing and burning) on a range of these communities.

This report documents the history of some of these long-term experiments, and discusses briefly their present and future role in the scientific study of upland communities.

1.1 Long term experiments on vegetation change at Moor House

1.1.1 Rationale

Ecologists and land managers have always been interested in detecting vegetation change for 2 main reasons:

(1) Adverse changes may affect the quality of the vegetation as a resource; either in terms of dry matter production, palatability and nutrient content for agriculture, or in terms of species diversity and numbers of rare species for conservation.

(2) Change detected under experimental conditions may throw some light on the factors and processes controlling these changes.

In the uplands, vegetation change is generally slow, because of the effects of the adverse climate on production and decomposition. This slow speed of change means that experiments

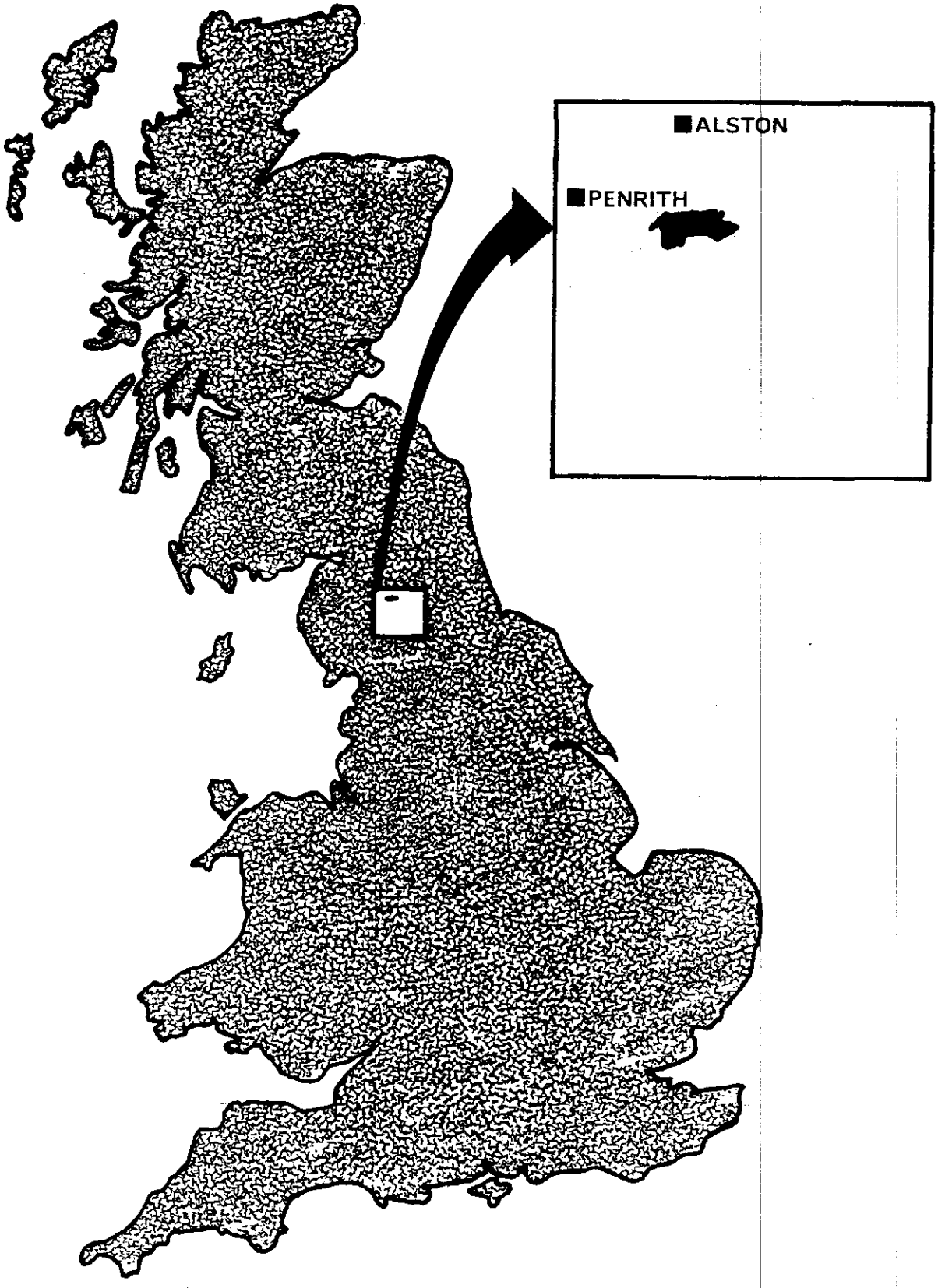


Figure 1.1 Geographical position of Moor House NNR.

designed to detect change must be done over a very long time period, if reliable predictive information is to be obtained. Many of the experiments at Moor House are at least 13 years old, and some are now over 30 years old. These experiments are of great scientific value, for the following reasons:

(1) They provide a known baseline for measuring change in species composition and vegetation structure.

(2) They provide a series of plots with a known and well documented history in the recent past (12-30) years, which can, if suitable care is taken to safeguard them, be used for other scientific studies.

(3) They provide information on man's management of these communities, either for predictive purposes, or for the validation of models derived from short-term data.

(4) They provide sites for supporting studies of other scientific work; for example, for nutrient accumulation and decomposition studies to support the findings of the IBP work.

(5) They have produced a large data base collected at considerable accumulated expense, yet, if necessary, the studies can be continued for a minimal annual outlay (c. 4 weeks/year for a 2-man team).

1.1.2 Scope of this report

Long-term ecological studies pose special problems for the investigators (summarized with comments on their applicability to Moor House in Table 1.1). Two of these problems merit special consideration, and are discussed in detail here:

(1) Continuity between principal investigators.

All of the experiments have been supervised by Mr M. Rawes through most of their history, although 2 other members of the NC staff (Mr K.J.F. Park and Dr R.J. Elliott) were in charge of some of the experiments in the early days. However, in 1982, when M. Rawes retired, and ITE agreed to continue the recording of the experiments, it was envisaged that continuity between investigators could not be guaranteed in the medium term (<10 years), and certainly not in the long-term (>30 years). Thus, future changes in personnel are inevitable, and clearly care must be taken to ensure that these changes do not interfere with the validity of the data collection. To try and smooth over the 1982 change, and future changes, it was decided to produce this report, documenting in detail the methods used to record the experiments. These methods were already well documented (by M. Rawes), but were debugged by a new observer (Dr R.H. Marrs) in the field, with reference to M. Rawes where difficulties arose.

(2) Data base-ease of information retrieval and use

All of the data accumulated by NC and NCC research workers are stored in box files and/or the Reserve Record at the

Table 1.1 Problems associated with long-term ecological studies, and notes on their relevance to the Moor House experiments

Problems	Comments on the Moor House study
Sampling strategies must be able to detect future changes of unknown extent or variability[1].	All experiments now use point quadrats distributed regularly or randomly over defined plots with 100-1000 points/plot.
Advantage must be taken of new techniques, whilst maintaining comparability[1].	Stratified point quadrats were introduced in the late 1960s; direct reference to earlier data can be done by calculation.
Enthusiasm must be maintained[1].	Each experiment is visited only once in a 10-year cycle; a fresh site/vegetation type is, therefore, visited each year.
Studies must be time and cost efficient[1].	Four weeks for a 2-man team each year.
Study sites must be secure[2].	Moor House is a NNR, but vandalism is possible especially on sites near the Pennine Way enclosures. All enclosures must be maintained stockproof (responsibility of NCC).
Maintenance of supplementary recording.	Continuation of climatological recording is important, for example, when assessing the reasons for observed vegetation change.
Identification of new threats to the experiments.	Large numbers of rabbits were noted in 1985, if rabbits are allowed to graze the enclosed plots, the long-term changes in species abundance and nutrient cycling with cessation of sheep grazing will be destroyed.
Continuity between principal investigators must be maintained[3,4].	See text (Page 3)
Resources must be available for results to be analysed and published regularly[1].	Analysis of data up to 1980 has been published (Rawes 1981, 1983; Rawes & Hobbs 1985; Welch & Rawes 1964). Speed and ease of analysis will be improved by data transfer to computer.

References

1. Le Cren (1984)
2. Walton (1984)
3. Walton (1985)
4. Hill & Radford (1985)

North West Regional Office of the NCC. In this form, most of the data are not easily accessible for comparisons or calculations. In order to increase their usefulness all of the data on species change in the 10 experiments discussed in this report have now been transferred to computer storage.

This report, therefore, details the methods for recording each of the long-term experiments on vegetation change at Moor House, and also gives a guide to the data available on computer file.

1.2 Sampling methods

Detailed instructions for each experiment are given in Sections 2-11, and only general procedures are reproduced here. These general methods are used for all of the 10 experiments reported here.

1.2.1 Site location

The location, vegetation type, altitude, and best means of access are given for each experiment in Table 1.2 and Figure 1.2

1.2.2 Sampling methods

At each experimental site the study plots are marked with permanent hardwood pegs; generally these pegs must be replaced every 20-25 years. The exact sampling locations are shown in Sections 2-11, but are located by placing transects (using 30 m tapes) across the plots. Care must be taken to ensure that the tapes are exactly positioned at the baseline, and they are taut and straight across the plots. In many experiments, the individual sampling positions were also marked with small canes. Many of these canes are now missing, but hopefully these canes will be replaced shortly.

At each sampling position a point quadrat frame (dimensions shown in Figure 1.3) is placed at right angles to the transect lines, and the vegetation sampled in one of two ways:

(1) The unstratified method, where only the first hit (presence) of each species by the pin is recorded.

(2) The stratified method, where the pin is divided into 4 height strata (Figure 1.3):

Stratum 1 = >30 cm,

Stratum 2 = 20-30 cm,

Stratum 3 = 10-20 cm,

Stratum 4 = 0-10 cm,

and the number of hits of each species in each stratum recorded.

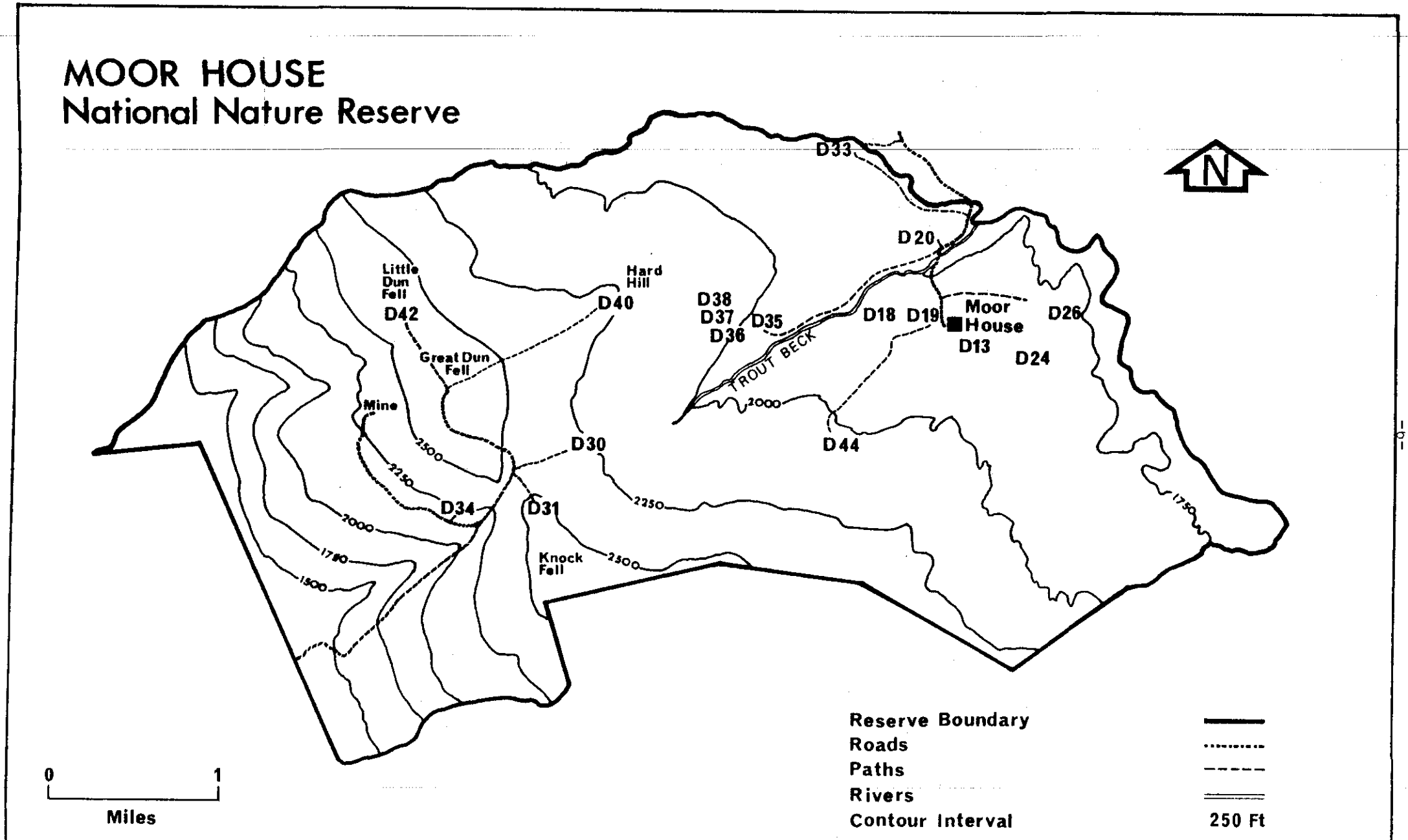
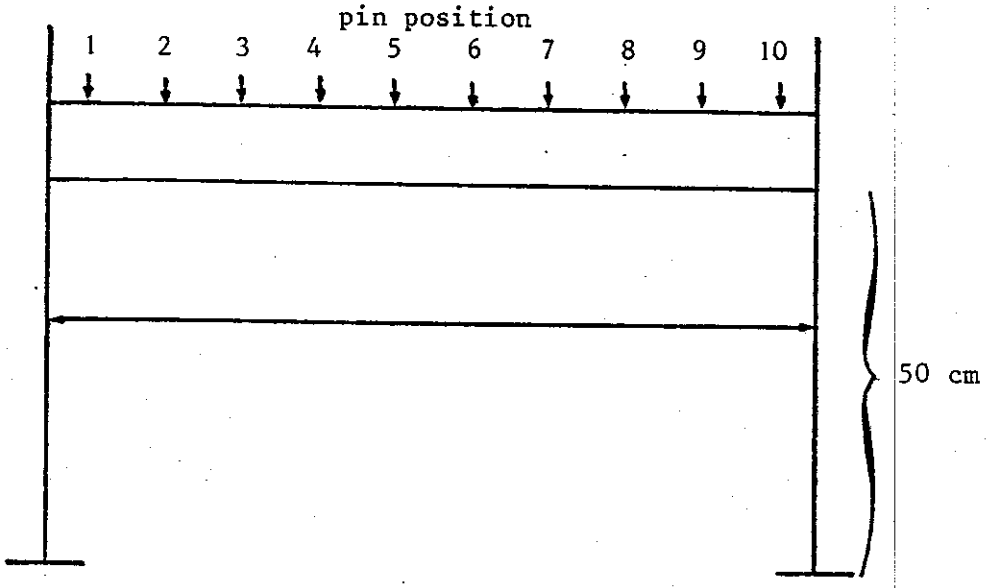


Figure 1.2 Map of Moor House Reserve showing experimental sites with best means of access.

Table 1.2 Location of the long-term experiments on vegetation change at Moor House NNR

Vegetation type	Location name	Experiment code	Grid reference	Altitude (m)	Best means of access (see als Figure 1.2)
Blanket Bog	Hard Hill (Burning & Grazing Experiment)	D35 = Block A D36 = Block B D37 = Block C D38 = Block D	NY 743330 NY 740330 NY 736330 NY 738331	600 610 617 632	Along Troutbeck
Calcareous Flush	Moss Burn (Johnny's Fluch)	D44	NY 748316	632	Along Moss Burn
Juncus squarrosus grassland	J1	D20	NY 757336	549	From Moor House Road
Nardus stricta grassland	N1	D33	NY 748345	488	" " "
Festuca ovina grassland	Hard Hill	D40	NY 724317	678	From Great Dun Fell
Festuca ovina grassland	Little Dun Fell	D42	NY 707328	815	" " "
Agrostis-Festuca grassland	Knock Fell	D31	NY 719311	754	" " "
Blanket Bog	Troutbeckhead	D30	NY 724318	685	" " "
Blanket Bog	Silverband	D34	NY 710310	685	From Silverband Road
Blanket Bog	Bog Hill	D26	NY 768328	550	From Bog End Road

(1) Dimensions of point quadrat frame (1 cm = 10 cm)



(2) Dimensions of the pin used in point quadrat studies (1 cm = 5 cm)

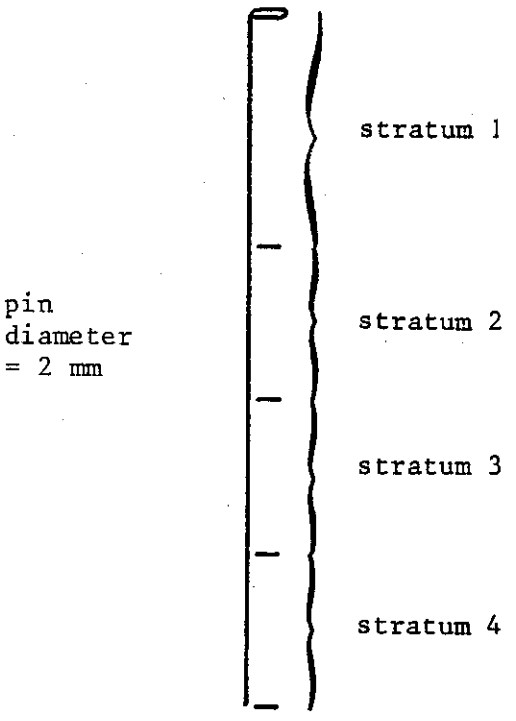


Figure 1.3 Scale diagram of (1) the point quadrat frame and (2) the pin used in the Moor House studies

With both these methods, the pin is dropped vertically through the point quadrat frame until the pin meets the point of first real resistance. Information on the presence (ie first hit) of bryophytes, lichens, bare ground, rocks and unidentifiable litter is also recorded, and in most cases these data are included in a separate data set (labelled under Bryophytes) of Stratum 4. At some sites, these data have to be collected using forceps to sample the ground at the base of the pin.

The stratified method is preferred wherever possible, as it provides more information on species abundance (it provides an estimate of true cover), and vegetation structure.

1.3 The Moor House data base

As in the previous section, general information about the data base is given here, but the data base for each experiment is detailed individually in Sections 2-11. In all of these Sections all computer filenames are given in block capitals (eg **FILENAME.123**), and all of the files are stored on the PDP 11/34 computer at Monks Wood Experimental Station. To minimize the likelihood of errors creeping into the data set during the transfer, the procedure outlined in Figure 1.4 was followed.

1.3.1 Data base structure*

For each experiment there are 2 index files relating species names to integer code numbers. These code numbers represent species names in all datafiles. There is an index for higher plants (**PLINDEX**), and one for bryophytes (**BRINDEX**), which also includes the codes for lichens, rocks, litter, etc.

At each sampling date, each experimental plot has 2 separate datafiles, one for the higher plants (encoded **PL** or **P**), and one for bryophytes, etc (encoded **BR** or **M**).

1.3.2 Datafiles

The basic structure of all the datafiles is shown in Table 1.3. Basically there are 3 main parts:

(1) Integer N. This integer is usually divisible exactly by either 100, or 50. N is the number of point quadrats sampled in a given file. Where N is exactly divisible by 100, the data are stored in 100 digit lengths, and where N is exactly divisible by 50 the data are stored in 50 digit lengths. In one experiment (Hard Hill burning experiment - Section 2), some of the early vegetation assessments were done using the Domin scale. Where Domin numbers were used N = 5 or N = 25.

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* The database presented here was designed for the Monks Wood computer. When these data are transferred to a larger computer with a hierarchical file structure (hopefully in 1986), the current filenames may have to be transposed, i.e. **FILENAME.123** becoming **123.FILENAME** .

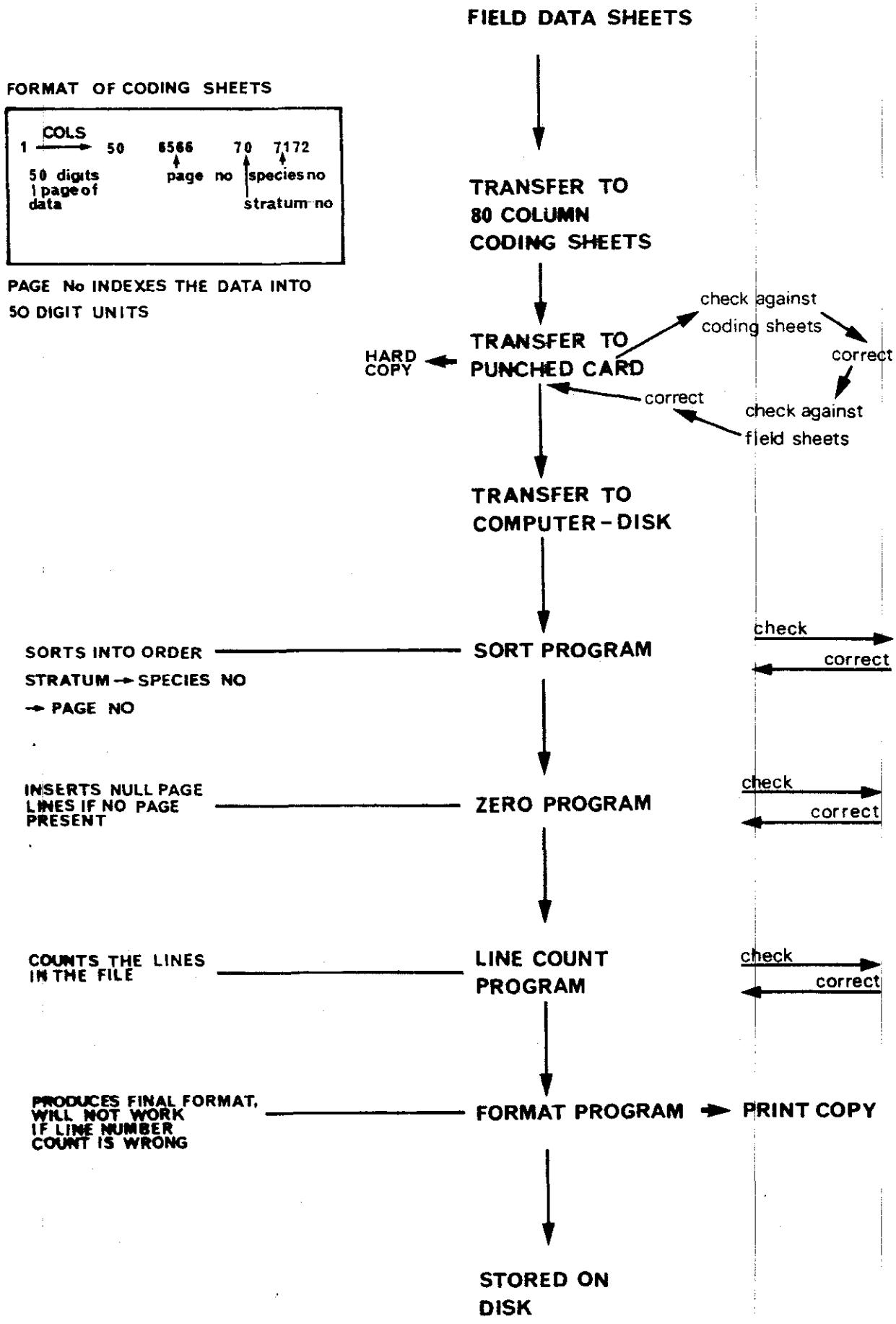

Figure 1.4 Procedure used for transferring data from field sheets to computer storage.

(2) Stratum/Species code. This is usually denoted by a 3-digit number (XYZ). The first digit (X) represents the stratum code (ie 1, 2, 3, 4), and the last 2 numbers (YZ) the species code (see index files). In a few files, 2-digit codes only are given; these numbers are the species codes.

(3) Data. The data stored in lines of digits, with each digit representing one point quadrat or Domin record. For point quadrat datafiles, the number of lines of data, when multiplied by either 50 or 100, as appropriate, equals N. In all of the datafiles the order of data follows the following convention:

transect1[pos1(pin1,pin2...pinN),pos2...posN], transect2,...transectN

where pos = the point quadrat frame position or sample quadrat on the transect, and

where pin = the pin number sampled at a given frame position or sample quadrat.

Steps 2 and 3 are repeated for all stratum/species combinations until the end of the file is reached. The stratum/species combinations have been ordered on the basis of strata (1 = first), and then species (species 1 = first).

Table 1.3 Illustrated example of a datafile from the Moor House experiments.

Line 1	250	(N = No of point quadrat records sampled)
Line 2	121	(Stratum/species code = stratum 1; species 21)
Lines 3	Data 50 digits)	
4	Data 50 digits)	
5	Data 50 digits)	5 lines x 50 digits = 250 = N
6	Data 50 digits)	
7	Data 50 digits)	
Repeat lines 2-7 until end of file.		

1.4 Future research

1.4.1 Recording programme

In the past, the experiments have been recorded more or less in 5 groups:

(1) Blanket Bog - Hard Hill burning experiment (Section 2). This experiment has 4 replicates/treatment.

(2) Low Level Grasslands - J1 and N1 (Sections 4 and 5).

(3) High Level Grasslands - Hard Hill, Little Dun Fell and Knock Fell (Sections 6, 7 and 8).

(4) Blanket Bog - Silverband and Troutbeckhead (Sections 9 and 10), although Bog Hill (Section 11), which was started in 1971 and has only been recorded once, should also be included.

(5) Base-rich Flush - Moss Burn (Johnny's) Flush (Section 3).

The sampling of each group has often been done at the same time (ie in the same year), so that comparisons between the sites can be done. This comparison is especially valuable because the treatment plots in Groups 2-5 are unreplicated, because of restricted finance in the past, and limitations on fencing by common rights of grazing (Rawes 1981). Clearly it would be valuable from a scientific view to maintain this type of sampling programme, but because of financial constraints only one experiment can be recorded each year. This sampling will be done on a 10-year cycle, and although sampling within groups will still be done in sequential years (Table 1.4), unfortunately this means that there will be a separation of one or 2 years between sampling experiments in the same group.

The recording and sampling programme proposed for the 10 years between 1982 and 1992 is shown in Table 1.4

1.4.2 Complementary studies

This report only details the basic information required to maintain the present monitoring programme: i.e. to record the experiments, and to use the information in the existing database. There is, however, a wealth of information, which has been collected in other complementary studies, and these data may be suitable for further checking of results, or validating models produced from the basic experimental programme. These additional data are available for consultation, either in the Moor House 'Boxfiles' or in the Moor House Reserve Record: both archived at NCC's north-west Regional office at Blackwell. Examples of the types of information available include:

(1) Vegetation maps of all enclosures at different times.

(2) Braun-Blanquet assessments of vegetation in 3 experiments (Hard Hill, Little Dun Fell and Knock Fell).

Table 1.4 The planned recording and management in the first 10-year cycle of the Moor House Programme (1982-1992) supervised by ITE

Year	Section	Experiment
1. Recording Plan		
1982	2	Hard Hill burning experiment (D35-38)
1983	3	Moss Burn Flush (D44)
1984	4	J1 (D20)) Low level
1985	5	N1 (D33)) grasslands
1986	6	Hard Hill (D40))
1987	7	Little Dun Fell (D42)) High level grasslands
1988	8	Knock Fell (D31))
1989	9	Silverband (D34))
1990	10	Troutbeckhead (D30)) Blanket Bog
1991	11	Bog Hill (D26))
2. Management Plan		
1984 or 1985	2	Burn the short rotation plots of the Hard Hill burning experiment

(3) Photographs - close ups of vegetation, plus black and white and colour photographs of experimental plots.

(4) Soil analyses.

(5) Production measurements.

(6) Additional experiments which may be included in the long-term experimental study at a later date (e.g. D13 - House Hill; D24 - Green Hole; D18 - Burnt Hill; D19 - Rough Sike; see Figure 1.2 for location).

1.4.3 Future work and possible collaboration

One of the main objects of writing this report is to describe the ongoing experiments and accumulated data base so that other research workers are aware of their existence, and of the possibility of using them in collaborative work, for example:

(1) To test or validate hypotheses developed in other areas.

(2) To use the data base to develop models of vegetation change.

As an example of this potential use, a start has been made to study the effects of release from sheep grazing on the dry matter and nutrient content of the vegetation and litter, and soil chemistry. Some studies have already been done, but it is hoped to expand this work to studies of decomposition processes, perhaps using the cotton strip method (Latter 1977).

It is hoped that these experiments, and their associated monitoring programme will prove to be a valuable resource for studying ecological processes in upland communities.

2 HARD HILL BURNING EXPERIMENT (D35-38)

2.1 History

This experiment was started in 1954 by Dr R J Elliott to investigate effects of grazing and long-term rotational burning treatments on blanket bog (Calluneto-Eriophoretum).

2.2 Experimental layout and design

There are 4 blocks (A = D35; B = D36; C = D37; D = D38), blocked across altitude with A being the lowest (594 m), and D the highest (625 m). The layout of the experiment is shown in Figure 2.1, with an expanded layout of treatments in Figure 2.2. There are 2 grazing treatments (fenced and grazed), with 3 rotational burning treatments (burnt 1954 only - treatment N; burnt 1954 + at 10 year intervals - treatment S; burnt 1954 + 20 year intervals - treatment L). These treatments are applied to plots arranged in a randomized block split-plot experimental design, with:

4 blocks x 2 main treatments x 3 sub-treatments
(fenced & grazed) (N, S, L)

Thus, there are 6 treatments, coded:

N, S, L } burning treatments - grazed

NF, SF, LF } burning treatments - fenced

In addition, at each block a reference area (labelled the control treatment) was left unburnt in 1954, and apart from being grazed, has not been managed since.

Each treatment plot measures c. 30 m x 30 m, and the fenced enclosure is thus 30 m x 90 m.

2.3 Application of burning treatments

A history of the burning treatments applied to date (1985) is shown in Table 2.1. The aim is to burn in the fourth year of the decade, ie exactly 10 or 20 years after the start of the experiment. This has not always been possible, because of inclement weather, and burning has sometimes been postponed for one or even 2 years.

Table 2.1 Burning treatments applied to the Hard Hill burning experiment

Treatment	1954	1965	1975	1985	To be applied 1994
N	√				
S	√	√	√	√*	√
L	√		√		√

*Block D postponed to 1986.

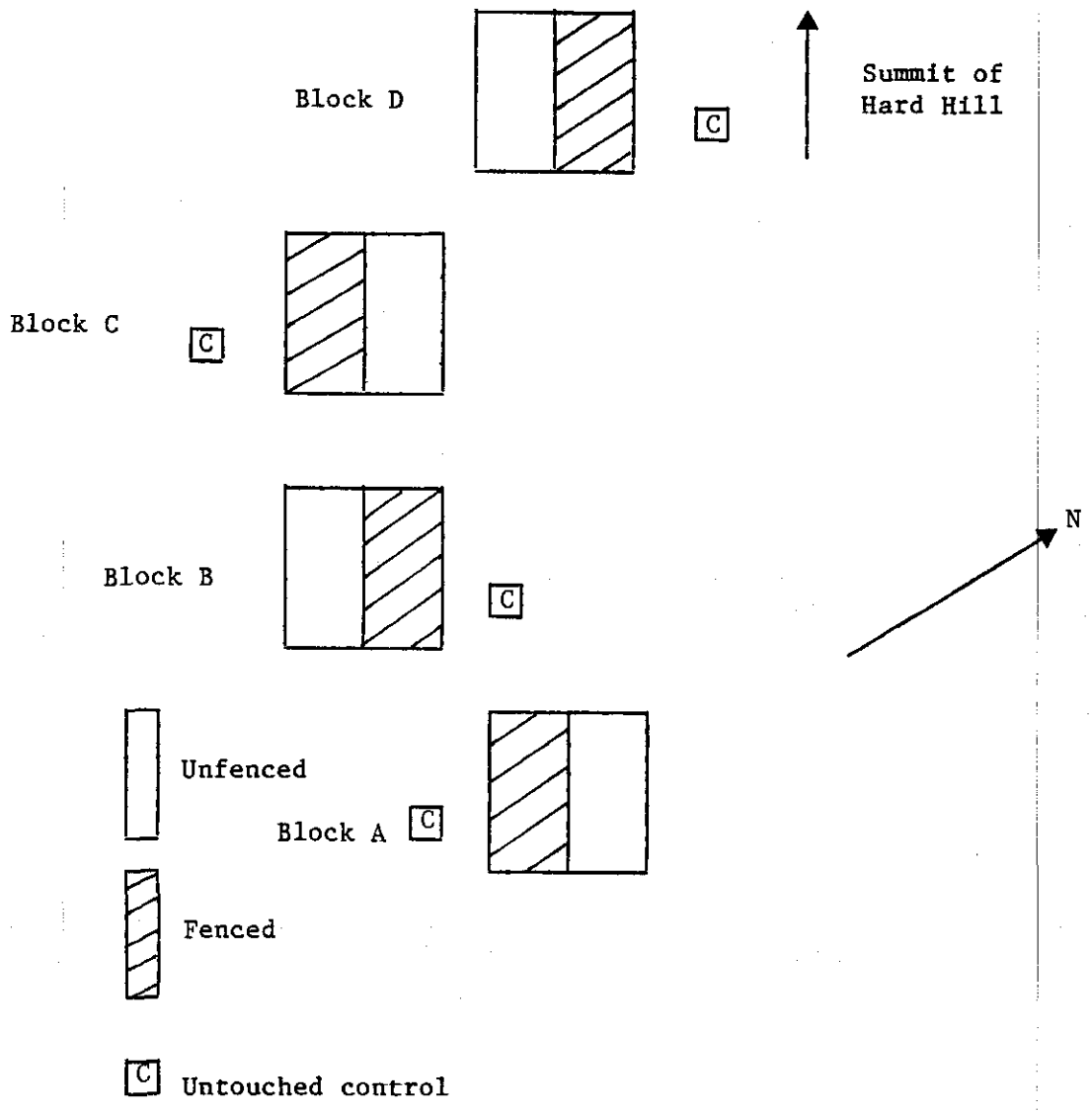

Figure 2.1 Layout of blocks in the Hard Hill burning experiment.

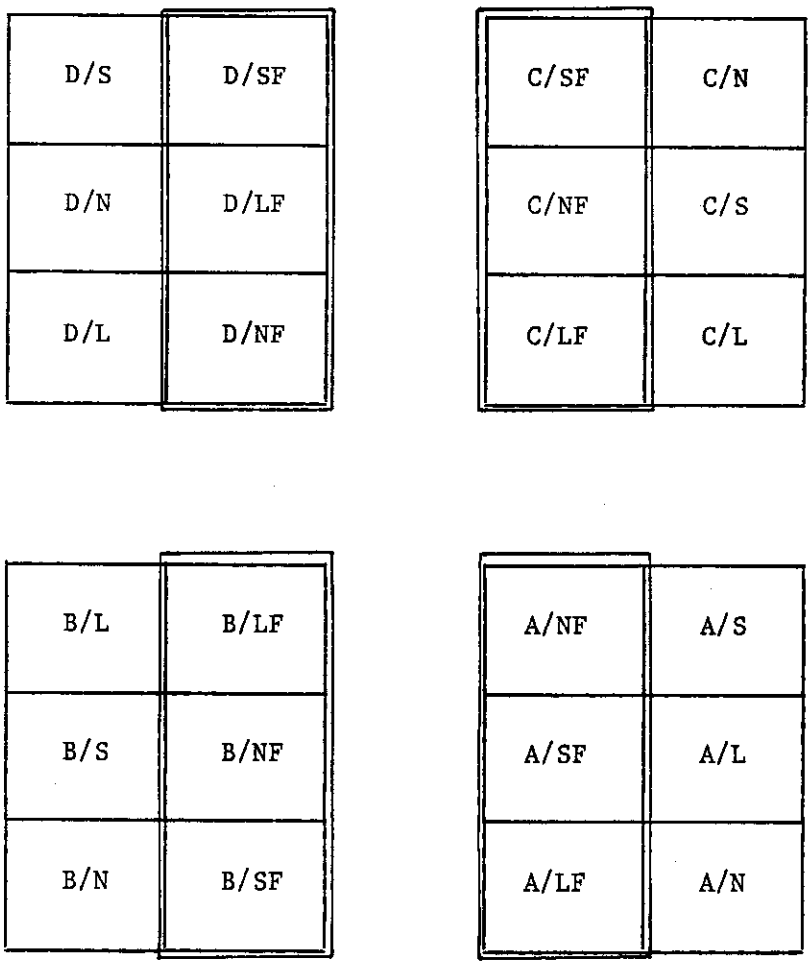

Figure 2.2 Arrangement of treatments at each block

2.4 Sampling procedure

Two methods of sampling have been used:

2.4.1 Domin scale (1961 and 1965)

In 1961, 25 1 m^2 quadrats were positioned at the intersection of a 5 yd grid as shown in Figure 2.3, and at each quadrat the Domin value of each species was assessed. In 1965, the same technique was used at 5 randomly positioned 1 m^2 quadrats in the N and NF treatments.

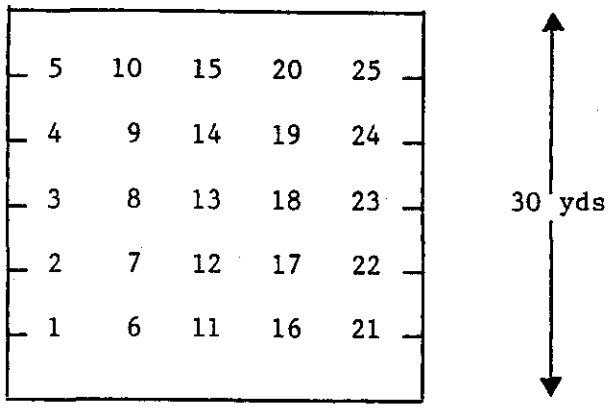

Figure 2.3 Positions of the 25 1 m^2 quadrats sampled in 1961

2.4.2 Point-quadrat studies (1972/73 et seq.)

A 14 m x 6 m sampling plot was marked in each treatment plot, and divided into 7 transects using measuring tapes, as shown in Figure 2.4.

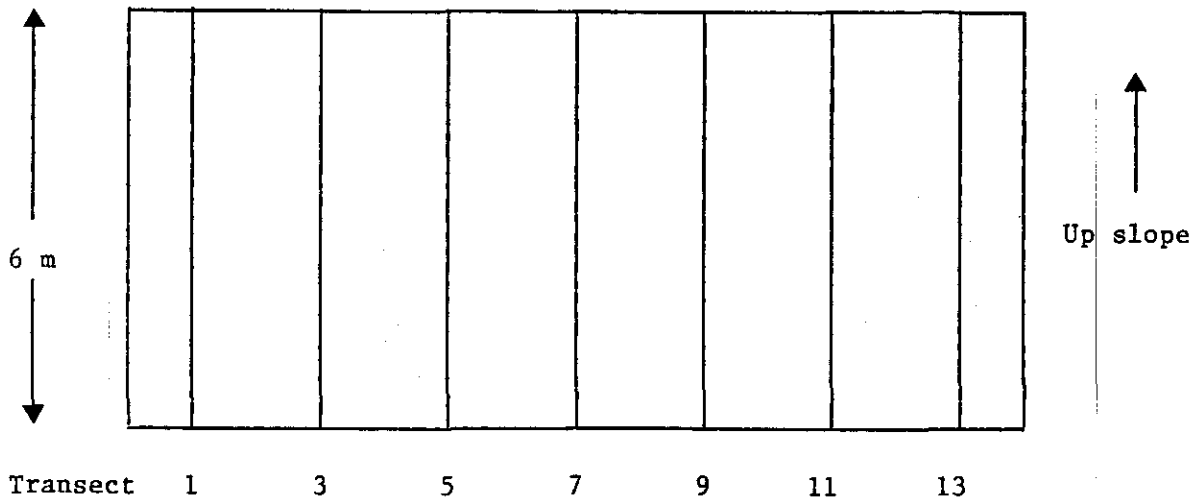

Figure 2.4 Positions of the measuring tapes for the location of sample quadrats

Along each of these 7 transects (1, 3, 5, 7, 9, 11, 13) there are 2 sides, the left hand side (denoted A) and the right hand side (denoted B), each with 6 possible 1 m^2 areas, 20 of these 1 m^2 quadrats have been randomly chosen for sampling.

Each quadrat is denoted by:

an integer (1, 3, 5, 7, 9, 11, 13)	/	an integer (1-6)	/	A or B

Thus, any 1 m^2 quadrat within the sampling area has a unique code, eg:

1, 3, B = Transect 1, quadrat 3 (between 2-3 m along transect) on the right side of the tape.

Within the 1 m^2 quadrat to be sampled, the 1 m point-quadrat frame, with 10 possible sampling positions is set at 10, 30, 50, 70 and 90 cm along the tape, as shown in Figure 2.5. At each of the 5 positions, 1 random point along the frame is sampled (1-10). In Figure 2.5, 2, 4, 5, 3, 10 are sampled.

In 1972, 2 random points were sampled from each frame position in some tratments, (AS, ASF, AL, ALF, ACONT), but in all other treatments one pin per frame was used. Stratified pins were used throughout.

In 1982, only 1 pin per frame was used, and stratified pins were used only in Block B; in all other blocks (A, C, D), no height stratification was used.

2.5 Information stored in the data base

2.5.1 Index to species code numbers

Higher plants = **PLINDEX. HHB**
Bryophytes/lichens = **BRINDEX. HHB**

2.5.2 Positions of point-quadrats

The randomly selected positions for point quadrats in each treatment are held in separate files for each Block:

Block A = **ACODE. HHB**
Block B = **BCODE. HHB**
Block C = **CCODE. HHB**
Block D = **DCODE. HHB**

2.5.3 Data

The data for each treatment is held in 2 separate files for each sampling occasion, the first containing data on higher plants, the second containing data on bryophytes/lichens. These data files are coded as follows:

AB. C DE

where: **A** = Block (A, B, C, D)
B = Treatment code (N, S, L, NF, SF, LF, CONT)
C = P = Higher plant or M = Bryophyte
DE = 2 digit year code, ie 61 = 1861, 65 = 1965, 72 = 1972, 82 = 1982.

eg **CNF.P72** = higher plant data for Block C, Treatment NF in 1972.

The full set of point quadrat data (200 points) for AS, ASF, AL, ALF and ACONT in 1972 is in similar files prefixed with F, and the 100 point data are in files with the above notation.

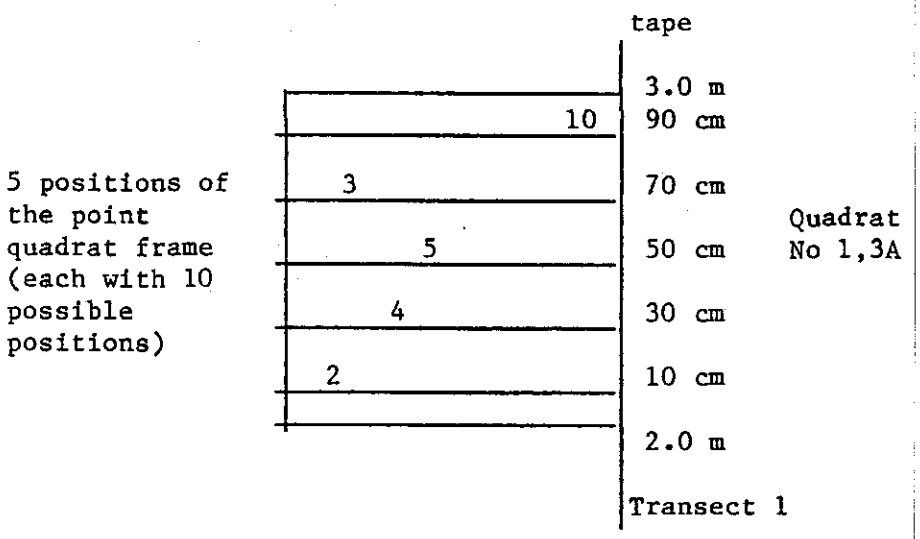

Figure 2.5 An example of the way points are sampled within the 1 m^2 quadrat

3.1 Experimental layout

This experiment was started in 1972, when 2 plots (10 m x 6 m) were marked across the flush (Figure 3.1). The lower plot was fenced to exclude sheep grazing. The plots were initially matched by eye, and the only differences apparent were:

(1) The grazed plot had more moss cover on the south side.

(2) The enclosed plot had more scattered Juncus effusus.

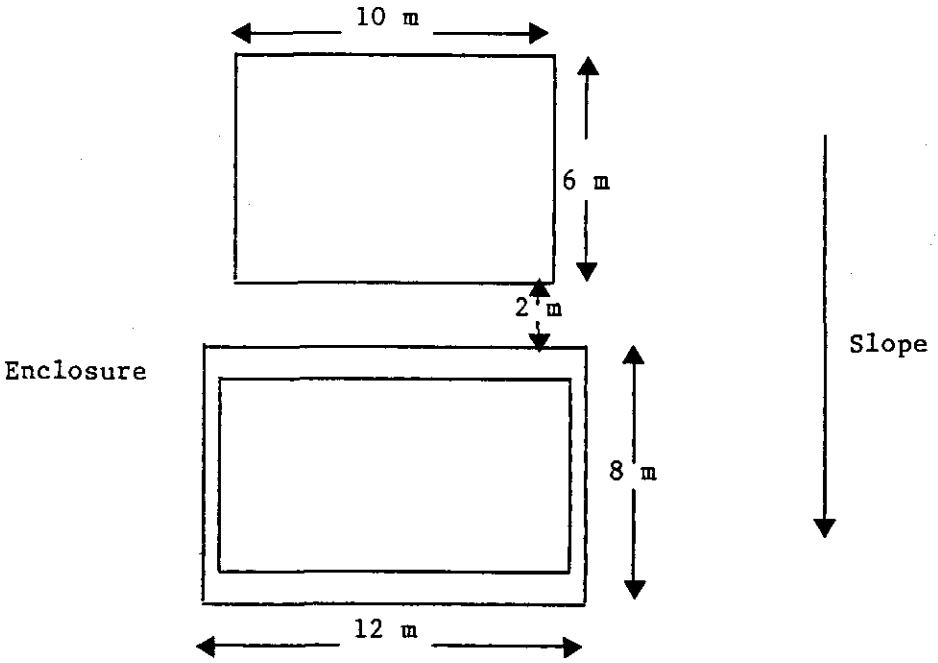

Figure 3.1 Layout of the experimental plots at Johnny's Flush

3.2 Sampling procedure

The 10 m x 6 m plots, identified by blue corner posts, are gridded into 1 m quadrats (Figure 3.2), all sampling is based on this grid.

This experiment has been recorded on 3 occasions, 1972, 1974 and 1983; on each occasion stratified point quadrats were used.

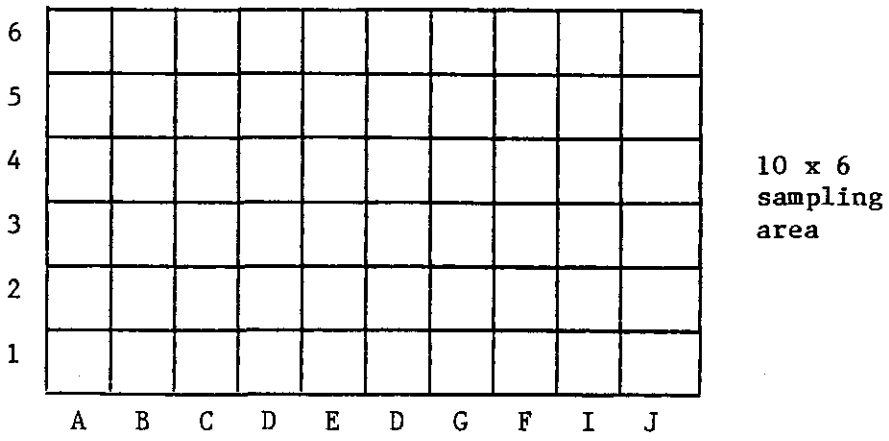

Figure 3.2 Layout of the sample grid laid out across both the grazed and the enclosed plots.

3.2.1 1972 sampling

In 1972, 30 1 m^2 quadrats were randomly selected (Table 3.1), and in each quadrat 2 10 point-quadrat positions were sampled (Figure 3.3). Thus, 600 individual points were sampled in each treatment; ie 30 quadrats x 20 points.

Table 3.1 Quadrats sampled in 1972

Grazed:	A1, A2, A5, A6	Enclosed:	A2, A4, A5
	B2, B4, B5		B2, B4, B6
	C2, C3, C6		C1, C3, C5
	D2, D4		D1, D3, D4, D5
	F2. F6		F4, F5
	G3, G5, G6		G1, G2
	H2, H6		H1, H2
	I1, I3, I4, I6		I1, I3, I4, I5
	J2, J3, J4		J4, J5, J6

3.2.2 1974 (et seq.) sampling

All 60 1 m^2 quadrats were sampled using a 5 pin point-quadrat frame (Figure 3.4), giving 300 points in each treatment; ie 60 quadrats x 5 points.

3.2.3 Comparison of 1972 data with subsequent data

It is possible to compare the data directly by (1) extracting points 2, 4, 6, 8 and 10 from the 20 pins from each quadrat in the 1972 data, and (2) extracting the appropriate quadrats from the 1974 data. These subsets each contain 150 points.

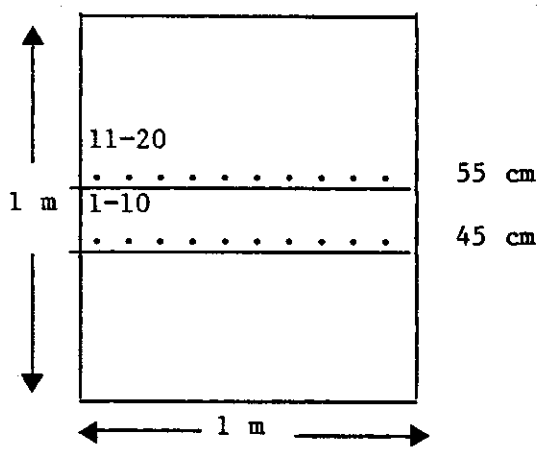

Figure 3.3 Pin positions sampled in 30 m^2 quadrats in 1972

3.3 Information stored in the database

3.3.1 Index to species code numbers

Higher plants = **PLINDEX. D44**
Bryophytes/lichens = **BRINDEX. D44**

3.3.2 Data

The data for each treatment is held in 2 separate files for each sampling occasion, the first containing data on higher plants,and the second containing data on bryophytes, ie:

1972 Enclosed higher plants - **ENCPL72.D44**
" Enclosed bryophytes - **ENCBR72.D44**
" Grazed higher plants - **GRAPL72.D44**
" Grazed bryophytes - **GRABR72.D44**

1974 Enclosed higher plants - **ENCPL74.D44**
" Enclosed bryophytes - **ENCBR74.D44**
" Grazed higher plants - **GRAPL74.D44**
" Grazed bryophytes - **GRABR74.D44**

1983 Enclosed higher plants - **ENCPL83.D44**
" Enclosed bryophytes - **ENCBR83.D44**
" Grazed higher plants - **GRAPL83.D44**
" Grazed bryophytes - **GRABR83.D44**

A further set of files with the same names, but prefixed with the letter **C**, contains the data that is common to all dates.

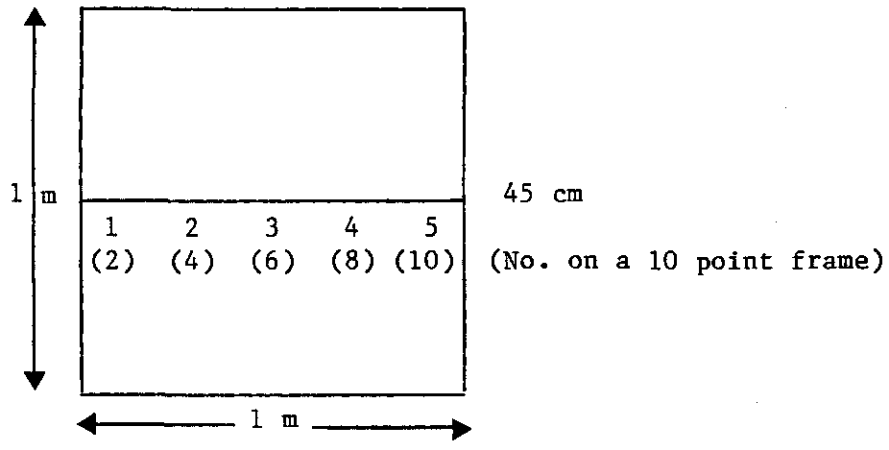

Figure 3.4 Pin positions sampled in all 60 $1m^2$ quadrats from 1974.

4 J1 - JUNCUS SQUARROSUS GRASSLAND (D20)

4.1 Experimental layout

This experiment was started in 1967 on an area that had been used in previous studies (J1). The area was split into 2 areas, one fenced to exclude grazing, the other left for free range sheep grazing (Figure 4.1). Each plot was subdivided as shown in Figure 4.2 with marker canes.

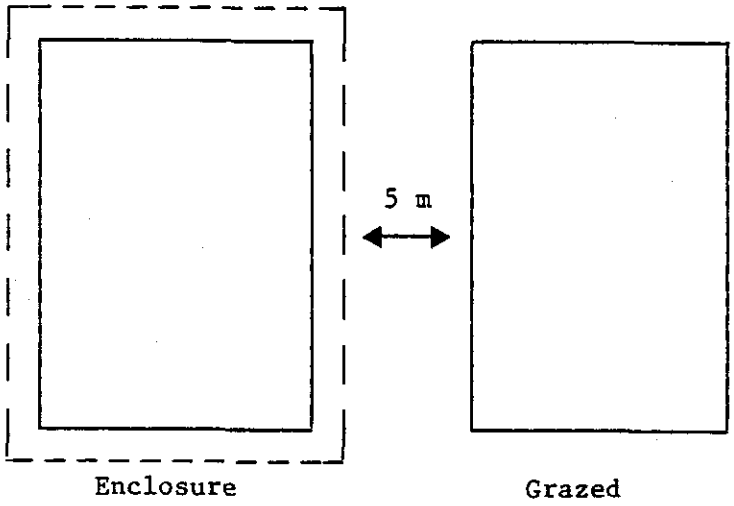

Figure 4.1 Layout of the experimental plots in the Juncus squarrosus grassland (J1).

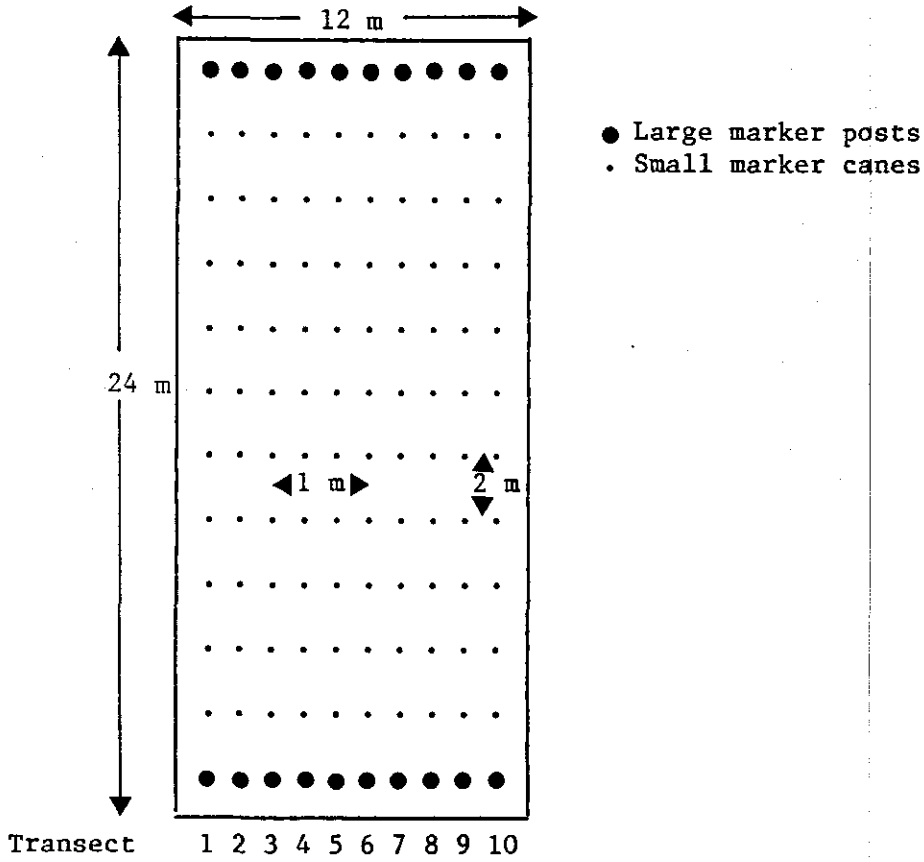

Figure 4.2 Subdivision of the plots into 10 transects, each with 10 frame positions for point quadrat studies

There are 10 belt transects, each with 10 point quadrat frame positions (Figure 4.2). The point quadrat frame is placed between the small marker cones (Figure 4.3).

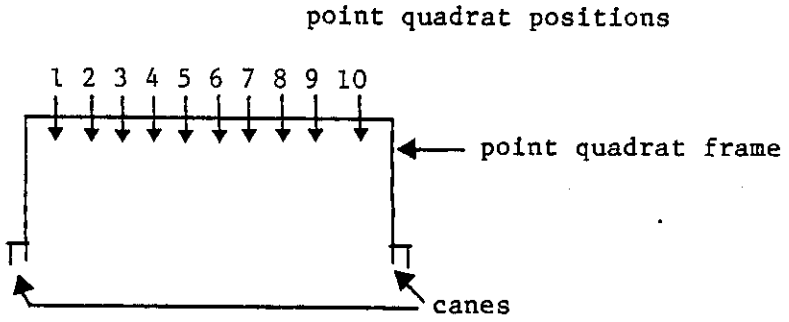

Figure 4.3 Vertical position of point quadrat frame between the small marker canes

If all point quadrat positions are sampled there will be 1000 points in both the enclosed and grazed treatments, ie 10 transects x 10 positions x 10 points in each treatment.

4.2 Sampling

Sampling was done in 1967, 1970, 1973, 1976, 1981 and 1984.

4.2.1 1967

All 1000 points were sampled in each plot using the unstratified point quadrat method. Higher plants and bryophytes were recorded.

4.2.2 1970

All 1000 points were sampled using the unstratified point quadrat method, but 500 points (Transects 2, 4, 6, 8, 10) were sampled using the stratified method. Only higher plants were recorded.

4.2.3 1973

A randomly chosen subset of 500 points was sampled using the unstratified point quadrat method, and a further subset of 250 was sampled with the stratified method. Height stratification of Juncus squarrosus was done separately at all 500 points. The location of the sampling positions for both the 500 and 250 subsets are given on Table 4.1. Both higher plants and bryophytes were recorded in 1973.

Table 4.1 Transect positions recorded in 1973

Subset	Transect No	Position on the transect	
		Enclosed	Grazed
Unstratified (500 points)	1	2, 3, 6, 8	1, 3, 7, 10
	2	1, 2, 3, 5, 7	1, 4, 6, 7, 8
	3	1, 2, 3, 6, 7, 8	2, 5, 6, 7, 8, 10
	4	2, 3, 5, 6, 8, 9, 10	4, 5, 7, 8, 9
	5	10	1, 4, 5, 8, 10
	6	1, 3, 4, 5, 6, 7	1, 3, 5, 7
	7	1, 4, 5, 7, 10	3, 4, 6, 7, 9, 10
	8	3, 4, 5, 8, 9	2, 5, 7, 10
	9	4, 5, 7, 8, 10	1, 3, 5, 6, 8, 9, 10
	10	1, 2, 5, 6, 7, 8	2, 3, 7, 8
Stratified (250 points)	2	1, 2, 3, 5, 7	1, 4, 6, 7, 8
	3		7
	4	2, 3, 5, 6, 8, 10	4, 5, 7, 8, 9
	6	1, 3, 4, 6, 7	1, 3, 5, 7
	7		7
	8	3, 5, 8, 9	2, 5, 7, 10
	9		3
	10	1, 2, 5, 7, 8	2, 3, 7, 8

4.2.4 1976

All 1000 points were done in the grazed plot, but in the enclosed plot, transect 1 was lost, and hence data are available for only 900 points. The stratified method was used throughout, and both higher plants and bryophytes were recorded.

4.2.5 1981

A subset of 500 unstratified points (transects 1, 3, 5, 7, 9) was sampled in the grazed plots only. Higher plants and bryophytes were recorded.

4.2.6 1984 *et seq.*

All 1000 points were done using the height stratified method, and both higher plants and bryophytes were recorded.

4.3 Information stored in the database

4.3.1 Index to species code numbers

Higher plants = **PLINDEX.D20**
Bryophytes/lichens = **BRINDEX.D20**

4.3.2 Data

1967 - 1000 points unstratified

Enclosed higher plants	=	**ENCPL67.D20**
Enclosed bryophytes	=	**ENCBR67.D20**
Grazed higher plants	=	**GRAPL67.D20**
Grazed bryophytes	=	**GRABR67.D20**

1970 - 1000 points unstratified

Enclosed higher plants	=	**ENCPL70.D20**
Grazed higher plants	=	**GRAPL70.D20**

- 500 points stratified subset

Enclosed higher plants	=	**SENCPL70.D20**
Grazed higher plants	=	**SGRAPL70.D20**

1973 - 500 points unstratified

Enclosed higher plants	=	**ENCPL73.D20**
Enclosed bryophytes	=	**ENCBR73.D20**
Grazed higher plants	=	**GRAPL73.D20**
Grazed bryophytes	=	**GRABR73.D20**

- 500 points stratified

Enclosed Juncus squarrosus	=	**ENCJU73.D20**
Grazed Juncus squarrosus	=	**GRAJU73.D20**

- 250 point stratified subset

Enclosed higher plants	=	**SENCPL73.D20**
Enclosed bryophytes	=	**SENCBR73.D20**
Grazed higher plants	=	**SGRAPL73.D20**
Grazed bryophytes	=	**SGRABR73.D20**

1976 - 900/1000 points stratified

Enclosed higher plants	=	**ENCPL76.D20**
Enclosed bryophytes	=	**ENCBR76.D20**
Grazed higher plants	=	**GRAPL76.D20**
Grazed bryophytes	=	**GRABR76.D20**

1981 - 500 points unstratified

Grazed higher plants	=	**GRAPL81.D20**
Grazed bryophytes	=	**GRABR81.D20**

1984 - 1000 points stratified

Enclosed higher plants	=	**ENCPL84.D20**
Enclosed bryophytes	=	**ENCBR84.D20**
Grazed higher plants	=	**GRAPL84.D20**
Grazed bryophytes	=	**GRABR84.D20**

5 N1 - NARDUS STRICTA GRASSLAND (D33)

5.1 Experimental layout

This experiment was started in 1967 on an area that had been used in previous studies (N1). Two treatments (enclosed and grazed) were laid out on the site as shown in Figure 5.1. In each treatment there are 10 belt transects, each with 10 frame positions. If all points are sampled there will be 1000 points, ie 10 transects x 10 positions x 10 points in each treatment. In this study, the point quadrat frame is centred on the marker canes (Figure 5.2).

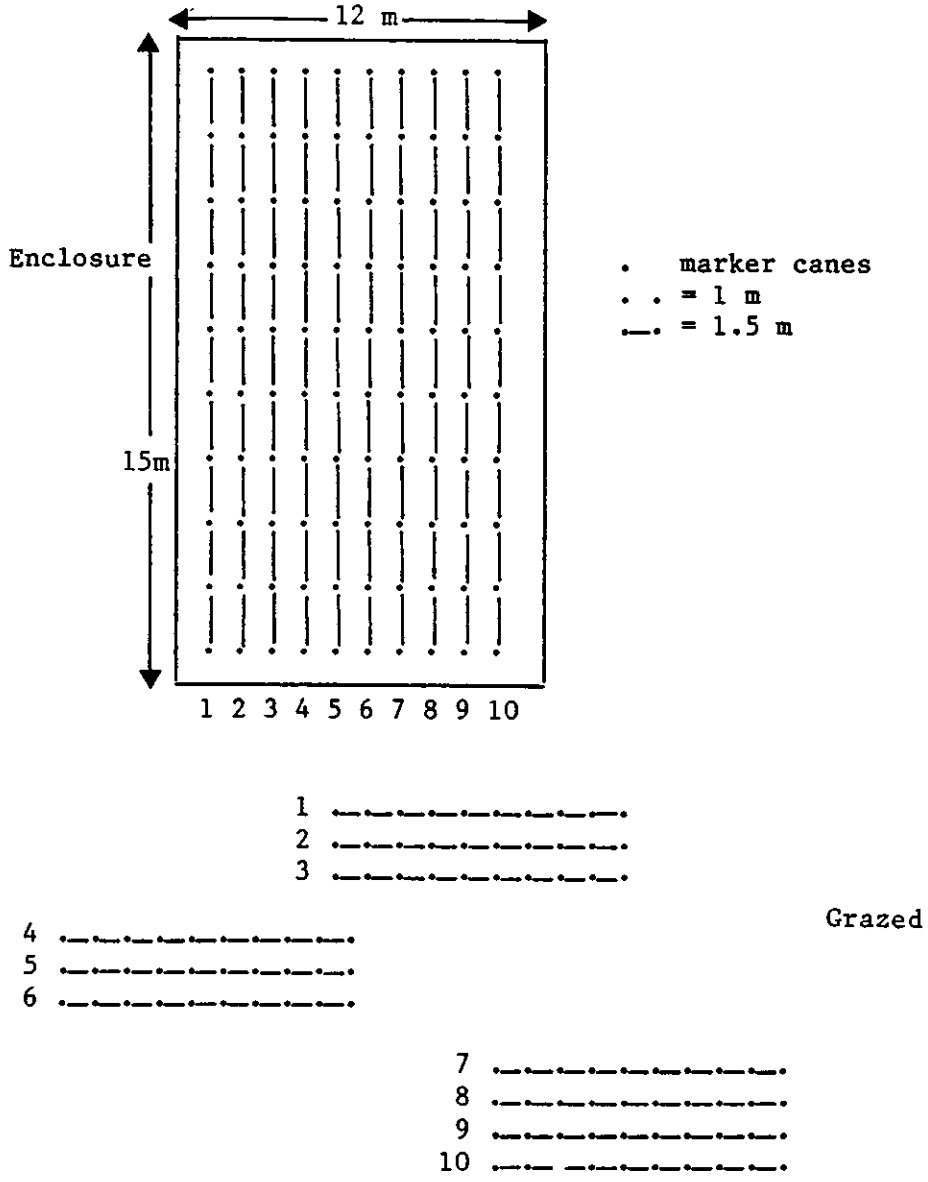

Figure 5.1 Layout of the experimental plots in the Nardus stricta grassland (N1)

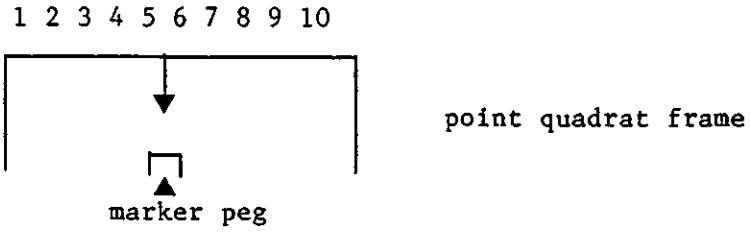

Figure 5.2 Position of point quadrat frame in relation to the marker pegs.

5.2 Sampling

Sampling was done in 1967, 1970, 1973, 1976, 1981 and 1985.

5.2.1 1967

All 1000 points were sampled in each plot using the unstratified point quadrat method. Higher plants and bryophytes were recorded.

5.2.2 1970

All 1000 points were sampled using the unstratified point quadrat method, but 500 points (transects 2, 4, 6, 8, 10) were sampled using the stratified method. Only higher plants were recorded.

5.2.3 1973

A randomly chosen subset of 500 points was sampled using the unstratified point quadrat method, and a further subset of 250 was sampled with the stratified method. The location of sampling positions for both the 500 and 250 subsets is given in Table 5.1. Both higher plants and bryophytes were recorded in 1973.

5.2.4 1976

All 1000 points were sampled using stratified point quadrats. Higher plants and bryophytes were recorded.

5.2.5 1981

A subset of 500 unstratified points (transects 2, 3, 6, 7, 10) was sampled in the grazed plots only. Higher plants and bryophytes were recorded.

5.2.6 1985 *et seq*.

All 1000 points were sampled using stratified point quadrats. Higher plants and bryophytes were recorded.

Table 5.1 Transect positions recorded in 1973

Subset	Transect No	Position on the transect	
		Enclosed	Grazed
Unstratified (500 points)	1	1, 8, 9	1, 2, 5, 7, 8, 9, 10
	2	1, 4, 6, 8, 9, 10	1, 2, 3, 4, 5, 7, 10
	3	2, 3, 6, 9, 10	1, 2, 3, 4, 6, 8, 9, 10
	4	1, 2, 5, 8, 10	8
	5	1, 2, 3, 5, 6, 8, 10	2, 4, 10
	6	1, 2, 3, 4, 5, 10	2, 4
	7	1, 4, 6, 8, 9, 10	1, 4, 5, 6, 8, 9, 10
	8	3, 5, 6, 9, 10	2, 3, 4, 5, 7, 8, 9
	9	1, 5, 6, 8	3, 4, 5, 10
	10	7, 9, 10	3, 6, 7, 10
Stratified (250 points)	2	1, 4, 6, 8, 9, 10	1, 2, 3, 4, 5, 7, 10
	3		2, 9
	4	1, 2, 5, 8, 10	8
	6	1, 2, 3, 4, 5, 10	2, 4
	7		4, 8
	8	3, 5, 6, 9, 10	2, 3, 4, 5, 7, 8, 9
	10	7, 9, 10	3, 6, 7, 10

5.3 Information stored in the database

5.3.1 Index to species code numbers

Higher plants = **PLINDEX.D33**
Bryophytes/lichens = **BRINDEX.D33**

5.3.2 Data

1967 - 1000 points unstratified

Enclosed higher plants = **ENCPL67.D33**
Enclosed bryophytes = **ENCBR67.D33**
Grazed higher plants = **GRAPL67.D33**
Grazed bryophytes = **GRABR67.D33**

1970 - 1000 points unstratified

Enclosed higher plants = **ENCPL70.D33**
Grazed higher plants = **GRAPL70.D33**

- 500 points stratified subset

Enclosed higher plants = **SENCPL70.D33**
Grazed bryophytes = **SGRAPL70.D33**

1973 - 500 points unstratified

Enclosed higher plants	=	**ENCPL73.D33**
Enclosed bryophytes	=	**ENCBR73.D33**
Grazed higher plants	=	**GRAPL73.D33**
Grazed bryophytes	=	**GRABR73.D33**

- 250 points stratified

Enclosed higher plants	=	**SENCPL73.D33**
Enclosed bryophytes	=	**SENCBR73.D33**
Grazed higher plants	=	**SGRAPL73.D33**
Grazed bryophytes	=	**SGRABR73.D33**

1976 - 1000 points stratified

Enclosed higher plants	=	**ENCPL76.D33**
Enclosed bryophytes	=	**ENCBR76.D33**
Grazed higher plants	=	**GRAPL76.D33**
Grazed bryophytes	=	**GRABR76.D33**

1981 - 500 points unstratified

Grazed higher plants	=	**GRAPL81.D33**
Grazed bryophytes	=	**GRABR81.D33**

1985 - 1000 points stratified

Enclosed higher plants	=	**ENCPL85.D33**
Enclosed bryophytes	=	**ENCBR85.D33**
Grazed higher plants	=	**GRAPL85.D33**
Grazed bryophytes	=	**GRABR85.D33**

6 FESTUCA GRASSLAND - HARD HILL (D40)

6.1 Experimental layout

The experiment was set up in 1954 on an area of grassland dominated by Festuca ovina near the summit of Hard Hill. Two experimental plots were studied, an enclosed and a grazed plot (introduced 1962), (Figure 6.1). In each of these plots 10 transects were studied, each with 10 sampling positions; as there are 10 points at each frame position, this gives a maximum of 1000 points for each treatment. The point quadrat frame is straddled across the transect as shown in Figures 6.1 and 6.2

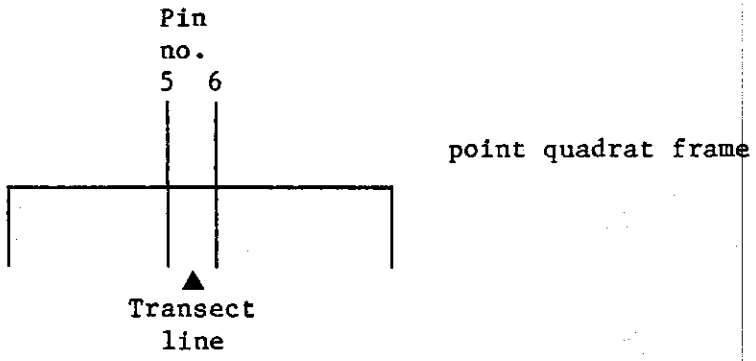

Figure 6.2 Positioning of the point quadrat frame relative to the transect line

6.2 Sampling

Sampling was done in 1955, 1962, 1970 and 1977.

6.2.1 1955

All 1000 points in the enclosed plot only were sampled using the unstratified point quadrat method. Higher plants and bryophytes were recorded.

6.2.2 1962

All 1000 points in both the enclosed and grazed plots were sampled using the unstratified point quadrat method. Higher plants and bryophytes were recorded.

6.2.3 1970

A subset of 500 points were sampled (transects 2, 4, 6, 8 and 10) in both enclosed and grazed plots. The stratified point quadrat method was used, but only higher plants were recorded.

6.2.4 1977 et seq.

All 1000 points were done using the stratified point quadrat method, and both higher plants and bryophytes were recorded.

6.3 Information stored in the database

6.3.1 Index to species code numbers

Higher plants = **PLINDEX.D40**
Bryophytes/lichens = **BRINDEX.D40**

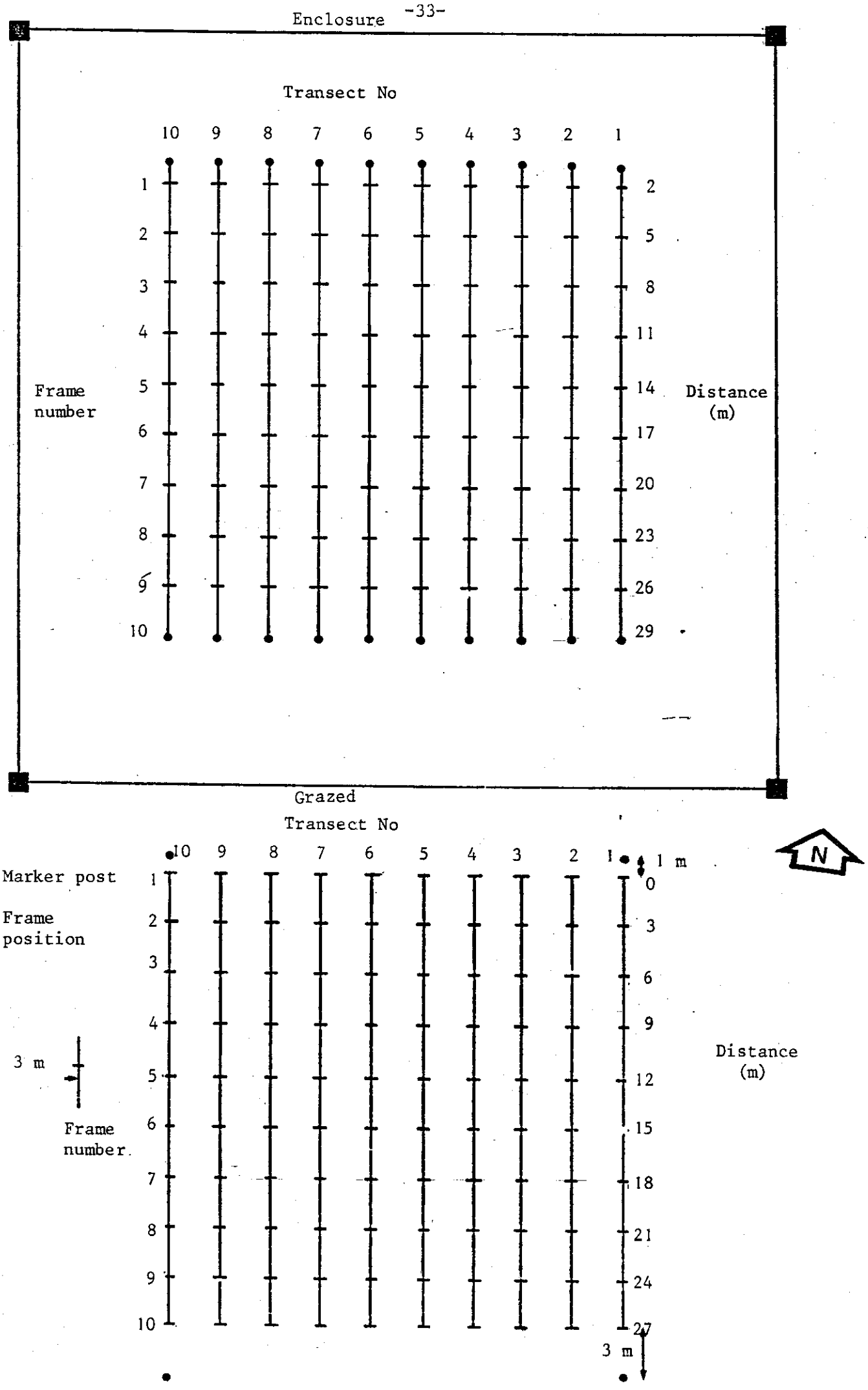

Figure 6.1 Plot layout at the Hard Hill grassland site

6.3.2 Data

1955 - 1000 points unstratified

Enclosed higher plants	-	**PL55.D40**
Enclosed bryophytes	-	**BR55.D40**

1962 - 1000 points unstratified

Enclosed higher plants	-	**ENCPL62.D40**
Enclosed bryophytes	-	**ENCBR62.D40**
Grazed higher plants	-	**GRAPL62.D40**
Grazed bryophytes	-	**GRABR62.D40**

1970 - 500 point stratified subset

Enclosed higher plants	-	**SENCPL70.D40**
Grazed higher plants	-	**SGRAPL70.D40**

1977 1000 points stratified

Enclosed higher plants	-	**ENCPL77.D40**
Enclosed bryophytes	-	**ENCBR77.D40**
Grazed higher plants	-	**GRAPL77.D40**
Grazed bryophytes	-	**GRABR77.D40**

7 FESTUCA GRASSLAND - LITTLE DUN FELL (D42)

7.1 Experimental layout

This experiment was started in 1954 on grassland dominated by Festuca ovina. Two experimental plots were studied, an enclosed and a grazed plot (introduced in 1962) (Figure 7.1). In each of these plots 10 transects were studied, each with 10 sampling positions; as there are 10 points at each frame position, this gives a maximum of 1000 points for each treatment. The point quadrat frame is straddled across the transect as shown in Figures 7.1 and 7.2.

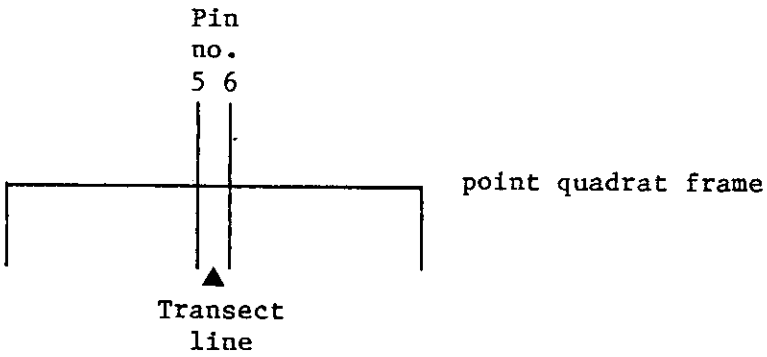

Figure 7.2 Positioning of the point quadrat frame relative to the transect line

7.2 Sampling

Sampling was done in 1955, 1962, 1970, 1974 and 1977.

7.2.1 1955

All 1000 points in the enclosed plot only were sampled using the unstratified point quadrat method. Higher plants and bryophytes were recorded.

7.2.2 1962

All 1000 points were done in both the enclosed and grazed plots using the unstratified method. Higher plants and bryophytes were recorded.

7.2.3 1970

All 1000 points were done in both enclosed and grazed plots using the unstratified method, with a subset of 500 points (transects 2, 4, 6, 8, 10) done by the stratified method. Only higher plants were recorded.

7.2.4 1974

A randomly chosen subset of 500 points (Table 7.1) was sampled using the stratified point quadrat method. Both higher plants and bryophytes were recorded.

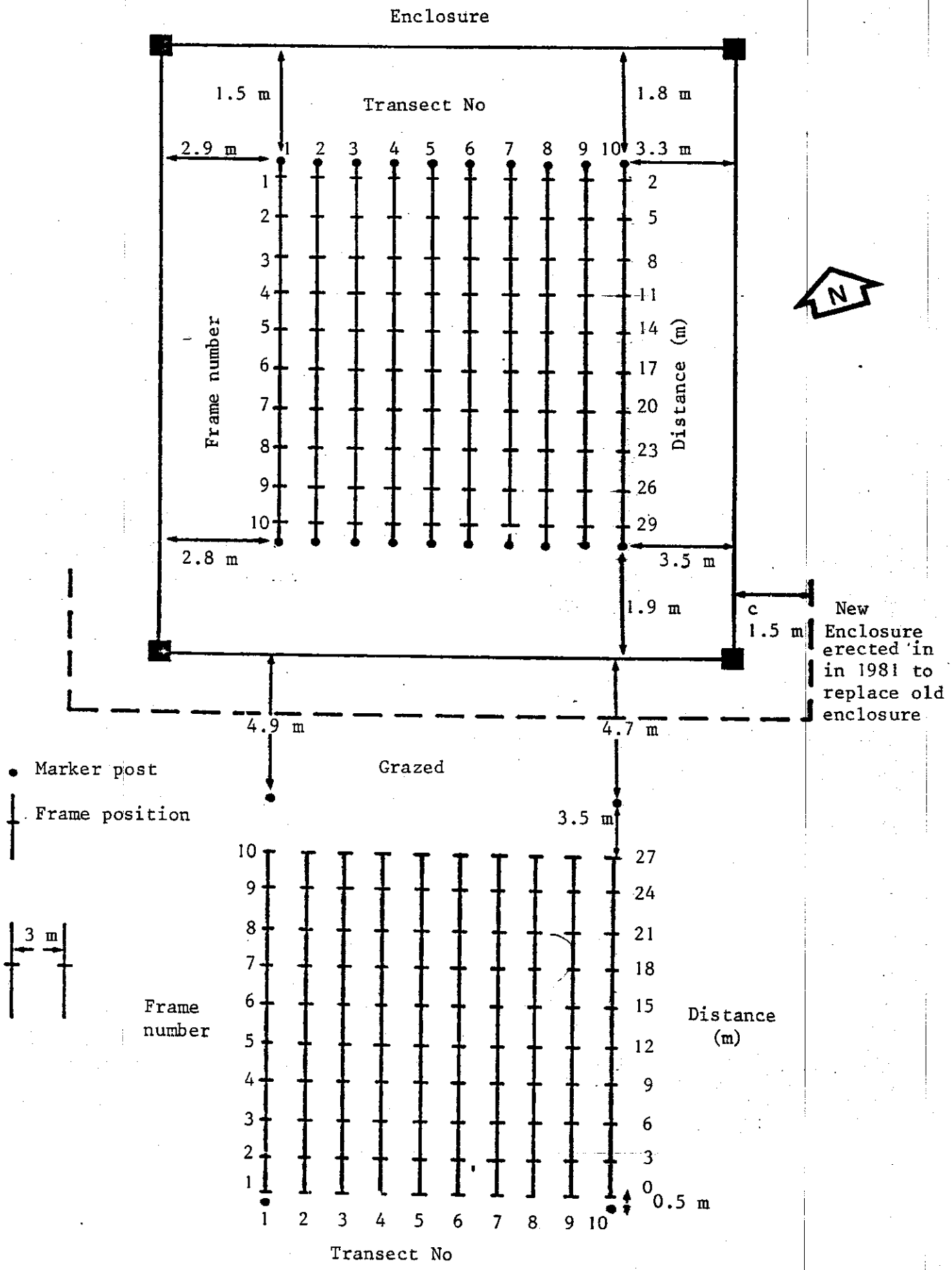

Figure 7.1 Plot layout at Little Dun Fell

Table 7.1 Transect positions recorded in 1974

Transect No	Enclosed	Grazed
1	1, 3, 9	1, 3, 6, 7, 9
2	1, 2, 5, 8, 9	2, 6, 7, 8, 9
3	3, 8, 10	7, 10
4	1, 5, 7, 10	5, 7, 8, 9, 10
5	4, 7, 10	1, 3, 5, 7
6	1, 2, 3, 5, 6, 7, 9	2, 3, 5, 8, 10
7	1, 2, 4, 5, 8, 10	2, 3, 5
8	1, 2, 3, 4, 5, 6, 10	1, 3, 4, 5, 7, 9
9	2, 3, 4, 6, 7, 8, 9	1, 2, 3, 5, 6, 7, 8
10	2, 4, 6, 7, 8	1, 3, 4, 5, 6, 7, 8, 10

7.2.5 1977 et seq.

All 1000 points were done with the stratified method in both enclosed and grazed plots. Both higher plants and bryophytes were recorded.

7.3 Information stored in the database

7.3.1 Index to species code numbers

Higher plants = **PLINDEX.D42**
Bryophytes/lichens = **BRINDEX.D42**

7.3.2 Data

1955 - 1000 points unstratified

Enclosed higher plants = **ENCPL55.D42**
Enclosed bryophytes = **ENCBR55.D42**

1962 - 1000 points unstratified

Enclosed higher plants = **ENCPL62.D42**
Enclosed bryophytes = **ENCBR62.D42**
Grazed higher plants = **GRAPL62.D42**
Grazed bryophytes = **GRABR62.D42**

1970 - 1000 points unstratified

Enclosed higher plants = **ENCPL70.D42**
Grazed higher plants = **GRAPL70.D42**

- 500 point stratified subset

Enclosed higher plants = **SENCPL70.D42**
Grazed higher plants = **SGRAPL70.D42**

1974 - 500 point stratified subset

Enclosed higher plants	=	**ENCPL74.D42**
Enclosed bryophytes	=	**ENCBR74.D42**
Grazed higher plants	=	**GRAPL74.D42**
Grazed bryophytes	=	**GRABR74.D42**

1977 - 1000 points stratified

Enclosed higher plants	=	**ENCPL77.D42**
Enclosed bryophytes	=	**ENCBR77.D42**
Grazed higher plants	=	**GRAPL77.D42**
Grazed bryophytes	=	**GRABR77.D42**

8 AGROSTIS-FESTUCA GRASSLAND - KNOCK FELL (D31)

8.1 Experimental layout

The experiment was set up in 1955 on an area of Agrostis-Festuca grassland near the summit of Knock Fell. Two experimental plots were studied, an enclosed and a grazed plot (introduced in 1962) (Figure 8.1). In each of these plots 10 transects were studied, each with 10 sampling positions; as there are 10 points at each frame position, this gives a maximum of 1000 points for each treatment. The point quadrat frame is straddled across the transect as shown in Figures 8.1 and 8.2.

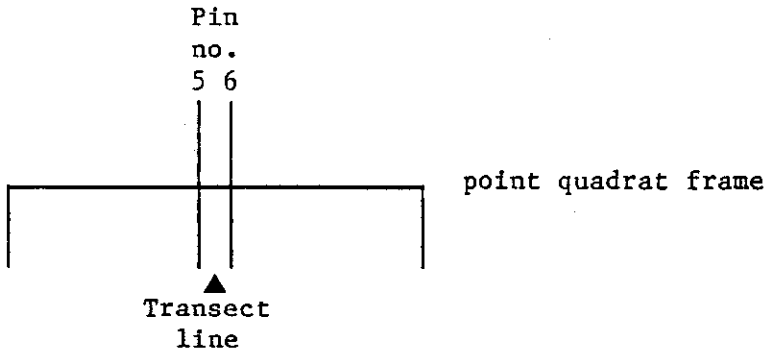

Figure 8.2 Positioning of the point quadrat frame relative to the transect line

Unfortunately, the Pennine Way now passes through part of the grazed experimental plot (transects 9 and 10), and some of the observed changes in vegetation in this area may be attributed to increased trampling pressure from walkers, who have steadily increased in numbers during the last 25 years.

8.2 Sampling

Sampling was done in 1956, 1962, 1966, 1970, 1978 and 1981

8.2.1 1956

All 1000 points in the enclosed plot were sampled using the unstratified point quadrat method. Higher plants and bryophytes were recorded.

8.2.2 1962

All 1000 points were sampled in both plots using the unstratified point quadrat method. Higher plants and bryophytes were recorded.

8.2.3 1966

All 1000 points were sampled in both plots using the unstratified point quadrat method. Higher plants and bryophytes were recorded.

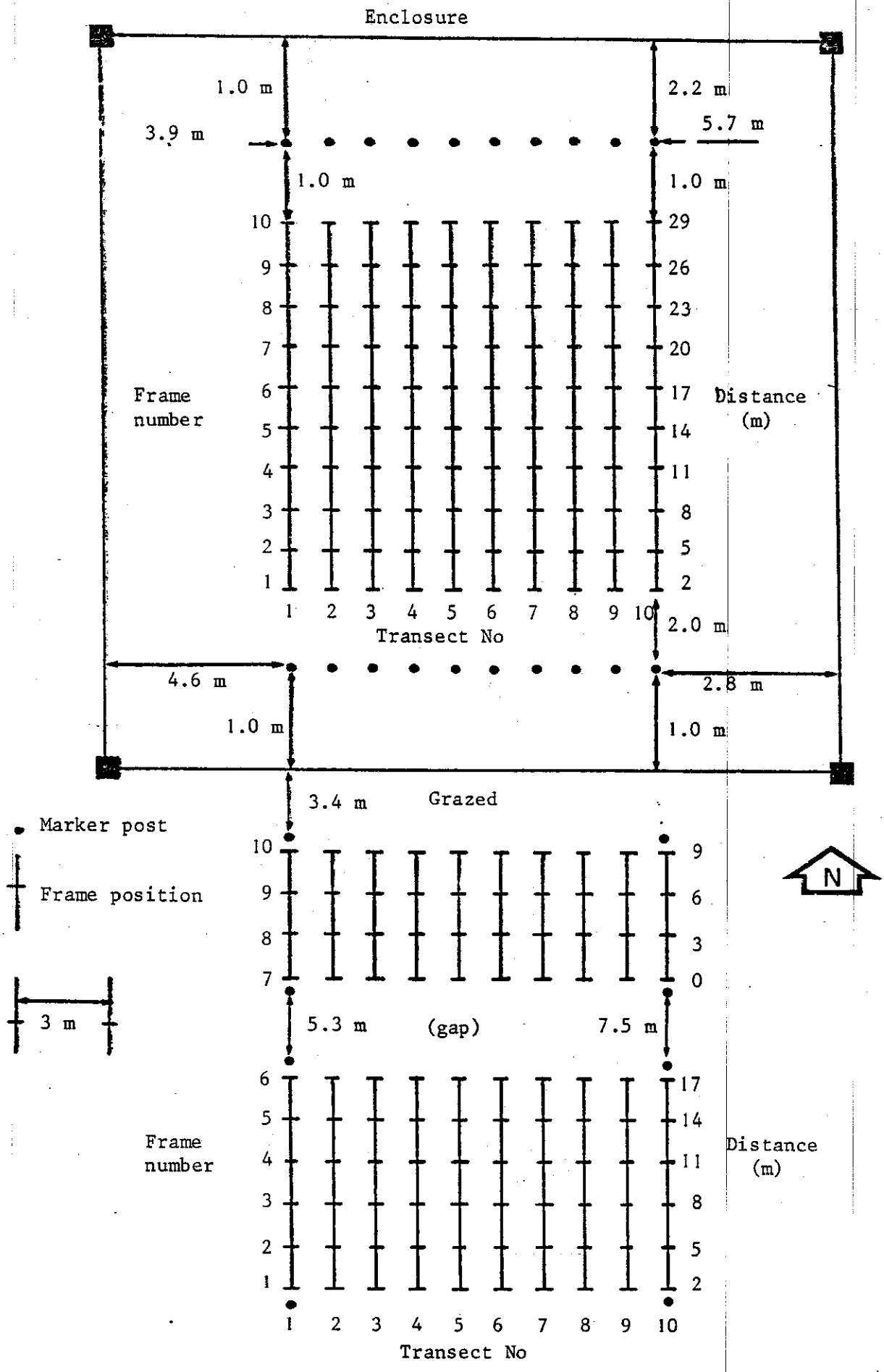

Figure 8.1 Plot layout at Knock Fell

8.2.4 1970

All 1000 points were done in both plots using the unstratified point quadrat method, and a subset of 300 points (transects 2, 4, 8) done using the stratified method. Only higher plants were recorded.

8.2.5 1978

All 1000 points were done in both plots using the stratified point quadrat method. Both higher plants and bryophytes were recorded.

8.2.6 1981

All 1000 points were done in the grazed plot, using the unstratified point quadrat method. Both higher plants and bryophytes were recorded.

8.2.7 Future sampling

All 1000 points will be done in both plots using the stratified point quadrat method. Both higher plants and bryophytes will be recorded.

8.3 Information stored in the database

8.3.1 Index to species code numbers

Higher plants = **PLINDEX.D31**
Bryophytes/lichens = **BRINDEX.D31**

8.3.2 Data

1956 - 1000 points unstratified

Enclosed higher plants = **ENCPL56.D31**
Enclosed bryophytes = **ENCBR56.D31**

1962 - 1000 points unstratified

Enclosed higher plants = **ENCPL62.D31**
Enclosed bryophytes = **ENCBR62.D31**
Grazed higher plants = **GRAPL62.D31**
Grazed bryophytes = **GRABR62.D31**

1966 - 1000 points unstratified

Enclosed higher plants = **ENCPL66.D31**
Enclosed bryophytes = **ENCBR66.D31**
Grazed higher plants = **GRAPL66.D31**
Grazed bryophytes = **GRABR66.D31**

1970 - 1000 points unstratified

Enclosed higher plants = **ENCPL70.D31**
Grazed higher plants = **GRAPL70.D31**

- 300 points stratified subset

Enclosed higher plants = **SENCPL70.D31**
Grazed higher plants = **SGRAPL70.D31**

1970 - 1000 points stratified

Enclosed higher plants = **ENCPL78.D31**
Enclosed bryophytes = **ENCBR78.D31**
Grazed higher plants = **GRAPL78.D31**
Grazed bryophytes = **GRABR78.D31**

1981 - 1000 points unstratified

Grazed higher plants = **GRAPL81.D31**
Grazed bryophytes = **GRABR81.D31**

9 ERIOPHORETUM - SILVERBAND (D34)

9.1 Experimental layout

This experiment was started in 1966 on a wet area dominated mainly by Eriophorum, with very little Calluna, and where the surface vegetation was discontinuous, with much bare peat present. Narthecium ossifragum was abundant in the wetter patches, and Empetrum nigrum on the drier hummocks. Two experimental plots were studied, an enclosed and a grazed plot (Figure 9.1). In each of these plots 5 transects, each with 10 sampling positions were studied; as there are 10 points at each position, this gives a maximum total of 500 points for each treatment. The point quadrat frame is straddled across the transect as shown in Figures 9.1 and 9.2.

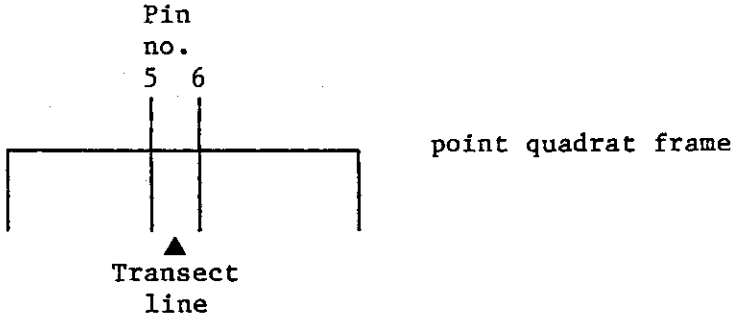

Figure 9.2 Positioning of the point quadrat frame relative to the transect line

9.2 Sampling

Sampling was done in 1966, 1970, 1974 and 1980.

9.2.1 1966

All 500 points were sampled in each plot using the unstratified point quadrat method. Higher plants and bryophytes were recorded.

9.2.2 1970

All 500 points were recorded using the stratified point quadrat method, but only higher plants were recorded.

9.2.3 1974 and 1980 et seq.

All 500 points were recorded using the stratified point quadrat system, and both higher plants and bryophytes were recorded.

9.3 Information stored in the database

9.3.1 Index to species code numbers

Higher plants = **PLINDEX.TSB**
Bryophytes/lichens = **BRINDEX.TSB**

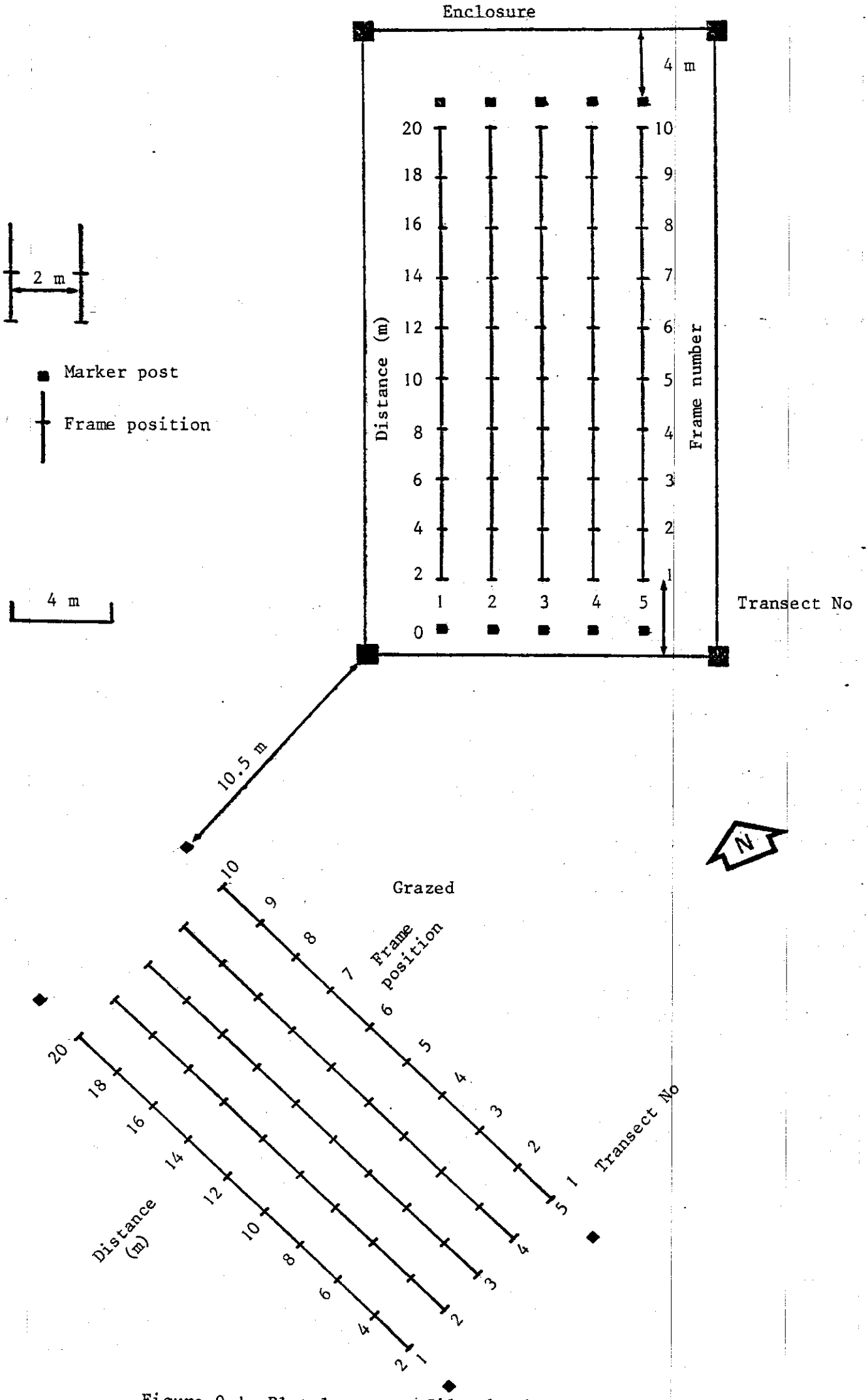

Figure 9.1 Plot layout at Silverband

9.3.2 Data (all 500 points)

1966 - unstratified

Enclosed higher plants	=	**ENCPL66.D34**
Enclosed bryophytes	=	**ENCBR66.D34**
Grazed higher plants	=	**GRAPL66.D34**
Grazed bryophytes	=	**GRABR66.D34**

1970 - stratified

Enclosed higher plants	=	**ENCPL70.D34**
Grazed higher plants	=	**GRAPL70.D34**

1974 - stratified

Enclosed higher plants	=	**ENCPL74.D34**
Enclosed bryophytes	=	**ENCBR74.D34**
Grazed higher plants	=	**GRAPL74.D34**
Grazed bryophytes	=	**GRABR74.D34**

1980 - stratified

Enclosed higher plants	=	**ENCPL80.D34**
Enclosed bryophytes	=	**ENCBR80.D34**
Grazed higher plants	=	**GRAPL80.D34**
Grazed bryophytes	=	**GRABR80.D34**

10 ERIOPHORETUM - TROUTBECKHEAD (D30)

10.1 Experimental layout

This experiment was started in 1966 in an area where the vegetation is dissected by gulley erosion. The vegetation predominantly Eriophorum, with Empetrum nigrum, and a little Calluna, Rubus chamaemorus and Vaccinium myrtillus. Two experimental plots were studied, an enclosed and a grazed plot (Figure 10.1). In each of these plots, 5 transects, each with 10 sampling positions were studied; as there are 10 points at each position, this gives a maximum total of 500 points. The point quadrat frame is straddled across the transect as shown in Figures 10.1 and 10.2.

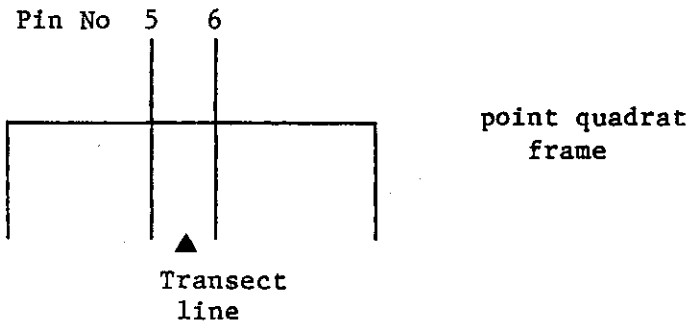

Figure 10.2 Positioning of the point quadrat frame relative to the transect line

10.2 Sampling

Sampling was done in 1966, 1970, 1974 and 1980.

10.2.1 1966

All 500 points were sampled in each plot using the unstratified point quadrat method. Higher plants and bryophytes were recorded.

10.2.2 1970

All 500 points were recorded using the stratified point quadrat method, but only higher plants were recorded.

10.2.3 1974 and 1980 et seq.

All 500 points were recorded using the stratified point quadrat system, and both higher plants and bryophytes were recorded.

10.3 Information stored in the database

10.3.1

Index to species code numbers

Higher plants = **PLINDEX.TSB**
Bryophytes/lichens = **BRINDEX.TSB**

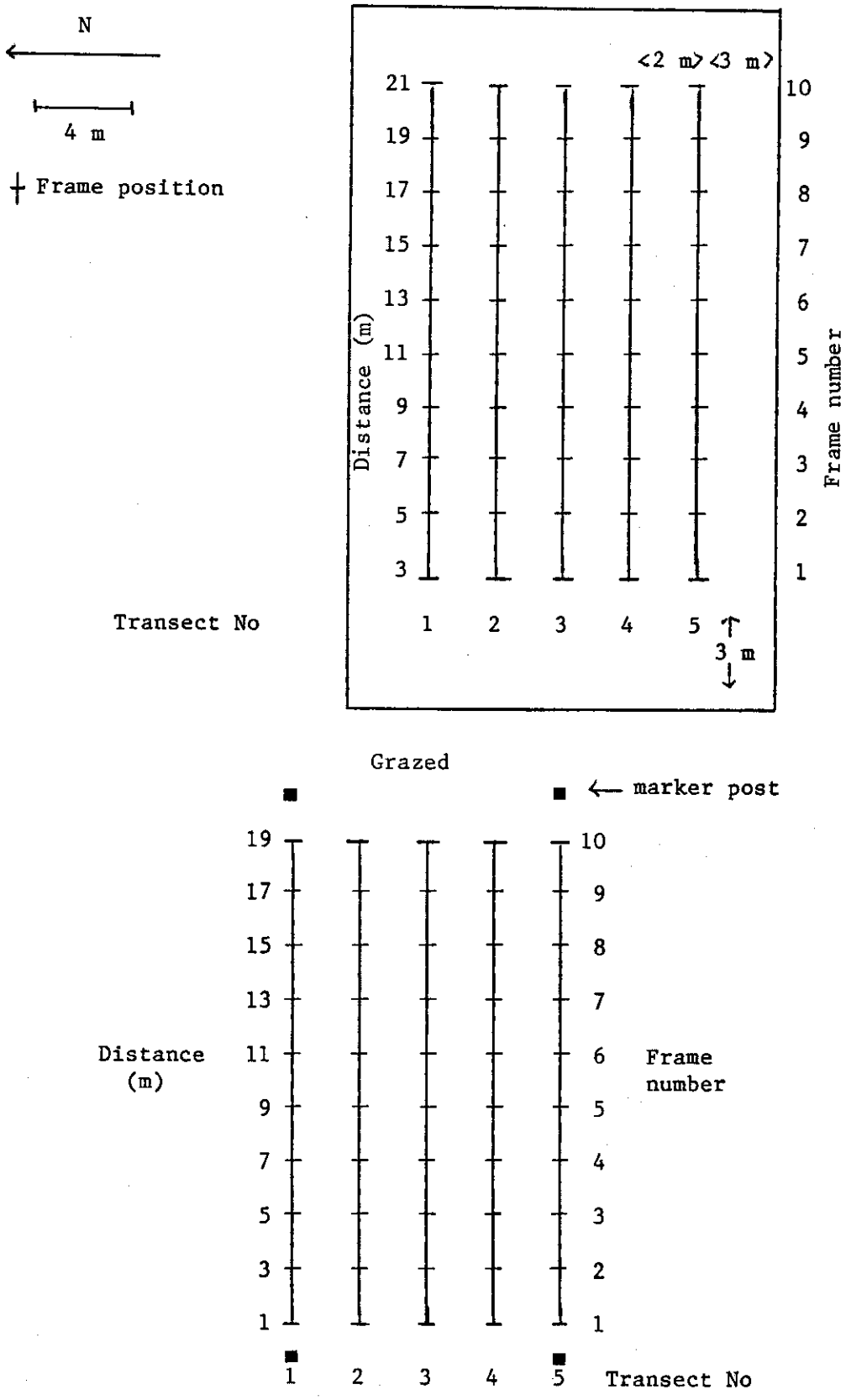

Figure 10.1 Plot layout of the Troutbeckhead site

10.3.2 Data (all 500 points)

1966 - unstratified

Enclosed higher plants	=	**ENCPL66.D30**
Enclosed bryophytes	=	**ENCBR66.D30**
Grazed higher plants	=	**GRAPL66.D30**
Grazed bryophytes	=	**GRABR66.D30**

1970 - stratified

Enclosed higher plants	=	**ENCPL70.D30**
Grazed higher plants	=	**GRAPL70.D30**

1974 - stratified

Enclosed higher plants	=	**ENCPL74.D30**
Enclosed bryophytes	=	**ENCBR74.D30**
Grazed higher plants	=	**GRAPL74.D30**
Grazed bryophytes	=	**GRABR74.D30**

1980 - stratified

Enclosed higher plants	=	**ENCPL80.D30**
Enclosed bryophytes	=	**ENCBR80.D30**
Grazed higher plants	=	**GRAPL80.D30**
Grazed bryophytes	=	**GRABR80.D30**

11 CALLUNA-ERIOPHORETUM - BOG HILL (D26)

11.1 Experimental layout

This study was started in 1953 when an enclosure was erected to provide a relatively large area of blanket bog free from sheep grazing, which could be used for research purposes. This site was not, however, included in the long-term monitoring programme until 1971, when 2 plots, one inside and one outside the enclosure were studied (Figure 11.1).

11.2 Sampling procedure

Each of the 2 sampling areas (14 m x 9 m) is divided into 7 belt transects using measuring tapes as shown in Figure 11.2. This procedure divides the area into 63 positions, each with 2 1 m^2 quadrats, denoted A and b (Figure 11.2), and each 1 m^2 quadrat having a unique code (e.g. 43B; Figure 11.2). Forty of these 1 m^2 quadrats were chosen randomly as sampling quadrats.

Within each 1 m^2 sampling quadrat, the 1 m point-quadrat frame, with 10 possible sampling positions is set at 10, 30, 50, 70 and 90 cm along the tape, as shown in Figure 11.3. At each of the 5 frame positions, 2 random points along the frame are sampled.

In 1971, 400 points were done using the unstratified method, and a randomly chosen subset of 200 done using the stratified method.

11.3 Information stored in the data base

11.3.1 Index to species code numbers

Higher plants = **PLINDEX.D26**
Bryophytes/lichens = **BRINDEX.D26**

11.3.2 Index to sampling quadrats/points

Enclosed = **ECODE.D26**
Grazed = **GCODE.D26**

11.3.3 Data

1971 - 400 points unstratified

Enclosed higher plants = **ENCPL71.D26**
Enclosed bryophytes = **ENCBR71.D26**
Grazed higher plants = **GRAPL71.D26**
Grazed bryophytes = **GRABR71.D26**

- 200 points stratified

Enclosed higher plants = **SENCPL71.D26**
Enclosed bryophytes = **SGRAPL71.D26**

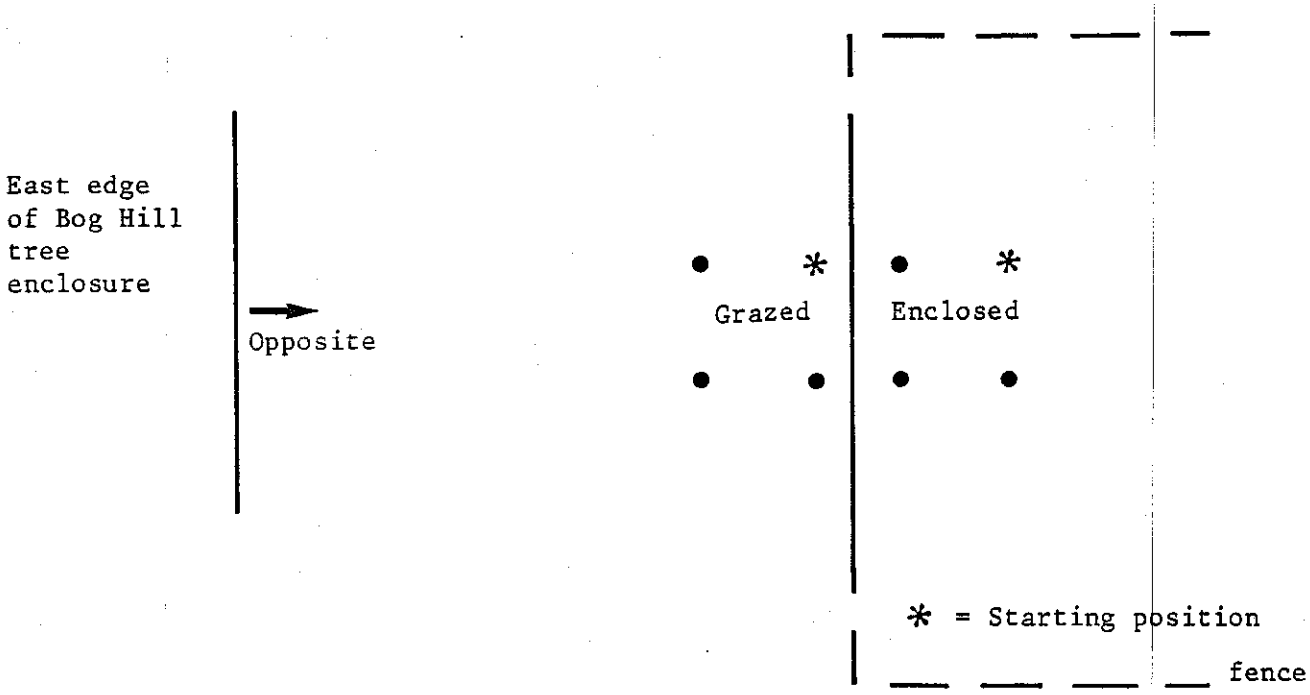

Figure 11.1 Layout of the Bog Hill study (not to scale).

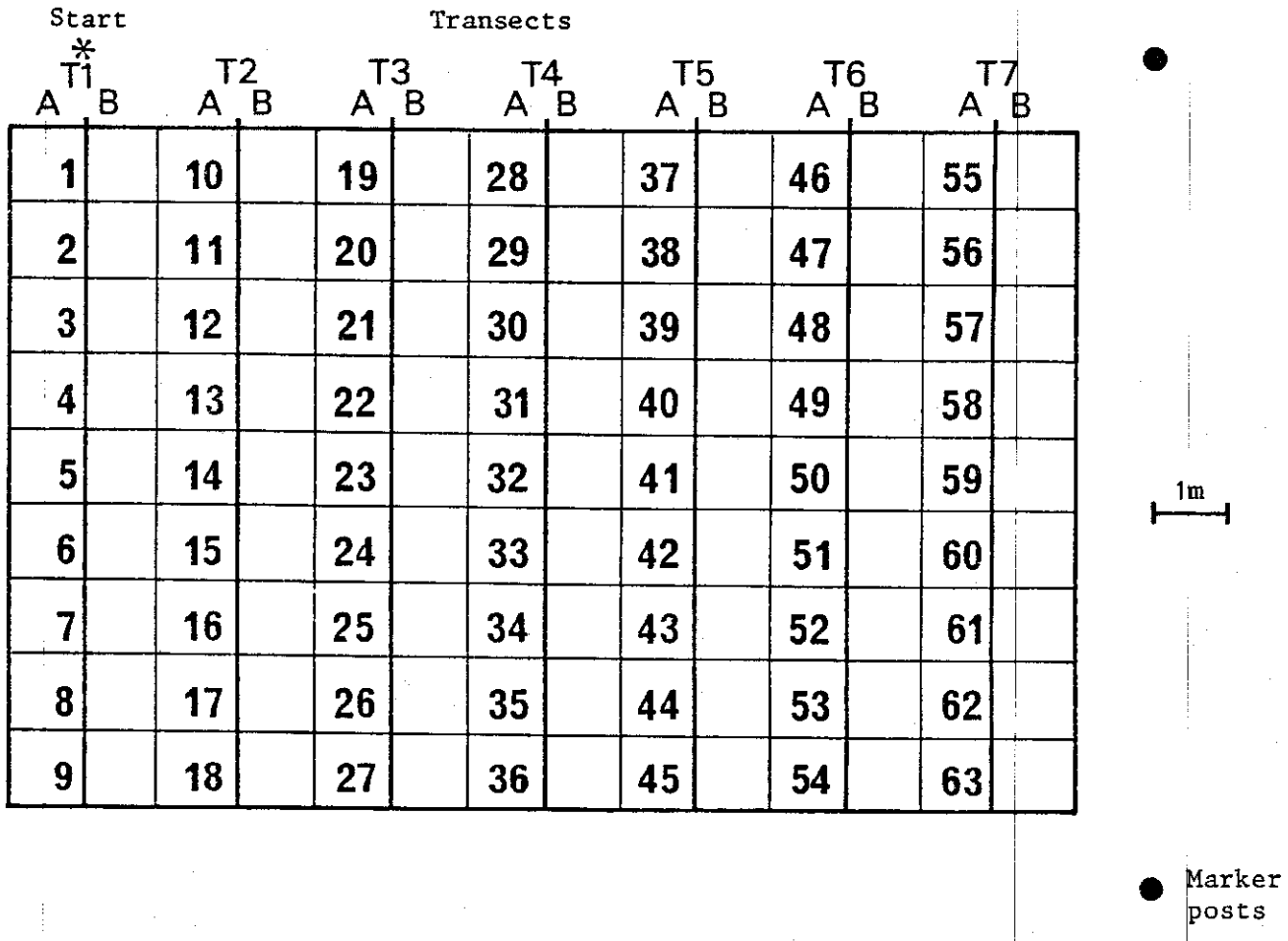

Figure 11.2 Diagram showing the layout of sampling quadrats used in both grazed and enclosed plots at Bog Hill: forty quadrats are chosen randomly.

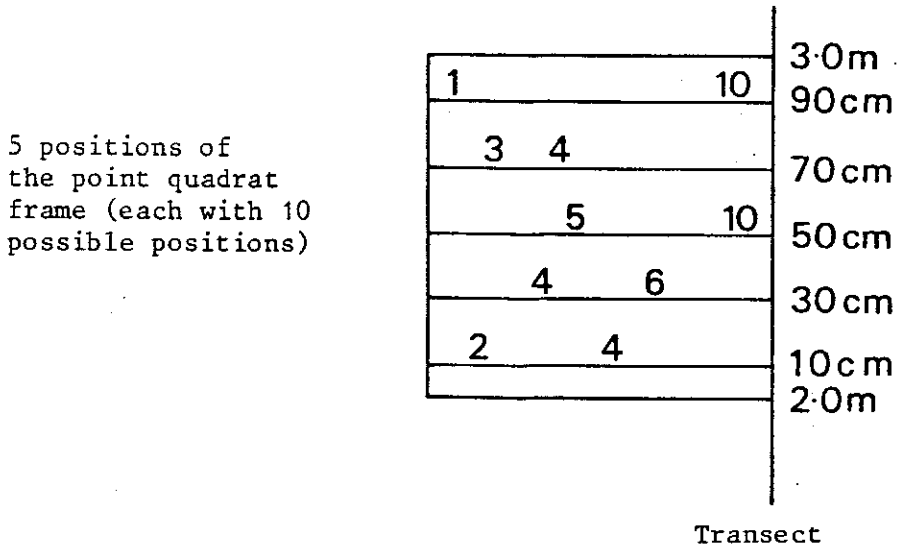

Figure 11.3 An example of the way points are sampled within the 1 m^2 quadrat.

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