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THE NETTLECOMBE GRASSLAND EXPERIMENT 1968–1990

STUDENT INVESTIGATIONS OF CONTINUITY AND CHANGE IN A GRASSLAND SWARD

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ABSTRACT

The Nettlecombe Grassland Experiment was established, in March 1968, as a vehicle for teaching vegetation sampling techniques to A-level biologists. Four treatments (A: mown fortnightly during the growing season, B: mown annually in June, C: unmown, and D: cleared in March 1968 and subsequently unmown) are arranged in a 4 × 4 Latin Square. One hundred, randomly distributed, point quadrats are taken in each plot. The vegetation is grouped into eight taxa—6 species and the rest in one of two "catch-all" categories. By the end of November 1990, 120 sets of data had been obtained by a wide range of students and the resulting patterns are briefly analysed. Initially, the differential effects of the mowing regimes dominated the results but, latterly, long-term trends, related in part to climatic changes, have influenced the patterns. Ant hills have also complicated the issue since 1982.

As a teaching resource, the data derived from the experiment justify the sampling technique and, through its various failings, the experiment itself encourages discussion on the manner in which such investigations should be planned.

INTRODUCTION

WHEN FIRST established, in 1967, the Leonard Wills Field Centre had direct access to very little land for teaching purposes—just Nettlecombe Court and its immediate garden. It was (erroneously) anticipated that traditional biology courses would be difficult to organise

FIG. 1.
The grass plots, situated in a corner of Court Field near the southwest range of Nettlecombe Court, photographed on 2nd May, 1985. The weather station is visible on the right of the photograph, and between it and the grass plots can be seen some of Dr. Tilling's snail cages. Oil drums in the foreground contained North Sea crude for other experimental purposes.

from this Centre and the Scientific Director of the Field Studies Council, Dr John Carthy, encouraged Nettlecombe staff to adopt a more experimental approach to A-level courses.

Discussion with experienced Wardens, especially with Charles Sinker at Preston Montford Field Centre, convinced me that long-term botanical experiments are easier to conduct than zoological ones in terrestrial habitats. Sampling need not involve collection of material and animals have only to be fenced out! Grassland was the most readily-available habitat and it was considered that mowing ought to be the easiest experimental management to apply. Lawnmowers are always with us but proprietary brands of agricultural chemicals could be expected to come and go.

A small triangular area of Court Field, immediately adjacent to the Court croquet lawn, was leased from the Nettlecombe Estate early in 1968 and fenced against stock (Fig. 1). A Class 3 climatological station was established at the southern end (see Ratsey, 1973) and the resulting data are published in *The Monthly Weather Report* commencing with volume 86 (Meteorological Office, 1970/71). For many years in the 1970's and early 1980's, the central area was a snail garden for experiments involving banded garden snails, *Cepaea hortensis* and *C. nemoralis*, (Tilling, 1983; 1985*a*, *b*; 1986). The northern section is devoted to the Grassland Experiment.

It cannot be overstressed that this is a teaching experiment which was not anticipated to have any research interest whatsoever. All the routine data have been collected by different groups of students, whose only common factors are (1) their presence on a course at Nettlecombe Court and (2) they had never sampled the plots before. The object of the exercise was (and remains) to provide a vehicle for the teaching of vegetation-sampling techniques that can overcome the problems of Identification, Quantification, Unforeseen

Table 1.
A combined flora for the Nettlecombe Grassland Experiment from data collected by Dr Brian Turner (London University) in August 1988 and Dr Charles Turner (Open University) in April 1990

Species	A Plots	B Plots	C Plots	D Plots
Anthoxanthum odoratum	*	*	*	*
Dactylis glomerata		*	*	*
Agrostis tenuis	*	*	*	*
Agrostis stolonifera	*	*	*	*
Festuca rubra	*	*	*	*
Holcus lanatus	*	*	*	*
Phleum pratense	*		*	*
Deschampsia flexuosa		*	*	*
Juncus effusus			*	*
Luzula campestris	*	*	*	*
Leontodon hispidus	*			
Leontodon autumnalis	*			
Lotus corniculatus	*	*	*	*
Achillea millefolium	*	*	*	*
Trifolium repens	*	*	*	*
Rumex crispus				*
Rumex acetosa	*	*	*	*
Rumex acetosella				*
Rumex obtusifolius			*	
Stellaria media			*	*
Stellaria graminea	*	*	*	*
Ranunculus acris		*		*
Ranunculus ficaria		*	*	*
Ranunculus repens	*	*	*	*
Veronica chamaedrys		*	*	*
Veronica serpyllifolia	*	*	*	
Galium saxatile	*			*
Potentilla erecta	*			
Urtica dioica			*	*
Plantago lanceolata	*	*		
Plantago media	*		*	
Heracleum sphondylium		*	*	*
Glechoma hederacea		*	*	*
Taraxacum officinale	*	*		
Senecio jacobaea	*		*	*
Prunella vulgaris	*	*	*	
Cirsium palustre	*			
Cirsium arvense	*			
Bellis perennis	*			
Conopodium majus		*	*	*
Rhytidiadelphus squarrosus	*	*	*	*
Total number of species	27	25	29	29

Accidents, and Student Boredom (= time) to produce worthwhile results. The value of the technique is assessed in relation to usefulness of the data collected.

A preliminary account was given by Crothers and Lucas (1982).

Materials, Methods and Experimental Design

Court Field was formed when the, bracken-dominated, Nettlecombe Deer Park was reclaimed for agriculture, ploughed and reseeded in 1960 (Rose and Wolseley, 1984). The

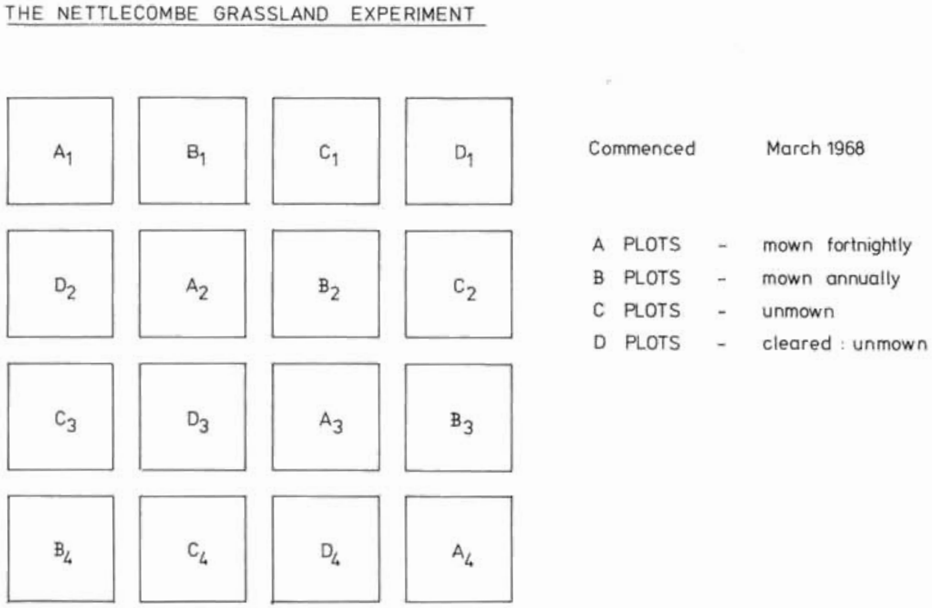

FIG. 2.

The Nettlecombe 4 × 4 latin square layout. The plots were 10 feet square, separated by paths 4 feet wide. North is towards the bottom right hand corner.

experimental area lies on almost flat land in the valley floor, at the foot of a steep south-facing slope. Despite its position, soil depth is shallow. This suggests landscaping of the site, probably in the early eighteenth century when the south-western range of the Court was "Georgianised" (Bush and Corbett, 1970).

Four experimental treatments were chosen:—

A: mown fortnightly, or whenever the adjacent croquet lawn was cut, during the growing season.

B: mown annually in June—to simulate hay cutting.

C: unmown.

D: cleared of turves in March 1968 and subsequently unmown.

The treatments were replicated four times in a Latin Square (Fig. 2) whose overall size was determined by the area available. Experimental design was modelled on the Preston Montford Plots, devised by Charles Sinker and well-established when I first saw them in 1964.

Mowing of the A Plots was initially performed using an ancient cylinder mower, and then by a series of "Flymo" air-cushion rotaries. Latterly we have used wheeled rotary mowers. The B Plots have been mowed by hand (scythe and/or shears) or with a mechanical scythe.

Photographs, now in the Centre Slide Collection, have been taken at irregular intervals from an adjacent high point (Nettlecombe Court roof), providing a visual record of the state of the plots.

A flora compiled by Charles Sinker in 1968 showed a restricted number of species, primarily the 1960 seed mixture plus some common agricultural weeds. Not surprisingly, the list had lengthened by 1990 (Table 1). Oak seedlings, mostly of turkey oak *Quercus* *cerris*, appear from time to time (there were two in 1990) but have not, as yet, persisted—but see the Appendix (p. 716). Neither bracken, *Pteridium aquilinum,* nor brambles, *Rubus fruticosus* agg., have arrived to date.

Students attending field courses at Nettlecombe Court range in age from 8 to 80 and come from a wide variety of backgrounds. They cannot be assumed to have any previous experience of British plant species. Moreover, biology courses, usually of one-week's duration (Crothers, 1987), are run throughout the "summer", from February to November, so that some are held at seasons when a flora is difficult to use.

It was always intended that courses should compare their results with those obtained by their predecessors, so it was essential to standardise the procedures. Six species of plants were selected for detailed study, with two "catch-all" categories to include all the others (Table 2). Unfortunately, no record was kept of the species in these categories.

Table 2.
The eight plant taxa used for the Nettlecombe Grassland Experiment

cocksfoot	*Dactylis glomerata*
yorkshire fog	*Holcus lanatus*
other grasses	
moss	*Rhytidiadelphus squarrosus*
buttercup	*Ranunculus repens*
clover	*Trifolium repens*
yarrow	*Achillea millefolium*
other plants	

The abundance of each taxon has been recorded as percentage cover from measurements taken at 100 randomly-distributed point quadrats in each plot (see Chalmers and Parker, 1989, for a description of the method). Point quadrats were preferred to frame quadrats because their use (a) does not itself alter plant cover and (b) greatly reduces the subjective element in sampling—important when the data are collected by different people on each occasion. Random sampling was preferred over systematic to avoid the regular trampling pattern that would inevitably result from repeated sampling of the same parts of each plot. Trampling was further reduced by taking 4 point quadrats around each of 25 randomly-selected points, instead of one at each of 100.

All in all, the experimental design minimises the problems of:
Identification—by requiring students to distinguish only eight taxa;
Quantification—by using point quadrats to minimise subjective estimates;
Unforeseen Accidents—by replication;
Boredom—by keeping the fieldwork short (less than 2 hours).

Organisation

Where possible the class was split into 8 groups, each of which sampled two plots and, subsequently, interpreted the data for one taxon. When the class size was smaller than 16, some plots were omitted from the survey on that day.

RESULTS

Data Collection

The simplest way of scoring point quadrat data is to record the first plant species hit by each pin. Data collection for the Nettlecombe experiment began in this way (Table 3), but it was immediately apparent that low-growing plants, such as moss, were progressively

Table 3.

The initial set of data (scoring first hit on each taxon). The 'D' Plots are bare ground at this time. Note the apparent disappearance of moss.

	A Plots					B Plots					C Plots				
	1	2	3	4	Av.	1	2	3	4	Av.	1	2	3	4	Av.
1. April 1968—before any mowing had taken place															
grass	88	90	74	44	74	78	92	77	56	76	87	92	80	73	83
moss	1	1	9	6	4	0	0	7	22	7	0	0	0	7	2
buttercup	3	5	8	11	7	10	5	6	2	6	2	3	11	4	5
clover	0	0	6	19	6	4	0	8	13	6	0	0	0	10	3
yarrow	0	1	1	2	1	0	0	1	0	0	0	1	3	0	1
other plants	0	1	0	0	0	0	1	1	0	1	0	1	1	3	1
2. 6th May 1968—after first mowing of the A Plots (29 April)															
grass	92	95	74	71	83	76	75	65	66	71	76	55	68	51	63
moss	0	0	3	1	1	0	0	5	2	2	1	9	0	5	4
buttercup	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
clover	0	0	6	38	11	3	5	24	21	13	0	5	0	16	5
other plants	3	2	12	13	8	4	8	5	11	7	0	1	5	4	3
3. 20th May 1968—after a second mowing of the A Plots (6 May)															
grass	98	98	85	51	83	96	97	91	96	95	93	90	88	84	89
moss	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
buttercup	2	1	3	7	3	2	3	4	2	3	7	4	4	3	5
clover	0	0	10	31	10	2	0	4	2	2	0	5	0	13	5
other plants	0	1	2	0	1	0	0	0	0	0	0	1	2	0	1

Table 4.

The second attempt (scoring all hits) adopted in late May 1968

	A Plots					B Plots					C Plots					D Plots				
	1	2	3	4	Av.	1	2	3	4	Av.	1	2	3	4	Av.	1	2	3	4	Av.
4. 25th May 1968—after the third mowing																				
cocksfoot	6	14	16	18	14	38	27	7	16	22	55	30	26	1	28					
yorkshire fog	7	5	3	1	4	16	3	0	11	8	17	11	11	6	11					
other grasses	95	86	90	84	89	72	88	79	69	77	86	59	97	96	85					
moss	3	7	18	19	12	5	0	37	24	17	0	19	2	37	15					
buttercup	6	10	18	19	13	6	6	19	25	14	4	18	8	7	9					
clover	1	0	15	55	18	7	2	16	24	12	0	8	0	35	11					
yarrow	0	4	1	1	2	0	0	5	8	3	0	4	3	1	2					
other plants	0	1	0	3	1	1	0	0	0	0	0	0	0	1	0					
5. 22nd June 1968—A plots now mown five times, B plots once																				
cocksfoot	0	18	37	13	17	25	49	35	32	35	11	17	18	5	13	0	0	0	0	0
yorkshire fog	5	10	32	7	14	7	41	23	45	29	27	23	41	58	37	3	6	0	12	5
other grasses	50	28	26	72	44	45	48	25	231	87	67	20	141	588	204	18	45	95	46	51
moss	7	16	0	15	10	0	0	4	41	11	0	0	28	53	20	6	0	49	0	14
buttercup	17	0	10	21	12	26	23	9	10	17	0	4	31	14	12	1	13	21	47	21
clover	11	0	16	47	19	12	10	13	18	13	1	5	5	55	17	5	4	1	5	6
yarrow	0	0	0	3	1	12	12	2	2	7	0	0	0	0	0	0	4	0	15	5
other plants	0	6	0	9	4	0	2	0	0	1	1	0	0	0	0	3	11	2	18	9
6. 6th July 1968—A plots now mown six times, B plots once																				
cocksfoot	49	99	0	0	37	69	99	34	37	60	63	169	92	4	82	27	26	4	0	14
yorkshire fog	23	3	0	0	7	27	25	40	0	23	28	88	24	24	41	30	2	14	1	12
other grasses	77	184	259	362	221	239	377	476	240	333	465	1115	885	1064	882	222	420	214	220	269
moss	0	2	24	36	16	0	2	18	15	9	4	4	1	35	11	43	47	52	59	50
buttercup	11	7	20	15	13	7	5	18	2	8	2	17	17	32	17	4	6	18	42	18
clover	9	0	17	91	29	10	1	42	38	23	0	4	0	51	14	48	10	1	9	6
yarrow	0	4	2	1	2	0	0	13	5	5	0	0	0	0	0	2	2	2	0	2
other plants	1	0	1	4	2	4	2	8	3	4	3	2	3	5	3	1	2	15	6	6

Table 5.
The revised system (scoring first hit on each taxon) adopted from July 1968 onwards, commencing at data set 7. This particular example was chosen for comparison with Table 6

	A Plots					B Plots					C Plots					D Plots				
	1	2	3	4	Av.	1	2	3	4	Av.	1	2	3	4	Av.	1	2	3	4	Av.
9. 27th August 1968																				
cocksfoot	26	33	33	25	29	37	37	27	20	30	55	68	60	2	46	2	9	0	1	3
yorkshire fog	12	2	0	25	10	19	0	8	15	11	0	22	12	0	9	24	4	0	2	8
other grasses	24	75	99	86	71	88	97	79	75	85	87	99	85	99	93	99	41	97	97	84
moss	13	15	46	99	43	12	2	64	40	30	6	7	5	15	8	71	35	50	27	46
buttercup	13	23	28	60	31	15	22	63	13	28	6	26	16	27	19	4	12	27	67	28
clover	10	1	21	59	23	4	1	42	38	21	0	1	0	15	4	31	20	6	15	18
yarrow	1	5	8	23	9	0	0	14	0	4	0	2	0	0	1	1	6	0	3	3
other plants	0	0	6	19	6	0	4	10	15	7	1	3	6	0	3	32	10	0	3	11

Table 6.
A recent set of data for comparison with Table 5

	A Plots					B Plots					C Plots					D Plots				
	1	2	3	4	Av.	1	2	3	4	Av.	1	2	3	4	Av.	1	2	3	4	Av.
115. 24th September 1990																				
cocksfoot	0	0	0	0	0	5	0	0	0	1	2	3	5	3	3	14	4	0	0	5
yorkshire fog	7	0	0	22	7	20	6	12	4	11	19	39	8	40	27	53	23	2	70	37
other grasses	87	94	99	44	81	73	91	92	56	78	96	62	84	65	77	89	87	85	88	87
moss	46	42	74	65	57	19	8	57	64	37	1	3	0	0	1	0	8	20	0	7
buttercup	0	0	2	7	2	0	5	10	8	6	0	1	1	22	6	0	0	1	31	8
clover	14	17	49	47	32	1	3	5	0	2	3	0	5	2	3	0	0	1	2	1
yarrow	13	10	6	17	12	27	19	31	42	30	29	33	16	6	21	39	12	36	31	30
other plants	9	2	8	37	14	12	25	1	36	19	59	14	9	20	26	23	43	46	43	39

underscored. The procedure was, accordingly, changed to score all hits by each pin (Table 4). As expected, moss reappeared in the table but, very soon, the sheer volume of data became unmanageable—and excessively tedious to collect (7 hours). Most students would not tolerate that (and few contracts could afford to) so a compromise revised system, scoring "first hit on each taxon" was adopted (Table 5). There is nothing very surprising in this, but comparable tables showing what happens when such data are collected in different ways are rarely seen in the literature.

Data Analysis

It is impractical to list all 120 sets of data collected so far (anyone who would like a copy should write to the author) but a recent autumnal set is included as Table 6 to show the sort of changes that have occurred.

Seasonal averages for spring (February–April), summer (May–July), and autumn (August–October) have been computed for all years in which sufficient data were recorded. They are presented in three different ways:—(1) in tabular form, (2) as pie charts to show the overall effects of the experimental treatments, i.e. pie charts of the "overall" column in the tables, (3) averaged, to highlight changes with time.

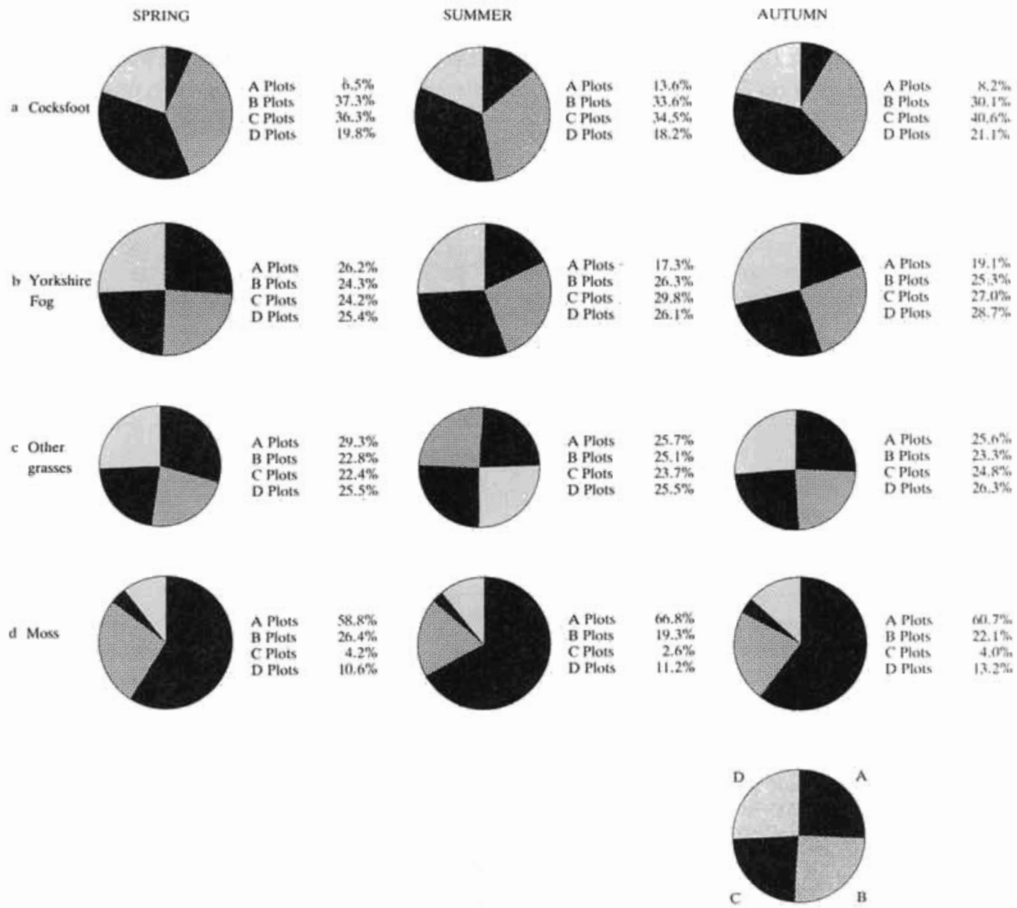

FIG. 3.

Pie Charts depicting the long-term average performance of the chosen plants under the four treatments. Data, from Table 7, are grouped by season: spring (February–April), summer (May–July), and autumn (August–October). 3a—cocksfoot, *Dactylis glomerata*; 3b—yorkshire fog, *Holcus lanatus*; 3c—other grasses; 3d—moss, *Rhytidiadelphus squarrosus*; 3e - buttercup, *Ranunculus repens*; 3f—clover, *Trifolium repens*; 3g—yarrow, *Achillea millefolium*, and 3h—other plants, under the four treatments.

(1) Tables 8–15 (p. 700–707)

The seasonal averages are given in two forms:—real arithmetical and smoothed. Smoothing was achieved by using three-year averages. Thus, the entry for 1989 is the mean of the 1988, 1989 and 1990 records, and so on. This procedure evens-out some of the irregularities inherent in the raw data. These smoothed data are considered in (3), below.

(2) Pie Charts (Fig. 3)

Spring, summer and autumn data show that seasonal differences are of small importance for most taxa. Cocksfoot (Fig. 3a) has been most successful in the B and C plots. It has been virtually eliminated from the A plots and made little initial headway in the D plots; such colonisation that has occurred was mostly vegetative, and marginal. Yorkshire fog (Fig. 3b) is more evenly distributed, particularly in spring. Increased growth in the long grass plots, later in the year, is reflected in the higher values recorded in C and D plots. Other grasses

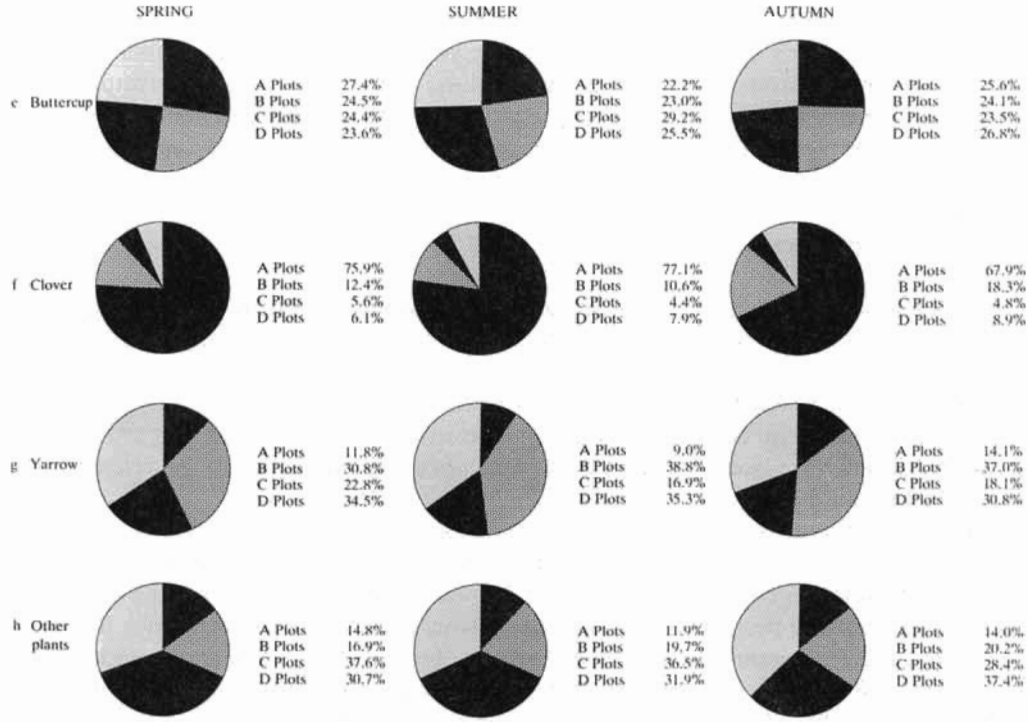

FIG. 3 (concluded).

(Fig. 3c) are evenly distributed. But it should not be assumed that the various species involved (Table 1) are evenly distributed.

Moss (Fig. 3d) and clover (Fig. 3f) do best in the A plots and least well in C. Buttercup (Fig. 3e) is remarkably evenly distributed overall, whilst yarrow (Fig. 3g) has prospered in B and D plots. Other plants (Fig. 3h) are most successful in C and D plots, with the balance changing through the year.

(3) Bar Charts of seasonal averages (Figs 4–11, p. 708–715)

Cocksfoot (Fig. 4) gives the general impresion of progressive decline, apparently matched by an increase in Yorkshire Fog (Fig. 5). Little pattern is discernible in the other grasses, (Fig. 6) probably because no record has been kept of the species' individual performances.

Moss (Fig. 7), buttercup (Fig. 8), clover (Fig. 9) and other plants (Fig. 11) data all follow a roughly synchronous, approximately seven year sequence of peaks and troughs but, while moss and other plants follow generally-upward trends; and buttercup a generally-downward one; in the case of clover the central peak was poorly-developed. Yarrow (Fig. 10) shows peaks and troughs but not synchronously with the others.

DISCUSSION

1. Botany

Indications so far

Cocksfoot, *Dactylis glomerata,* was the dominant plant until 1973, but has since declined. Tussocks of this grass are damaged by lawn mowing and have been eliminated from A plots. Annual mowing (B plots) had less effect, probably because a year's growth produced tussocks of sufficient size that the grass-cutter bounced over them without causing too much damage. In both B and C plots, cover initially rose—presumably in response to the cessation of cattle/sheep grazing—but, since the early seventies, it has steadily fallen away. Few tussocks are to be seen elsewhere in Court Field either. Colonisation of the D plots was slow, and the data probably reflect vegetative spread in from the margins more than colonisation by seed. Two, linked, theories have been advanced to "explain" these patterns:—

[a] The strain of this grass, included in the seed mixture used for the reclamation of Nettlecombe Deer Park in 1960, is alien to this valley. It spreads, at best, poorly by seed (few plants have appeared in the garden) and many of the tussocks present in 1990 have probably been there for thirty years and are steadily dying off.

[b] *D. glomerata* requires a higher nutrient level in the soil than is currently available for it. No fertilisers have been applied to the plots since 1967 and none to the remainder of Court Field since 1970.

Farmers are recommended to plough and reseed grass leys containing cocksfoot every 10 years, and fertilise regularly (W. W. Ker, personal communication). It will be noted that the main decrease in cover did occur about 10 years after re-seeding. All the results are compatible with the performance of an alien plant, declining in performance following cessation of the necessary management regimes. However, there is some evidence for resurgence. Not all the tussocks, present in 1990, were old. Perhaps we are witnessing natural selection for a form more in tune with local conditions.

The overall increase of yorkshire fog since the decline of cocksfoot, beginning in 1973, may reflect a simple expansion to fill the space available. It has not, so far, come to dominate the B plots—as it did at Preston Montford (C. A. Sinker, personal communication). There is just a hint, in the overall plots, of the peak and trough regime that characterises so many of these patterns.

Moss and clover are most successful in the short grass plots. Regular mowing removes competitors that would otherwise block out the sunlight. The differences between B and C plot averages highlight the effect of an annual cut that lets in light during June. The differences between C and D plots, which have been treated in exactly the same way since April 1968, must reflect the influence of an established sward versus disturbed ground. The other plants, by contrast, are most successful in C and D plots, showing that most are woody perennials damaged by mowing. The balance between C and D changes through the year, suggesting that the species composition still differs between them, even after 22 years. The even distribution of buttercup probably reflects the ability of this plant to adopt a growth form appropriate to its habitat, growing tall in long grass but keeping low in close mown turf. The unusual distribution of yarrow, favouring B and D plots, suggests that this weed of cultivation is suppressed by regular mowing, and was unable to colonise into the established sward. It does best in areas of intermediate disturbance.

Clearly, most of the plant taxa studied in this experiment are influenced by a pattern of (presumably) environmental factors that fluctuate in an approximately seven year cycle. The plants do not necessarily respond to the pattern in the same way, but as they all respond at much the same time, it is likely that the cause lies in some combination of climatic variables, yet to be identified. Nettlecombe Court weather station lies within 20m of the site and has been operated continuously since 1968 (although not with every instrument functioning all the time). Despite many hours spent on analysis of the weather data, no consistent correlations have been obtained to date. Most interpretations, nonetheless, link the trough shown by most species in the mid-seventies to the hot and dry period of 1975 and 1976, even though there does not appear to be a similar drop evident for the equally hot summers of 1989 and 1990. Yarrow is interesting in this context. It continued to rise during the mid seventies, when everything else went down—a phenomenon explained, at the time, by its more efficient root system. Latterly, its pattern is similar to everything else.

Projections for the Future

With the increasing requirement for environmental impact assessments prior to industrial development, more and more ecologists are being asked to make predictions. Analysis of historical events is much more useful if it can be used to predict the future. Having established what has happened to the plots during the last 20 or so years, students are asked to predict what will happen in the next 20—assuming that the experimental treatments continue. It is generally agreed that the A plots will remain much as they are now, perhaps getting more like the croquet lawn (but, because they will never receive the same level of trampling, not achieving such a high proportion of rosette plants). The B plots should remain grassland whilst, according to classical succession theory, some argue that C and D plots should progress via scrub to high forest. There is little sign of that happening, despite the fact that a very respectable sycamore wood has formed in another part of Court Field since 1972. Perhaps the plots are too small, or too isolated, or lack suitable perches (for seed-carrying birds) for sufficient seeds to arrive: or perhaps the soil is too shallow, or too dry, or too poor in nutrients for them to germinate.

Anthills

Large anthills, such as have graced the C and D plots for nearly ten years, present their own problems in terms of sampling technique; plot trampling; and interpretation. Their physical height demands a longer central pin for the point frame (some students are apprehensive as to the inmates' response to a steel rod being forced down into their citadel). Their physical presence determines where people have to stand within the plots and the changes in edaphic factors they produce must affect the flora. On top of this, the behaviour of rabbits, *Oryctolagus cuniculus*, is influenced by the presence of anthills: not only do young ones play "I'm the king of the castle" but their elders appreciate a loo with a view. Nutrient enrichment to the summit, a freely-drained steep side and beaten earth around the base cannot be ignored.

With the experiment as originally devised, it is impossible to separate the effects of "protection from mowing/grazing" from "presence of anthills".

2. A Teaching Resource

It is such a simple experiment, incorporating several notable design faults, that it forms a useful basis for a general discussion on field experiments. Students are asked to critiscise it and suggest modifications designed to enhance the whole procedure.

Latin Square

The treatments were replicated in a 4 × 4 Latin Square (Fig. 2) which meets the requirement that the plots each occur but once in each column and each row. Alas, the positions were not randomised within that framework and there remains a diagonal alignment of treatments. Fortunately, this is at right angles to the slope, such as it is, which minimises the problem.

Replication is always advisable, if only to reduce the possibility that patterns observed in the vegetation are simply the result of endemic edaphic factors (soil depth, moisture level, or nutrient content etc.). But even in a site as uniform as this one, replication is necessary to isolate the effects of unforeseen accidents (moles dug up B4 in 1969), and the erratic nature of colonisation. Several of the "other plants" became locally common in individual plots.

Plot Size

Sixteen square plots, of side 10 feet (Britain was an imperial nation in 1967), utilise the available space to best advantage. There was never any suggestion that this was the ideal size, merely that it was convenient for this site. Opinions have varied as to whether the plots are too large or too small. Those who say "too large" are concerned about the effects of trampling and favour longer, narrower, plots that could be sampled from the paths. Unfortunately, this solution increases edge effects, which might be important in the long-grass plots. Those who say "too small" generally favour much larger plots, 10 m square or larger, in which the trampling effect would be diffused. Almost certainly, the results are dependant on plot size. Succession is very slow in this experiment, as compared to the 12.5 acre plot at the other end of Court Field.

Sampling

Students are generally sceptical about the usefulness of point data. Few really believe that the figures obtained represent percentage cover and all are aware of the subjective nature of the technique in practice. Nevertheless, even with totally inexperienced people, repeatable results are obtained in the short term, and discrete long term trends emerge. Whatever their initial doubts, participants do generally agree that point data have produced useful information which would have been difficult to obtain by other means.

The inclusion of "catch-all" categories in the species list has been of doubtful value. In their favour it may be said that all hits are scored somewhere on the sheet, no information is wasted and there is no worry that people are "doing something wrong" when they fail to encounter one of the listed species. However, the resulting data are very hard to evaluate—especially those for "other grasses". But to ignore the most abundant category of plant present is unacceptable. The most useful of the recent suggestions is that we should highlight the two or three most abundant species, now hidden in "other grasses", and score them separately.

Unexpected Results

This experiment was established to study the effects of mowing. It has developed into an investigation of long-term fluctuations within a grassland sward. The method of data collection was not so constrained by experimental design that these, more interesting, developments were hidden. It is important for the designers of field experiments to realise that the relative importance of the various environmental factors is not immutable. In this case, grass-cutting is not the only constraint to succession.

Student Data

There are errors of identification in these data, greatest amongst the grasses. Occasionally, they are easy to recognise. For example, buttercup in April/May 1968 (Table 7). The

Table 7.
The initial set of data (scoring first hit on each taxon) for buttercup and other plants. An extract from Table 3

	A Plots					B Plots					C Plots				
	1	2	3	4	Av.	1	2	3	4	Av.	1	2	3	4	Av.
1. April 1968—before any mowing had taken place															
buttercup	3	5	8	11	7	10	5	6	2	6	2	3	11	4	5
other plants	0	1	0	0	0	0	1	1	0	1	0	1	1	3	1
2. 6th May 1968—after first mowing of the A Plots (29 April)															
buttercup	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
other plants	3	2	12	13	8	4	8	5	11	7	0	1	5	4	3
3. 20th May 1968—after a second mowing of the A Plots (6 May)															
buttercup	2	1	3	7	3	2	3	4	2	3	7	4	4	3	5
other plants	0	1	2	0	1	0	0	0	0	0	0	1	2	0	1

second group of students clearly failed to recognise leaves of *Ranunculus repens* as "buttercup" and so recorded them as "other plants".

As mentioned earlier, it cannot be overstressed that this is a teaching experiment. All the routine information has been collected by inexperienced students. Not surprisingly, these are noisy data, carrying a higher level of error than would be expected from research undertaken by a single investigator, or a professional team. Too many people discard student data out of hand, because it is impossible to assess the level of error contained therein. I would agree that too much reliance should not be placed on a single data set, but nobody has yet suggested to me that the overall trends displayed in this paper reflect human error.

Acknowledgements

This paper is based on the work of at least 2,500, but probably nearer 4,000 students who attended biology field courses at Nettlecombe Court between 1968 and 1990. Without their painstaking data collection, often under inclement conditions, none of this would have been possible. Thank you, also, to the many members of visiting staff who have supervised their charges on the plots. Special thanks here to John Barker, who has done this more than 20 times.

The initial suggestion came from the late Dr John Carthy, but my special thanks go to Charles Sinker for inspiring in me (an enthusiast for marine invertebrates) an interest in grass plots. Malcolm Litterick, my first Assistant Warden, had worked with Charles at Preston Montford. Together, we developed the Nettlecombe Grassland Experiment.

Table 8.
Seasonal means of cocksfoot percentage cover

			Year																							
			1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Overall
SPRING	OBSERVED	A Plots			8	30	2	7	3	5	7		8		1					8	1		1	2	4	6
		B Plots			48	50	51	49	59	38	35		29		27					35	10		20	25	11	35
		C Plots			69	39	55	51	49	42	42		21		23					25	4		18	26	11	34
		D Plots			16	30	19	30	34	22	17		17		18					13	4		9	13	19	18
		Overall			**35**	**37**	**32**	**34**	**36**	**27**	**25**		**19**		**17**					**20**	**5**		**12**	**16**	**11**	**23**
	SMOOTHED	A Plots			19	13	13	4	5	5	6	8	8	5	1					4	4	1	2	2	3	6
		B Plots			49	50	50	53	49	44	37	32	29	28	27					22	22	15	22	18	18	33
		C Plots			54	54	48	52	47	44	42	32	21	22	23					14	14	11	22	18	18	32
		D Plots			23	21	26	27	29	24	19	17	17	17	18					8	8	6	11	14	16	18
		Overall			**36**	**35**	**34**	**34**	**32**	**29**	**26**	**22**	**19**	**18**	**17**					**12**	**12**	**8**	**14**	**13**	**14**	**22**
SUMMER	OBSERVED	A Plots		9	5	1	9	11	15	16	24	22	19	29	19	13	7	9	0	5	1	1	0	3	2	10
		B Plots		63	27	74	47	30	29	27	38	28	18	40	2	14	11	16	13	22	7	4	6	12	10	24
		C Plots		44	78	74	46	56	32	25	27	12	16	26	5	14	14	8	8	16	6	10	6	13	11	25
		D Plots		6	18	24	15	20	22	14	25	13	13	21	7	16	7	9	9	14	8	5	8	9	7	13
		Overall		**31**	**32**	**43**	**29**	**29**	**25**	**20**	**29**	**19**	**17**	**29**	**8**	**14**	**10**	**11**	**8**	**14**	**5**	**5**	**5**	**9**	**7**	**18**
	SMOOTHED	A Plots		7	5	5	7	12	14	18	20	21	23	22	20	13	9	5	5	2	2	1	1	2	2	10
		B Plots		45	54	49	50	35	29	31	31	28	29	20	19	9	14	13	17	14	11	6	7	9	11	24
		C Plots		61	65	66	58	45	38	28	22	19	18	16	15	11	12	10	11	10	11	8	10	10	12	25
		D Plots		12	16	19	20	19	19	20	17	17	16	13	14	10	11	8	11	10	9	7	7	8	8	13
		Overall		**31**	**35**	**35**	**34**	**28**	**25**	**25**	**23**	**21**	**21**	**18**	**17**	**11**	**11**	**9**	**11**	**9**	**8**	**5**	**6**	**7**	**8**	**18**
AUTUMN	OBSERVED	A Plots	37	28	6	4		10		12				11			0			2	0	2	2	4	0	8
		B Plots	36	67	71	67		7		45				31			11			22	5	28	18	15	11	31
		C Plots	60	74	83	75		43		68				40			34			21	11	34	12	14	15	42
		D Plots	25	26	23	24		29		39				28			33			12	12	17	13	16	9	22
		Overall	**39**	**49**	**46**	**43**		**22**		**41**				**28**			**19**			**14**	**7**	**20**	**11**	**12**	**9**	**26**
	SMOOTHED	A Plots	32	24	13	5	7	10	11	12				11			0			1	1	1	3	2	2	8
		B Plots	51	58	68	69	37	7	26	45				31			11			14	18	17	20	15	13	31
		C Plots	67	72	77	79	59	43	55	68				40			34			16	22	19	20	14	15	44
		D Plots	26	25	24	23	26	29	34	39				28			33			12	13	14	15	13	13	23
		Overall	**44**	**45**	**46**	**44**	**32**	**22**	**31**	**41**				**28**			**19**			**11**	**14**	**13**	**15**	**11**	**11**	**27**

Table 9.
Seasonal means of Yorkshire fog percentage cover

			Year																							
			1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Overall
SPRING	OBSERVED	A Plots			18	6	1		28	48	15		36		25					32	36		20	40	20	25
		B Plots			4	12	11		16	31	16		21		28					17	40		33	24	37	23
		C Plots			16	10	13		11	32	13		38		25					16	31		26	28	40	23
		D Plots			17	13	17		40	26	15		29		39					16	20		24	24	37	24
		Overall			**14**	**10**	**10**		**24**	**34**	**15**		**31**		**32**					**20**	**32**		**26**	**29**	**33**	**24**
	SMOOTHED	A Plots			12	8	4	15	38	30	31	25	36	30	25					34	34	28	30	26	30	26
		B Plots			8	9	12	13	23	21	23	19	21	29	38					28	28	37	29	32	31	24
		C Plots			13	13	12	12	22	19	23	26	38	31	25					24	24	28	27	31	34	24
		D Plots			15	15	15	28	33	27	20	22	29	34	39					18	18	22	24	28	30	25
		Overall			**12**	**11**	**10**	**17**	**29**	**24**	**24**	**23**	**31**	**31**	**32**					**26**	**26**	**29**	**27**	**29**	**31**	**24**
SUMMER	OBSERVED	A Plots		12	12	26	21	11	18	35	20	26	33	29	16	33	21	33	16	27	24	16	11	20	21	22
		B Plots		15	1	19	19	26	29	62	18	26	15	17	45	39	67	49	60	22	36	35	37	37	34	32
		C Plots		32	29	22	31	38	37	59	22	42	53	12	61	39	40	51	49	18	28	27	32	40	42	36
		D Plots		11	24	32	34	24	34	49	28	34	34	22	43	39	38	56	41	16	26	18	27	39	34	32
		Overall		**18**	**16**	**24**	**26**	**25**	**29**	**51**	**22**	**32**	**34**	**20**	**41**	**38**	**41**	**47**	**41**	**20**	**28**	**24**	**27**	**34**	**33**	**31**
	SMOOTHED	A Plots		12	17	20	19	17	21	24	27	26	29	26	26	23	29	23	25	22	22	17	16	17	20	22
		B Plots		8	11	13	21	25	39	36	35	20	20	26	34	50	52	59	43	39	31	36	36	36	36	32
		C Plots		30	27	27	30	35	45	39	41	39	36	42	37	47	43	46	39	32	24	29	33	38	41	36
		D Plots		18	22	30	30	30	36	37	37	32	30	33	34	40	44	45	38	28	20	24	28	34	37	32
		Overall		**17**	**19**	**22**	**25**	**27**	**35**	**34**	**35**	**29**	**29**	**32**	**33**	**40**	**42**	**43**	**36**	**30**	**24**	**26**	**28**	**31**	**33**	**31**
AUTUMN	OBSERVED	A Plots	6	13	10	4		12		26				11			30			26	27	22	21	27	17	18
		B Plots	8	16	15	5		10		27				24			56			28	34	15	42	36	16	24
		C Plots	10	11	14	9		23		29				20			60			20	26	21	38	45	27	25
		D Plots	7	20	26	14		31		41				39			45			22	10	29	31	34	26	27
		Overall	**8**	**15**	**16**	**8**		**19**		**31**				**24**			**48**			**24**	**24**	**22**	**33**	**35**	**21**	**23**
	SMOOTHED	A Plots	9	9	9	7	8	12	19	26				11			30			26	25	23	23	22	22	18
		B Plots	12	13	12	10	8	10	19	27				24			56			31	26	30	31	31	26	23
		C Plots	11	12	12	12	16	23	26	29				20			60			23	22	28	35	36	36	25
		D Plots	13	18	20	20	22	31	36	41				39			45			16	20	23	31	30	30	27
		Overall	**11**	**13**	**13**	**12**	**13**	**19**	**25**	**31**				**24**			**48**			**24**	**23**	**26**	**30**	**30**	**28**	**23**

Table 10.
Seasonal means of other grasses percentage cover

			Year																							
			1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Overall
SPRING	OBSERVED	A Plots			54	72	93	84	74	49	57		38		73					21	54		62	68	67	62
		B Plots			38	25	36	57	39	48	32		38		68					36	53		70	71	60	48
		C Plots			37	15	12	48	59	40	34		39		68					42	74		72	61	60	47
		D Plots			66	54	39	71	63	48	34		38		38					44	70		57	73	54	54
		Overall			**49**	**42**	**45**	**65**	**59**	**46**	**39**		**38**		**62**					**36**	**62**		**65**	**68**	**60**	**53**
	SMOOTHED	A Plots			63	73	83	84	69	60	53	48	38	55	73					37	37	58	65	65	67	60
		B Plots			32	33	39	44	48	40	40	35	38	53	68					44	44	61	70	67	65	48
		C Plots			26	22	25	40	49	44	37	36	39	53	68					58	58	73	66	64	60	48
		D Plots			60	53	55	58	61	48	41	36	38	38	38					57	57	64	65	62	64	53
		Overall			**45**	**45**	**51**	**56**	**57**	**48**	**43**	**39**	**38**	**50**	**62**					**49**	**49**	**64**	**67**	**65**	**64**	**52**
SUMMER	OBSERVED	A Plots		80	42	76	57	79	46	65	55	80	46	56	56	47	43	53	78	72	55	66	63	65	65	61
		B Plots		54	58	47	55	60	61	76	57	68	47	39	85	53	38	65	71	67	55	62	65	70	64	60
		C Plots		61	48	35	39	45	28	71	36	55	48	25	54	70	68	75	70	64	68	70	75	73	64	56
		D Plots		69	81	84	55	60	47	82	29	46	42	23	49	51	61	65	76	70	68	70	73	76	63	61
		Overall		**66**	**57**	**60**	**51**	**61**	**45**	**74**	**44**	**62**	**46**	**36**	**61**	**55**	**52**	**64**	**74**	**68**	**62**	**67**	**69**	**71**	**64**	**59**
	SMOOTHED	A Plots		61	66	58	71	61	63	55	67	60	61	53	53	49	48	58	68	68	64	61	65	64	65	61
		B Plots		56	53	53	54	59	66	65	67	57	51	57	59	59	52	58	68	64	61	61	66	66	67	60
		C Plots		55	48	40	39	37	48	45	54	46	42	42	49	64	71	71	70	67	67	71	72	71	68	56
		D Plots		75	78	73	66	54	63	52	52	39	37	38	41	54	59	67	70	71	69	70	73	70	69	61
		Overall		**62**	**61**	**56**	**57**	**52**	**60**	**54**	**60**	**51**	**48**	**48**	**51**	**56**	**57**	**64**	**69**	**68**	**65**	**66**	**69**	**68**	**67**	**59**
AUTUMN	OBSERVED	A Plots	74	75	72	77		73		69				86			54			51	53	48	69	63	66	66
		B Plots	82	58	48	53		66		62				67			66			41	69	45	54	61	73	60
		C Plots	87	57	44	56		76		59				64			50			62	87	65	65	63	66	64
		D Plots	67	88	69	84		65		63				60			71			59	64	66	68	67	65	68
		Overall	**78**	**69**	**58**	**67**		**70**		**63**				**69**			**60**			**53**	**68**	**56**	**64**	**63**	**68**	**65**
	SMOOTHED	A Plots	74	73	75	75	75	73	71	69				86			54			52	50	56	59	66	64	67
		B Plots	70	63	53	50	59	66	64	62				67			66			55	52	56	53	63	67	60
		C Plots	72	63	52	50	66	76	68	59				64			50			74	71	72	64	64	64	64
		D Plots	77	75	80	76	74	65	64	63				60			71			61	63	66	67	67	66	68
		Overall	**73**	**68**	**65**	**63**	**69**	**70**	**66**	**63**				**69**			**60**			**61**	**59**	**62**	**61**	**65**	**65**	**65**

Table 11.
Seasonal means of moss percentage cover

			Year 1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Overall
SPRING	OBSERVED	A Plots			16	16	23	46	64	38	21		35		75					49	61		66	66	52	45
		B Plots			2	13	8	23	21	14	12		5		19					16	28		44	49	27	20
		C Plots			1	4	1	4	4	3	4		3		2					4	1		1	11	2	3
		D Plots			4	2	2	11	14	10	12		14		12					6	4		3	11	11	8
		Overall			**6**	**9**	**9**	**21**	**26**	**16**	**12**		**14**		**27**					**19**	**23**		**29**	**34**	**23**	**18**
	SMOOTHED	A Plots			16	18	28	44	49	41	29	28	35	55	75					55	55	63	66	61	59	46
		B Plots			7	8	15	17	19	16	13	8	5	12	19					22	22	36	46	40	38	20
		C Plots			3	2	3	3	4	4	3	3	3	3	2					3	3	1	6	5	6	3
		D Plots			3	3	5	9	11	12	11	13	14	13	12					5	5	3	7	8	11	8
		Overall			**7**	**8**	**13**	**18**	**21**	**18**	**14**	**13**	**14**	**21**	**27**					**21**	**21**	**26**	**31**	**29**	**29**	**19**
SUMMER	OBSERVED	A Plots		34	1	10	34	52	57	21	29	27	27	70	50	58	5	14	28	51	61	67	63	46	42	38
		B Plots		3	0	2	14	11	4	1	6	6	5	13	5	19	7	12	11	11	24	20	24	20	26	11
		C Plots		0	0	2	4	1	0	2	1	1	2	1	0	1	1	2	1	1	5	0	3	4	2	2
		D Plots		7	6	1	3	8	7	9	13	6	15	10	3	8	7	9	2	4	3	3	5	7	8	6
		Overall		**11**	**2**	**4**	**14**	**18**	**17**	**8**	**12**	**10**	**12**	**23**	**14**	**22**	**5**	**9**	**11**	**17**	**23**	**22**	**24**	**19**	**20**	**14**
	SMOOTHED	A Plots		18	15	15	32	47	43	35	26	28	41	49	59	38	26	16	31	47	60	64	59	50	44	38
		B Plots		2	2	5	9	10	5	4	5	6	8	8	12	10	13	10	11	16	18	23	21	23	23	11
		C Plots		0	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	3	2	3	2	3	3	2
		D Plots		7	5	3	4	6	8	9	9	11	10	9	7	6	8	6	5	3	3	4	5	6	7	6
		Overall		**6**	**5**	**6**	**12**	**16**	**14**	**12**	**10**	**12**	**15**	**17**	**20**	**14**	**12**	**8**	**12**	**17**	**21**	**23**	**22**	**21**	**19**	**14**
AUTUMN	OBSERVED	A Plots	30	28	18	29		57		32				69			18			22	38	71	59	53	50	41
		B Plots	22	1	15	14		15		11				11			20			12	7	18	19	25	19	15
		C Plots	11	0	2	10		3		4				2			0			0	0	1	2	3	2	3
		D Plots	50	2	3	7		6		13				3			7			1	4	10	7	6	5	9
		Overall	**28**	**8**	**9**	**15**		**20**		**15**				**21**			**11**			**9**	**12**	**25**	**22**	**22**	**19**	**17**
	SMOOTHED	A Plots	29	25	25	23	43	57	44	32				69			18			30	44	56	61	54	52	41
		B Plots	11	12	10	14	15	15	13	11				11			20			9	12	15	21	21	22	15
		C Plots	6	4	4	6	6	3	5	4				2			0			0	0	1	2	2	2	3
		D Plots	26	18	4	5	6	6	10	13				3			7			3	5	7	8	6	6	8
		Overall	**18**	**15**	**11**	**12**	**17**	**20**	**18**	**15**				**21**			**11**			**11**	**15**	**20**	**23**	**21**	**20**	**17**

Table 12.
Seasonal means of buttercup percentage cover

			1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Overall
SPRING	OBSERVED	A Plots			39	56	43	25	31	20	2		6		18					6	7		8	18	6	20
		B Plots			7	7	44	33	38	29	5		8		23					11	12		7	19	11	18
		C Plots			16	8	16	21	23	29	11		16		42					15	9		13	25	10	18
		D Plots			24	19	23	18	28	17	3		10		32					11	11		19	19	10	17
		Overall			**21**	**22**	**31**	**24**	**30**	**24**	**5**		**10**		**29**					**11**	**10**		**12**	**20**	**9**	**18**
	SMOOTHED	A Plots			47	46	41	33	25	17	11	4	6	12	18					7	7	7	13	11	12	18
		B Plots			7	19	28	38	33	24	17	6	8	15	23					11	11	9	13	12	15	17
		C Plots			12	13	15	20	24	21	20	13	16	29	42					12	12	11	19	16	18	18
		D Plots			21	22	20	23	21	16	10	6	10	21	32					11	11	15	19	16	14	17
		Overall			**22**	**25**	**26**	**28**	**26**	**19**	**14**	**8**	**10**	**19**	**29**					**10**	**10**	**11**	**16**	**14**	**15**	**17**
SUMMER	OBSERVED	A Plots		33	36	51	35	25	18	9	3	3	7	10	19	13	24	29	9	5	8	12	14	9	7	17
		B Plots		17	2	20	30	37	36	28	6	7	7	16	19	27	20	32	17	11	12	16	13	11	7	18
		C Plots		11	19	11	20	34	31	35	14	10	29	27	51	40	28	25	6	9	15	31	24	14	13	22
		D Plots		26	31	37	25	35	21	21	4	8	11	22	30	23	19	18	7	11	16	28	22	15	4	20
		Overall		**22**	**22**	**30**	**28**	**33**	**26**	**23**	**7**	**7**	**13**	**19**	**30**	**26**	**23**	**26**	**10**	**9**	**13**	**22**	**18**	**12**	**8**	**19**
	SMOOTHED	A Plots		34	40	41	37	26	17	10	5	4	7	12	14	19	22	21	14	7	8	11	11	10	8	17
		B Plots		10	13	17	29	34	34	23	13	6	10	14	21	22	26	23	20	14	13	13	13	10	9	18
		C Plots		15	14	17	22	28	33	27	19	18	22	36	39	40	31	19	13	10	18	23	23	17	13	23
		D Plots		29	31	31	32	27	26	15	11	8	14	21	25	24	20	14	12	11	18	22	22	14	9	20
		Overall		**22**	**24**	**26**	**30**	**29**	**27**	**19**	**12**	**9**	**13**	**21**	**25**	**26**	**25**	**19**	**15**	**10**	**14**	**17**	**17**	**13**	**10**	**19**
AUTUMN	OBSERVED	A Plots	22	27	57	53		27		5				18			28			8	11	22	25	9	3	22
		B Plots	25	18	18	34		39		15				23			26			20	20	20	21	12	8	21
		C Plots	20	14	12	16		24		25				42			17			16	33	26	22	15	7	21
		D Plots	28	26	26	32		37		15				32			23			8	24	37	26	10	6	23
		Overall	**24**	**21**	**28**	**34**		**31**		**15**				**29**			**23**			**13**	**22**	**26**	**24**	**12**	**6**	**22**
	SMOOTHED	A Plots	25	35	46	55	40	27	16	5				18			28			10	14	19	19	13	6	23
		B Plots	21	20	23	26	36	39	27	15				23			26			20	20	20	17	13	10	22
		C Plots	17	15	14	14	20	24	24	25				42			17			25	25	27	21	15	11	21
		D Plots	27	27	28	29	34	37	26	15				32			23			16	23	29	24	14	8	24
		Overall	**22**	**24**	**29**	**31**	**32**	**31**	**23**	**15**				**29**			**23**			**17**	**20**	**24**	**20**	**14**	**9**	**23**

Table 13.
Seasonal means of clover percentage cover

			Year																							
			1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Overall
SPRING	OBSERVED	A Plots			1	6	7	19	17	24	8		4		8					27	16		17	30	27	15
		B Plots			0	0	0	1	0	1	0		1		1					0	13		9	4	4	2
		C Plots			0	1	0	3	0	0	0		1		0					1	0		3	2	5	1
		D Plots			1	1	0	0	1	1	0		1		1					1	1		2	2	4	1
		Overall			**0**	**2**	**2**	**6**	**4**	**7**	**2**		**1**		**2**					**7**	**7**		**8**	**9**	**10**	**5**
	SMOOTHED	A Plots			4	5	11	14	20	16	16	6	4	6	8					21	21	16	23	24	28	14
		B Plots			0	0	0	0	1	0	1	0	1	1	1					7	7	11	7	6	4	3
		C Plots			1	0	1	1	1	0	0	0	1	0	0					1	1	1	3	3	3	1
		D Plots			1	1	1	1	1	1	1	1	1	1	1					1	1	2	2	3	3	1
		Overall			**1**	**1**	**3**	**4**	**6**	**4**	**4**	**2**	**1**	**2**	**2**					**7**	**7**	**8**	**9**	**9**	**10**	**5**
SUMMER	OBSERVED	A Plots		5	2	6	25	41	22	16	12	3	6	18	19	3	3	20	23	23	26	33	33	31	30	18
		B Plots		1	0	1	1	2	1	5	2	1	1	4	1	3	0	0	2	2	1	7	8	6	6	2
		C Plots		0	0	0	2	1	0	1	0	0	1	1	0	1	0	0	2	1	3	2	2	1	4	1
		D Plots		1	0	2	1	1	1	5	0	1	1	2	4	3	1	2	2	1	3	3	1	4	3	2
		Overall		**2**	**0**	**2**	**7**	**11**	**6**	**7**	**3**	**1**	**2**	**6**	**6**	**2**	**1**	**5**	**7**	**7**	**8**	**11**	**11**	**11**	**11**	**6**
	SMOOTHED	A Plots		3	4	11	24	29	26	16	10	7	9	14	13	8	9	15	22	24	27	31	32	31	31	18
		B Plots		1	1	1	1	1	2	2	3	1	2	2	3	1	1	1	2	2	4	5	7	7	6	2
		C Plots		0	0	1	1	1	1	1	0	0	1	1	1	0	0	1	1	2	2	2	2	3	3	1
		D Plots		1	1	1	1	1	2	2	2	1	1	3	3	3	2	2	2	2	2	2	3	3	4	2
		Overall		**1**	**1**	**3**	**7**	**8**	**8**	**5**	**4**	**2**	**3**	**5**	**5**	**3**	**3**	**5**	**7**	**8**	**9**	**10**	**11**	**11**	**11**	**6**
AUTUMN	OBSERVED	A Plots	18	0	4	13		36		27				18			10			35	40	31	43	41	29	25
		B Plots	18	0	0	2		7		5				4			12			9	6	10	8	9	4	7
		C Plots	9	0	1	0		1		2				1			0			2	0	1	3	3	1	2
		D Plots	17	0	1	1		1		1				2			0			9	3	4	3	3	1	3
		Overall	**15**	**0**	**1**	**4**		**11**		**9**				**6**			**5**			**14**	**12**	**11**	**14**	**14**	**9**	**9**
	SMOOTHED	A Plots	9	7	6	9	25	36	31	27				18			10			37	35	38	38	37	35	25
		B Plots	9	6	1	1	5	7	6	5				4			12			7	8	8	9	7	6	6
		C Plots	4	3	0	0	1	1	1	2				1			0			1	1	2	2	2	2	2
		D Plots	8	6	0	1	1	1	1	1				2			0			6	5	3	3	3	2	3
		Overall	**8**	**6**	**2**	**3**	**8**	**11**	**10**	**9**				**6**			**5**			**13**	**12**	**13**	**13**	**12**	**11**	**9**

Table 14.
Seasonal means of yarrow percentage cover

			1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Overall
SPRING	OBSERVED	A Plots			1	1	0	2	0	2	1		5		6					10	13		9	9	14	5
		B Plots			0	1	5	13	3	10	10		18		20					14	21		30	19	23	13
		C Plots			0	2	6	7	6	4	8		17		6					21	18		15	15	14	10
		D Plots			6	5	8	7	25	20	13		41		31					1	14		10	13	16	15
		Overall			**2**	**2**	**5**	**7**	**9**	**9**	**8**		**20**		**16**					**12**	**17**		**16**	**14**	**17**	**11**
	SMOOTHED	A Plots			1	1	1	1	1	1	1	3	5	5	6					12	12	11	9	10	11	5
		B Plots			1	2	6	7	9	8	10	14	18	19	20					18	18	26	25	24	21	14
		C Plots			1	3	5	6	6	6	6	13	17	11	6					19	19	17	15	15	14	11
		D Plots			6	6	7	13	17	19	16	27	41	36	31					8	8	12	12	13	15	17
		Overall			**2**	**3**	**5**	**7**	**8**	**9**	**9**	**14**	**20**	**18**	**16**					**14**	**14**	**16**	**15**	**15**	**15**	**12**
SUMMER	OBSERVED	A Plots		1	0	1	2	3	3	1	3	6	8	5	9	1	1	6	7	9	5	9	9	9	15	5
		B Plots		1	0	3	6	8	7	11	20	31	18	31	31	22	18	28	35	33	34	39	44	33	24	22
		C Plots		1	0	3	7	9	6	4	6	9	19	9	10	2	4	8	10	16	18	18	18	17	14	9
		D Plots		1	10	9	16	20	26	20	40	60	43	38	15	7	4	7	9	14	23	23	20	17	13	20
		Overall		**1**	**2**	**4**	**8**	**10**	**10**	**9**	**17**	**26**	**22**	**21**	**16**	**8**	**7**	**12**	**15**	**18**	**20**	**22**	**23**	**19**	**16**	**14**
	SMOOTHED	A Plots		1	1	1	2	2	2	2	3	5	6	7	5	4	3	5	7	7	7	7	9	11	12	5
		B Plots		1	1	3	6	7	9	12	21	23	27	27	28	24	23	27	32	34	35	39	38	33	28	22
		C Plots		1	1	3	6	7	6	5	6	11	12	13	7	5	4	7	11	15	18	18	18	16	16	9
		D Plots		5	6	11	15	20	22	28	40	47	47	32	20	9	6	7	10	15	20	22	20	17	15	20
		Overall		**2**	**2**	**5**	**7**	**9**	**10**	**12**	**17**	**22**	**23**	**19**	**15**	**10**	**9**	**11**	**15**	**18**	**20**	**22**	**21**	**19**	**18**	**14**
AUTUMN	OBSERVED	A Plots	4	1	0	3		4		3				10			20			6	10	27	8	22	15	9
		B Plots	5	2	4	4		11		26				36			27			37	46	41	45	37	25	25
		C Plots	1	1	2	4		8		5				18			6			20	19	18	23	23	22	12
		D Plots	3	3	7	12		23		39				39			12			20	28	33	25	22	23	21
		Overall	**3**	**2**	**3**	**6**		**11**		**18**				**26**			**16**			**21**	**26**	**30**	**25**	**26**	**21**	**17**
	SMOOTHED	A Plots	3	2	1	2	4	4	3	3				10			20			8	14	15	19	15	19	9
		B Plots	3	3	3	4	7	11	18	26				36			27			42	41	44	41	36	31	23
		C Plots	1	1	2	3	6	8	6	5				18			6			20	19	20	21	23	22	11
		D Plots	3	4	7	10	18	23	31	39				39			12			24	27	28	27	23	23	21
		Overall	**2**	**3**	**4**	**5**	**9**	**11**	**15**	**18**				**26**			**16**			**23**	**25**	**27**	**27**	**24**	**24**	**16**

Table 15.
Seasonal means of other plants percentage cover

			1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Overall
SPRING	OBSERVED	A Plots			2	6	6	6	6	7	1		4		18						19		8	13	15	8
		B Plots			1	1	5	7	12	7	4		8		11						22		21	13	15	10
		C Plots			3	6	9	15	13	22	22		39		35						31		36	20	27	21
		D Plots			5	9	2	18	19	15	10		13		35						32		16	24	31	17
		Overall			**3**	**5**	**6**	**12**	**12**	**13**	**9**		**16**		**24**						**26**		**20**	**17**	**22**	**14**
	SMOOTHED	A Plots			4	5	6	6	6	5	4	3	4	11	18						19	13	10	12	14	9
		B Plots			1	2	4	5	9	7	5	6	8	9	11						22	21	17	16	14	10
		C Plots			4	6	10	12	17	19	22	31	39	37	35						31	34	28	28	24	23
		D Plots			7	5	10	13	17	14	12	11	13	24	35						32	24	20	24	28	18
		Overall			**4**	**5**	**8**	**10**	**12**	**11**	**11**	**12**	**16**	**20**	**24**						**26**	**23**	**19**	**20**	**20**	**15**
SUMMER	OBSERVED	A Plots		3	0	4	14	4	5	2	2	3	3	8	8	8	6	16	20	17	13	13	14	12	13	8
		B Plots		2	1	8	11	11	9	15	9	10	11	11	12	13	16	22	19	27	26	22	23	22	10	14
		C Plots		2	5	3	34	29	24	13	26	38	50	27	26	25	26	22	30	42	39	41	33	17	22	26
		D Plots		11	8	16	21	18	17	15	12	26	17	24	33	24	16	23	21	35	40	37	33	27	28	23
		Overall		**5**	**3**	**8**	**20**	**15**	**14**	**11**	**12**	**19**	**20**	**18**	**20**	**17**	**16**	**21**	**22**	**30**	**30**	**28**	**26**	**20**	**18**	**18**
	SMOOTHED	A Plots		2	2	6	7	8	4	3	2	3	4	6	8	7	10	14	18	17	14	13	13	13	13	8
		B Plots		2	4	7	10	10	12	11	11	10	11	12	12	14	17	19	23	24	25	23	22	19	16	14
		C Plots		3	3	14	22	29	22	21	26	38	38	34	26	26	25	26	32	37	41	38	30	24	20	26
		D Plots		10	12	15	18	19	17	15	18	18	22	25	27	24	21	20	26	32	37	37	32	29	27	23
		Overall		**4**	**5**	**10**	**14**	**16**	**13**	**12**	**14**	**17**	**19**	**19**	**18**	**18**	**18**	**20**	**24**	**27**	**29**	**28**	**24**	**21**	**19**	**18**
AUTUMN	OBSERVED	A Plots	3	4	2	5				3				9			18			13	14	19	18	15	11	10
		B Plots	5	1	1	11				9				13			33			25	27	14	22	16	17	15
		C Plots	3	1	5	22				22				31			26			34	27	24	27	27	24	21
		D Plots	9	8	15	20				17				45			27			33	35	44	41	35	28	27
		Overall	**5**	**4**	**6**	**15**				**13**				**24**			**26**			**26**	**26**	**25**	**27**	**23**	**20**	**18**
	SMOOTHED	A Plots	2	3	4	5				3				9			18			14	15	17	17	15	13	10
		B Plots	3	2	4	11				9				13			33			26	22	21	17	18	16	15
		C Plots	4	3	9	22				22				31			26			31	28	26	26	26	25	21
		D Plots	12	11	14	20				17				45			27			34	37	40	40	35	32	28
		Overall	**5**	**5**	**8**	**15**				**13**				**24**			**26**			**26**	**26**	**26**	**25**	**23**	**22**	**19**

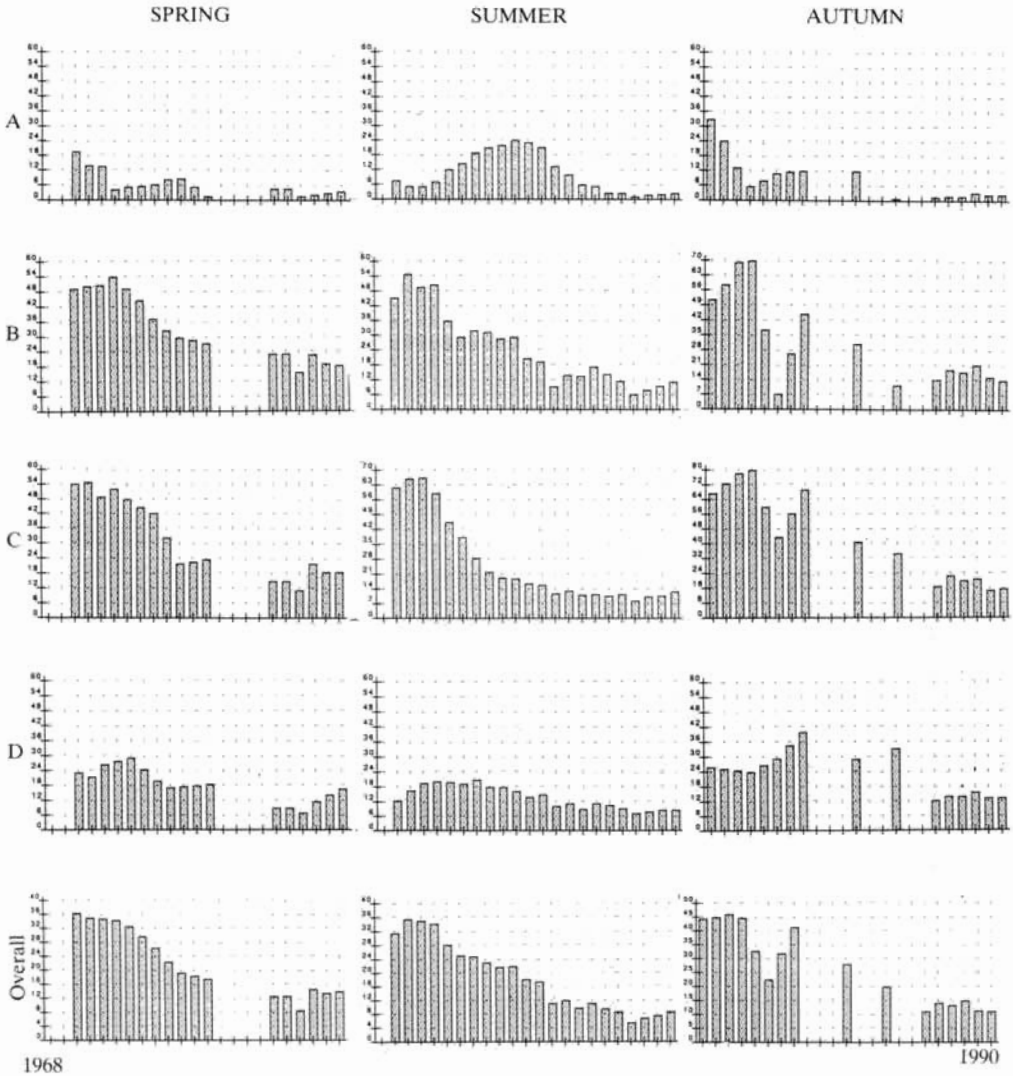

FIG. 4.

Bar Charts depicting the performance of Cocksfoot from 1968–1990. Smoothed data, from Table 8, are grouped by season: spring (February–April), summer (May–July), and autumn (August–October). Gaps indicate years in which no data were recorded in that season. The rows are A Plots, B Plots, C Plots, D Plots and the overall average.

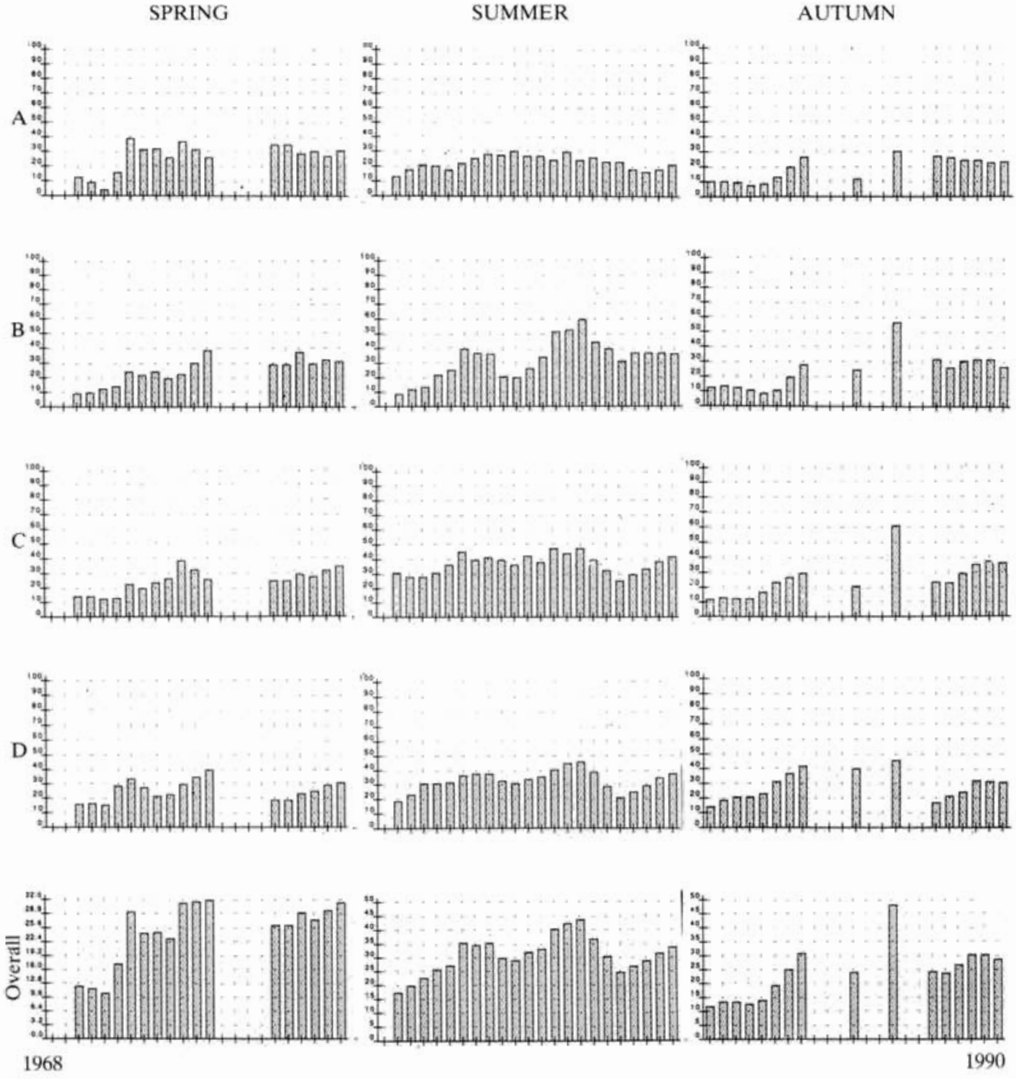

FIG. 5.
Bar charts depicting the performance of Yorkshire fog from 1968 to 1990. Smoothed data, from Table 9, are grouped by season.

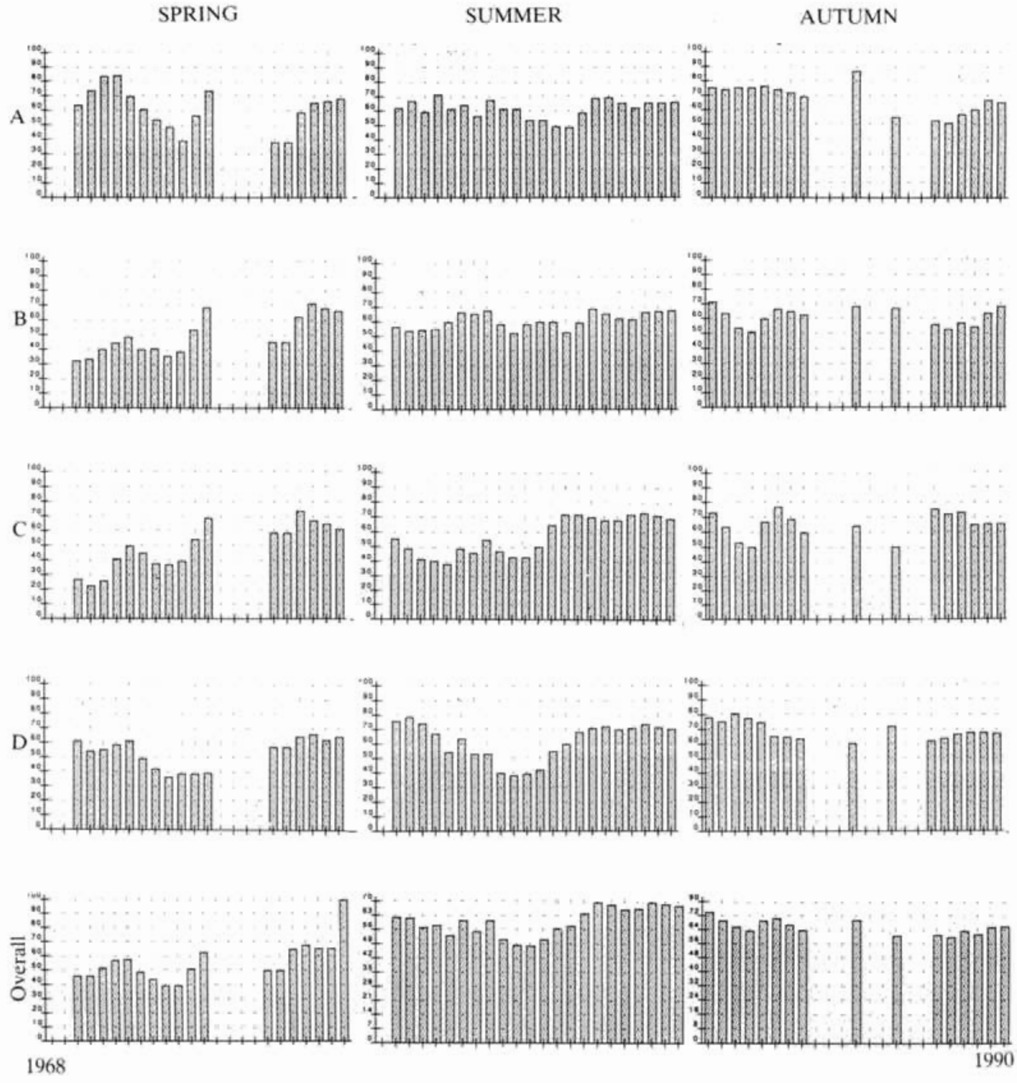

FIG. 6.
Bar charts depicting the performance of other grasses from 1968 to 1990. Smoothed data, from Table 10, are grouped by season.

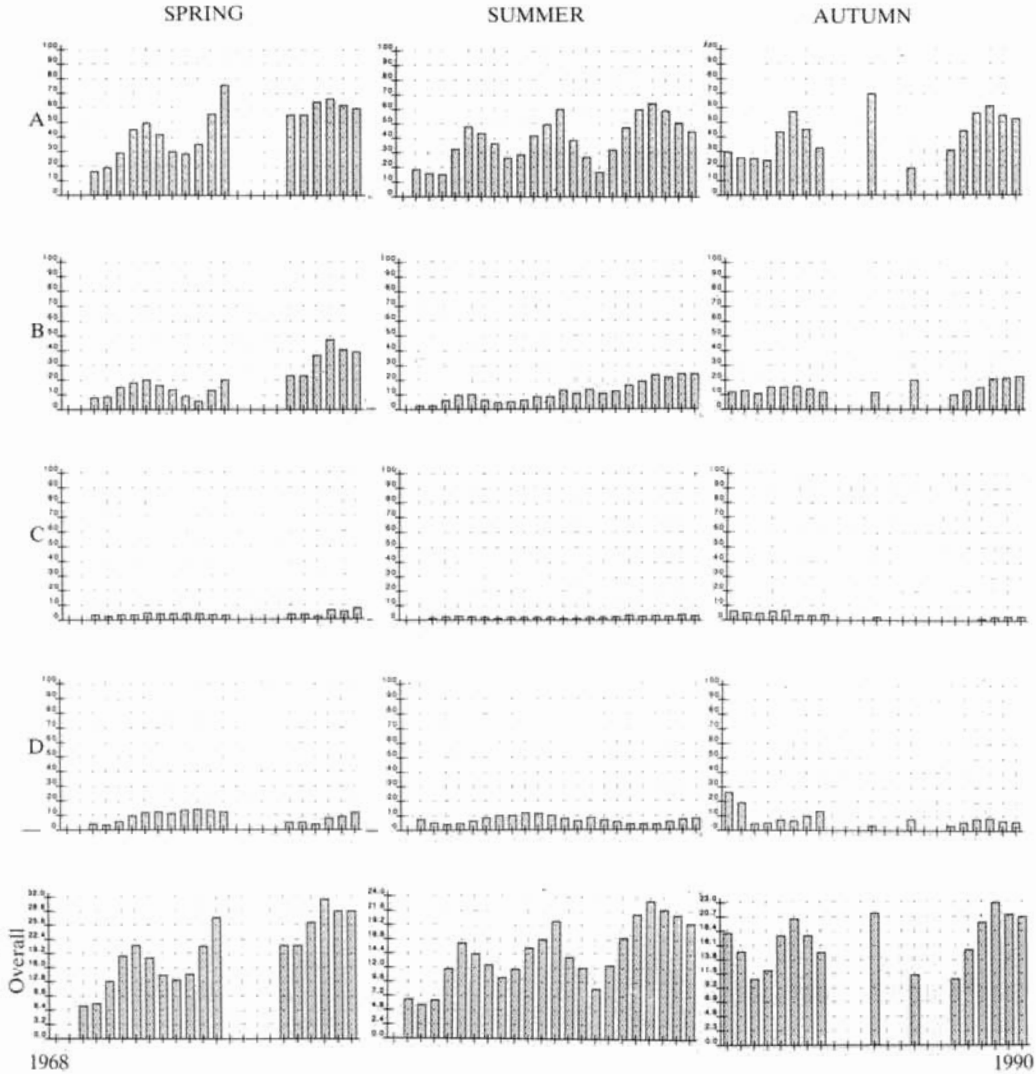

FIG. 7.
Bar charts depicting the performance of moss from 1968 to 1990. Smoothed data, from Table 11, are grouped by season.

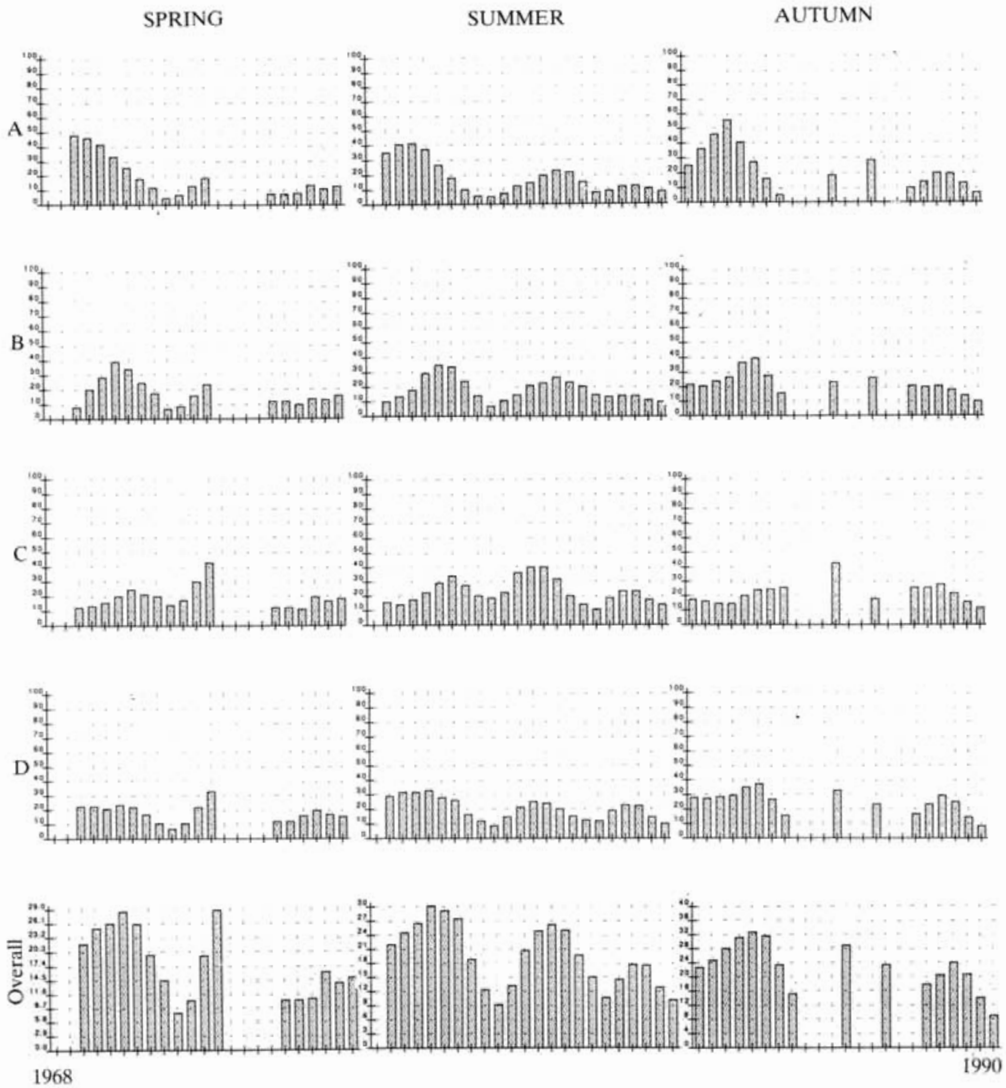

FIG. 8.
Bar charts depicting the performance of buttercup from 1968 to 1990. Smoothed data, from Table 12, are grouped by season.

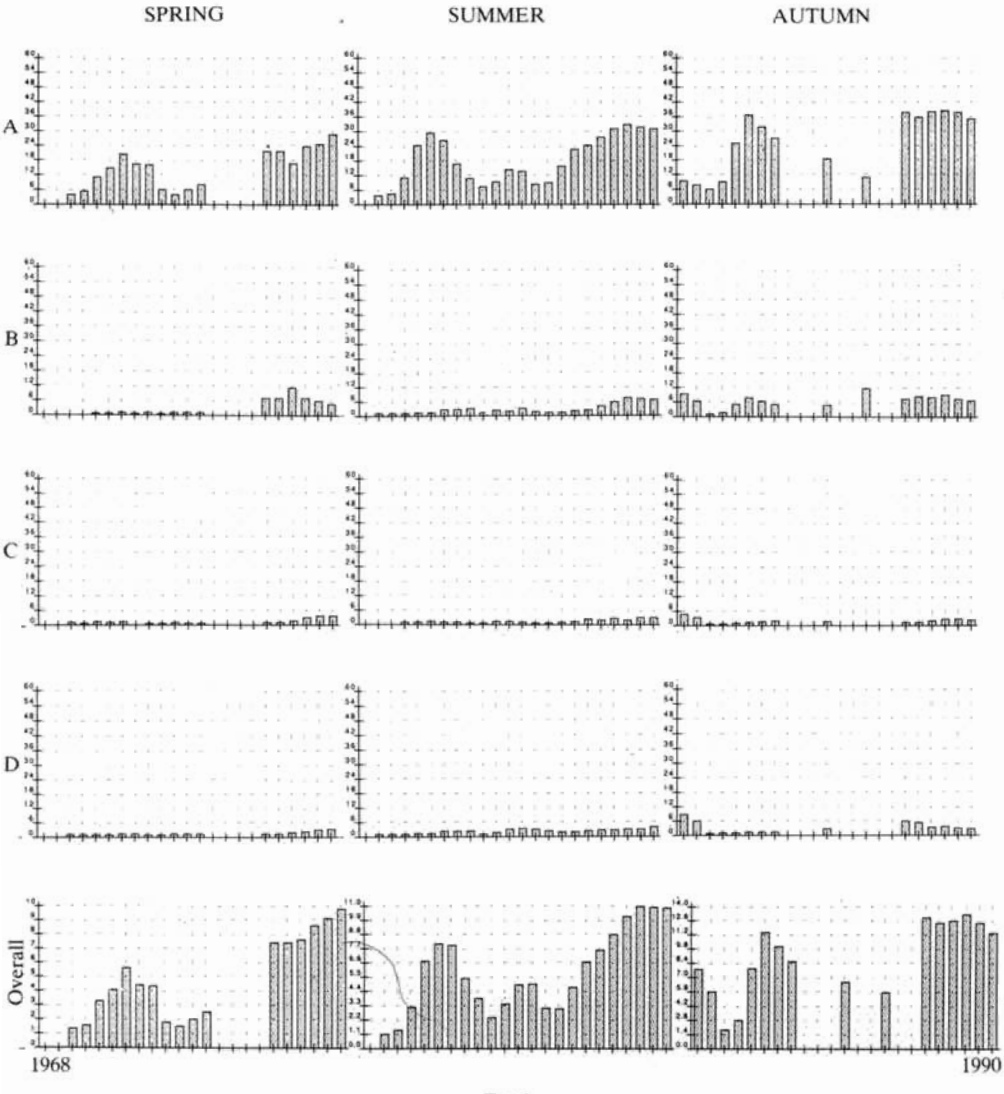

FIG. 9.
Bar charts depicting the performance of clover from 1968 to 1990. Smoothed data, from Table 13, are grouped by season.

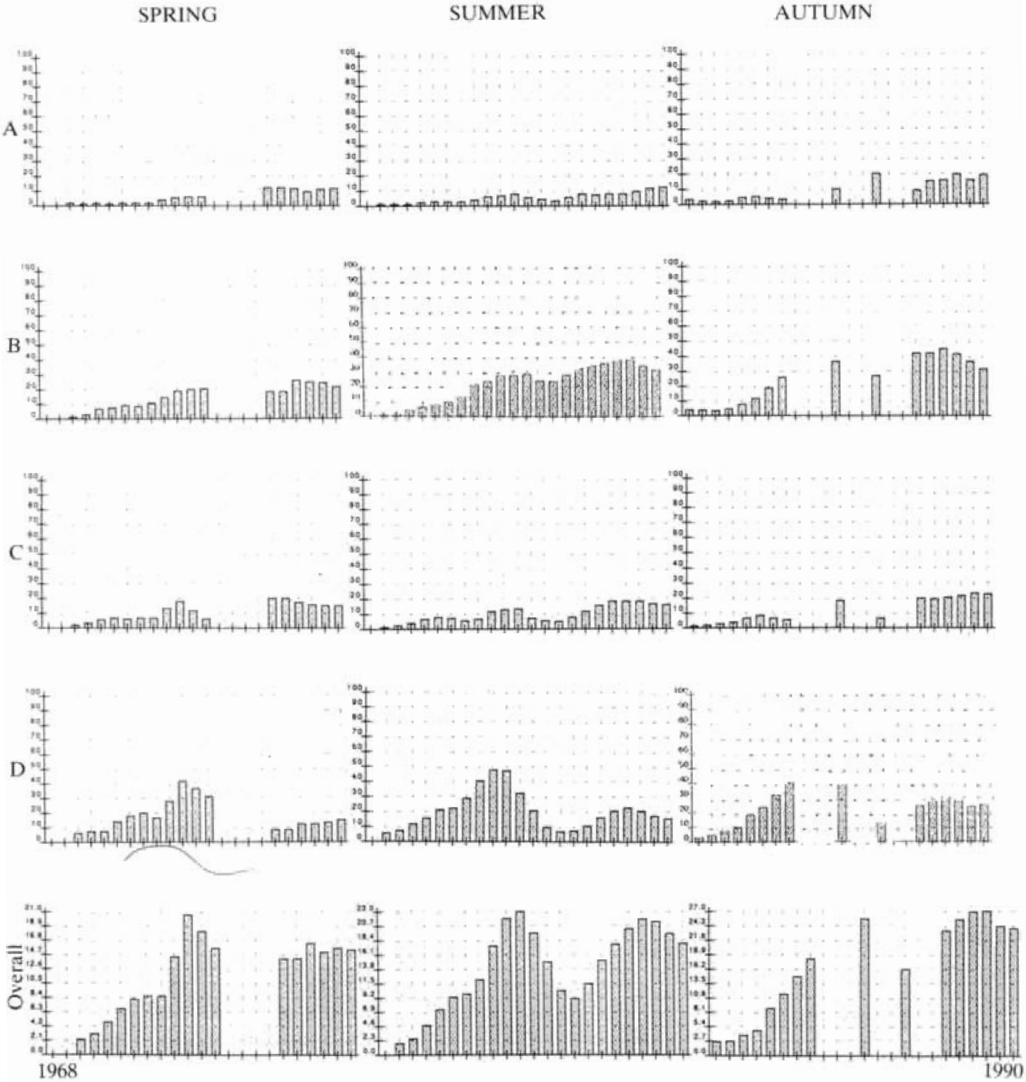

FIG. 10.
Bar charts depicting the performance of yarrow from 1968 to 1990. Smoothed data, from Table 14, are grouped by season.

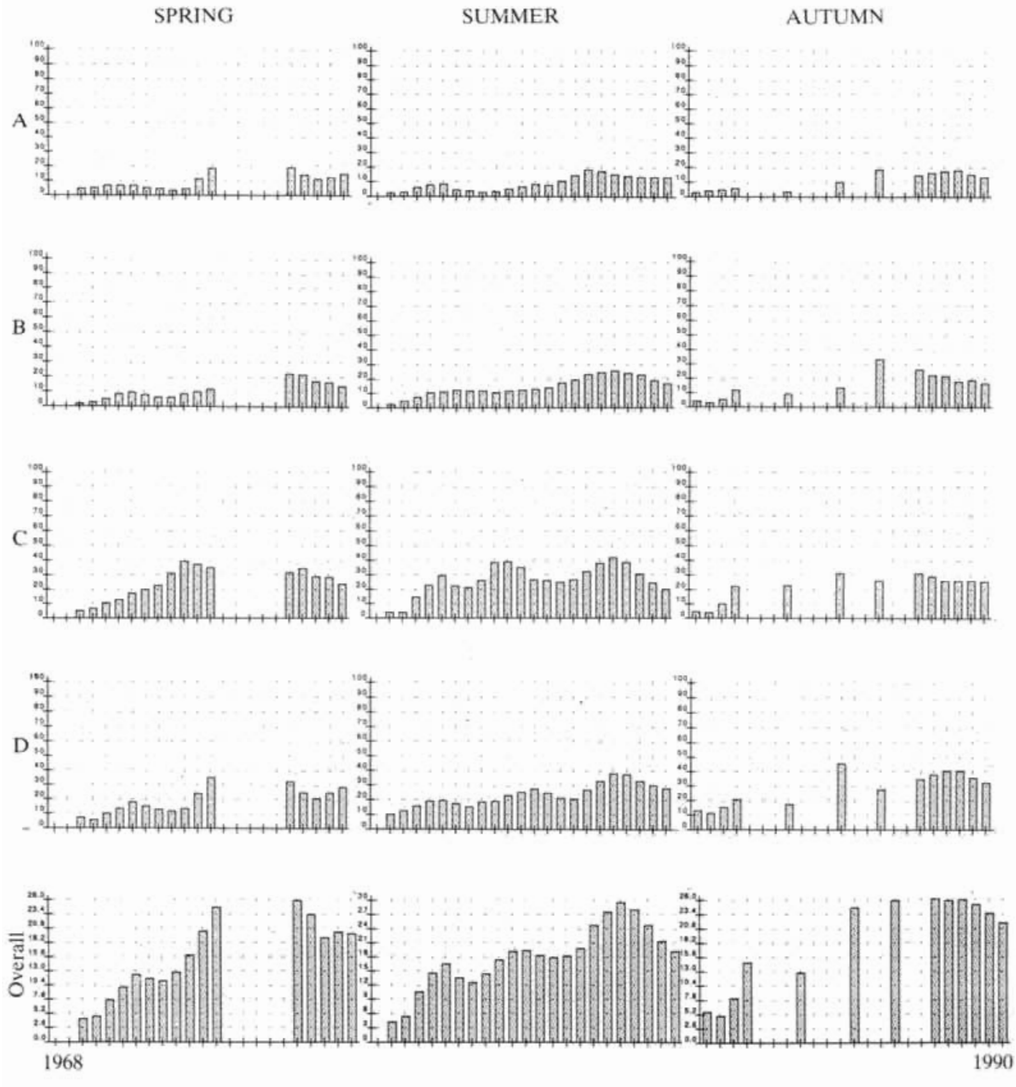

FIG. 11.
Bar charts depicting the performance of other plants from 1968 to 1990. Smoothed data, from Table 15, are grouped by season.

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APPENDIX (July 1991)

In early June 1991, all the Nettlecombe lawnmowers were inoperable at the same time, and we were left with no mechanical means of grass cutting until the end of July. As a result, tree seedlings were not mown away before their presence could be recorded. On 26th July, 17 oak seedlings were seen in the plots: 3 sessile oak, *Quercus petraea*, and 14 turkey oak, *Q. cerris*. Their distribution was as shown in the following tables.

Appendix Table 1.
The numbers of oak seedlings visible in the grass plots on 26th July 1991

	A Plots	B Plots	C Plots	D Plots	Totals
Row 1	0	3	2	1	6
Row 2	1	1	1	3	6
Row 3	0	2	0	1	3
Row 4	1	1	0	0	2
Totals	2	7	3	5	17

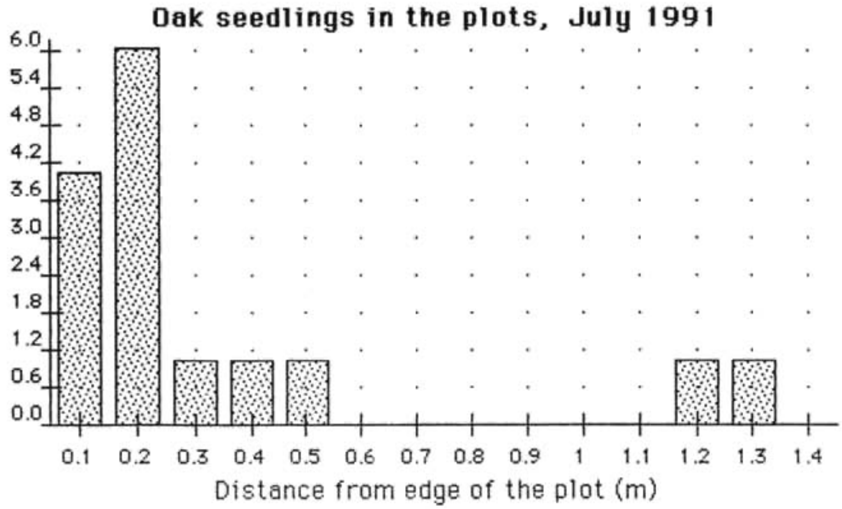
Most appeared in B and D plots, and most in the rows of plots furthest away from the house. Thinking that plot location might be more significant that plot management, the second table lists the same information by column and row, as in Fig. 2 p. 690, but no clear pattern emerges.

It was notable that most of the seedlings were very close to the edge of their plot (Appendix Fig. 1) . There are at least two reasons why this might be the case. Firstly, large seeds (including acorns and chestnuts) are distributed around Nettlecombe mainly by jackdaws, rooks and other crows. These birds can be observed, every autumn, flying past trees, tearing off fruit-laden twigs and flying down to the flat open grassland to feed on their trophies. The short grass plots are as suitable as anywhere else in Court Field for this purpose (although row 4 is a bit close to the house) and seedlings perhaps represent acorns

Appendix Table 2.
The numbers of oak seedlings visible in the grass plots on 26th July 1991, displayed by plot location

	Column 1	Column 2	Column 3	Column 4	Totals
Row 1	0	3	2	1	6
Row 2	3	1	1	1	6
Row 3	0	1	0	2	3
Row 4	1	0	0	1	2
Totals	4	5	3	5	17

which were lost amongst taller vegetation at the edge of the close mown turf. The second theory suggests that there will have been more light (at ground level) at the edge of the long-grass plots, coupled with a greater retention of moisture than in the short-grass, A plots. Only those seedlings with sufficient light and moisture survived until late July.



APPENDIX FIG. 1.
To show the distribution of oak seedlings around the margin of the grass plots, 26th July 1991. The centre of each plot is about 2 m from the edge

The grassland areas around the plots and over towards the weather station were also unmanaged in June and July 1991. Thirty-five more tree seedlings were found on 26th July, belonging to four species: sweet chestnut, *Castanea sativa*, 3: holm oak, *Quercus ilex*, 2: sessile oak, *Q. petraea*, 7: and turkey oak *Q. cerris*, 23. The nearest parent tree to this site is a very large turkey oak, which may account for that species' preponderance.

The absence of saplings from C and D plots cannot be explained by distance from parent trees, since birds must have brought more than 50 acorns and chestnuts into the enclosure. Nor can conditions be totally unfavourable for germination. This is not the first year that oak seedlings have been observed in the plots, but so far none has survived to a second summer. The fate of the 8 now growing in C and D plots will be studied with interest. The 9 growing in the A and B plots were mown in the evening of 27th July.