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FARMERS' PERCEPTIONS OF THE SCALE OF THE BRACKEN PROBLEM ON FARMS IN LESS FAVOURED AREAS IN ENGLAND AND WALES

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SUMMARY

(1) Despite widespread concern about the spread of bracken, *Pteridium aquilinum*, in upland areas of Britain, there are still few data on the plants' distribution, or on the scale and extent of problems caused by the plant to agriculture.

(2) Here we summarize farmers' perceptions of the extent of bracken encroachment on upland farms from a postal questionnaire done in 1988 of nearly 1000 EEC type 3 and 4 farms in the Less Favoured Areas of England and Wales.

(3) A total of 526 questionnaires (53·2%) was returned. In 1987 bracken occupied about 20% of upland grazings. In total, 12 090 LFA farms in the sample area owned and rented 1206 117 ha, of which farmers estimated that 154 054 ha supported bracken in varying densities. An additional 427 577 ha of commons had 136 095 ha of land with bracken. Thus, 1 ha in every 5·6 ha of upland grazing was estimated in 1987 to have had bracken on it.

(4) Despite worries about the continuing spread of bracken, farmers estimate that bracken on LFA farms in Wales has declined by 1·8% during the past 10 years. In England, the estimated average rate of increase was 2·5% over the same period.

(5) A national control programme against bracken was favoured by 68% of farmers, 7% were against and 25% were undecided.

(6) These results are discussed in the light of other recent studies on the distribution and rates of spread of bracken in Britain. We emphasize both the advantages and problems of using postal questionnaires in work of this kind.

INTRODUCTION

Bracken (*Pteridium aquilinum* (L.) Kuhn) is generally regarded as a serious and increasing problem in upland areas of Britain (Smith & Taylor 1986; Senior Technical Officer's Group, Wales 1988; Taylor 1990). The plant is an invasive weed of marginal land, particularly hill farms in northern and western Britain, and according to Taylor (1986) now covers approximately 6720 km^2 within the U.K. Other estimates (e.g. Lawson, Callaghan & Scott 1986) put the area of infested land within the U.K. at about half this. Average rates of spread have been estimated to be of the order of 1% $year^{-1}$, rising to 3% in some areas (Taylor 1986). In Scotland, 63 250 ha have bracken-dominated plant communities (1·8% of Scotland's rough grazing), with rates of spread of the order of 1% $year^{-1}$ (Miller, Morrice & Whitworth 1989).

Bracken is a problem for several reasons (Smith & Taylor 1986; Lawton 1988; Senior Technical Officer's Group, Wales 1988; Miller, Morrice & Whitworth 1989).

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It is poisonous when eaten by stock, dense stands eliminate grazing and make shepherding very difficult, and it acts as a reservoir for sheep ticks (*Ixodes ricinus* L.), and hence as a focus for tick-borne diseases. Sick animals hidden by bracken cannot be spotted early for treatment. The plant also causes problems on grouse moors by competing with heather, and again acting as a focus for tick-borne diseases (Hudson 1986). It has also been implicated as a human health hazard, primarily as a source of carcinogens in milk and water supplies (Galpin & Whitaker 1988; Taylor 1990).

Good quantitative estimates of the nature and extent of these potential problems are frequently lacking. Here we report the results of a postal questionnaire survey of nearly 1000 farms in Less Favoured Areas (LFA) of England and Wales (Lawton & Varvarigos 1989) designed to assess the scale and extent of the bracken problem as perceived by farmers. We also asked whether they would favour or be against efforts to control bracken on a national basis. We included only LFA farms in the survey because all other sources of information pointed to the fact that upland livestock farms, especially those in Less Favoured Areas, suffer most of the economic losses. Recent related surveys, including the use of a postal questionnaire to assess farmers' perceptions of the scale of the problem in Scotland, have been done by Miller, Morrice & Whitworth (1989). Earlier U.K. surveys are summarized by Taylor (1990).

METHODS

To maximize the rate of return, questionnaires were sent out between lambing and shearing times, i.e. in early July 1988. Follow-up letters were sent out in August to farmers who had not returned the questionnaire. Bracken has its maximum frond development at this time. To increase awareness, articles about the survey appeared in *Farmers' Weekly* and *Stock* magazines, encouraging farmers to reply. Data derived from the questionnaires relate to the production year 1987, unless stated otherwise. The questionnaire is reproduced in full in the Appendix. The structure of the questionnaire was agreed in consultation with Ministry of Agriculture, Fisheries and Food (MAFF) officials who have extensive experience of questionnaire surveys of English and Welsh farmers.

The bracken survey was based on farm distribution data, derived from the MAFF Agricultural Census (June 1987). The English and Welsh counties surveyed are listed in Table 1. The farms of interest were:

EEC Farm Type 3: hill and upland sheep (LFA).

EEC Farm Type 4: hill and upland cattle & sheep (LFA).

Three farm size groups were distinguished as follows:

Group 1: 0 – 15·9 BSUs.

Group 2: 16 – 39·9 BSUs.

Group 3: 40 + BSUs.

A BSU or British Size Unit equals 2000 European Currency Units of Standard Gross Margins at average 1978–80 values, and is used to measure the size of farm businesses in the U.K. (Barnard & Nix 1979; MAFF 1988).

A sample of 988 farms (1000 less twelve that were subsequently found to be unsuitable) was drawn from the total population of 12 090 LFA farms, stratified by county, farm type and farm size. (Three farm sizes and two types gave six size strata in each county). The questionnaires were posted in proportion to the farms popu-

TABLE 1. The population of holdings available for selection with the achieved numbers of returned questionnaires in parentheses

	EEC farm type 3			EEC farm type 4		
	Size groups			Size groups		
	1	2 & 3	Total	1	2 & 3	Total
England						
Durham and Northumberland	176 (7)	128 (7)	304 (14)	425 (21)	416 (21)	841 (42)
Cumbria	386 (20)	224 (9)	610 (29)	457 (20)	452 (22)	909 (42)
N. Yorkshire*	161 (7)	124 (7)	285 (14)	257 (9)	259 (12)	516 (21)
Devon and Cornwall	175 (7)	40 (0)	215 (7)	436 (21)	197 (7)	633 (28)
Total England			1414 (64)			2899 (133)
Wales						
Clwyd	374 (11)	179 (8)	553 (19)	288 (16)	213 (8)	501 (24)
Gwynedd	658 (26)	284 (16)	942 (42)	325 (15)	162 (9)	487 (24)
Powys	1162 (49)	654 (26)	1816 (75)	718 (24)	578 (24)	1296 (48)
Dyfed	590 (26)	173 (9)	763 (35)	505 (25)	180 (7)	685 (32)
Mid and West Glamorgan and Gwent	306 (9)	95 (5)	401 (14)	272 (12)	61 (4)	333 (16)
Total Wales			4475 (185)			3302 (144)
Grand totals	3988 (162)	1901 (87)	5889 (249)	3683 (163)	2518 (114)	6201 (277)

* West of the A1 road only (see text).

lations in the strata; 526 questionnaires (53·2%) were returned. Figure 1 contrasts the total questionnaires sent with those returned in the surveyed counties. Table 1 shows in parentheses the returns from each stratum. On Table 1, strata providing very few returns have been combined to eliminate any possibility of breaching confidentiality, as required by MAFF. Where necessary, however, these data were treated separately during analyses.

The sample of returns was close to, but not exactly proportional to the population. Therefore, the mean estimates were weighted according to the actual proportions of the strata in each county.

Stratum weight = Farm numbers in stratum/Farm numbers in county

To maintain reasonable sample sizes, data from Durham and Northumberland were analysed together, as were data from Devon plus Cornwall. In Wales, data from Mid & West Glamorgan and Gwent were pooled. The sample from North Yorkshire excludes parishes to the east of the A1 trunk road. The principle upland area lying to the east of the A1 is the North York Moors National Park. Exclusion

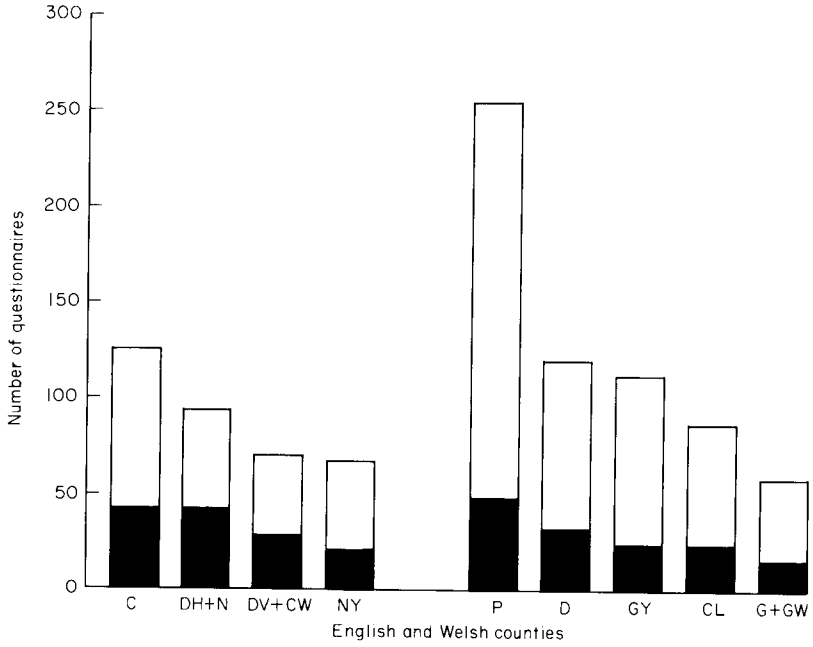

FIG. 1. Distributions of questionnaires sent showing proportions returned (■) and not returned (□) in the English and Welsh counties. In England, 355 questionnaires were sent, of which 196 (55·21%) were returned from Cumbria (C), Durham and Northumberland (DH + N), Devon and Cornwall (DV + CW) and North Yorkshire (NY). In Wales, 633 questionnaires were sent, of which 329 (51·97%) were returned from Powys (P), Dyfed (D), Gwynedd (GY), Clwyd (CL), and Mid and West Glamorgan and Gwent (G + GW).

was deliberate, because of the considerable coordinated efforts being made there by the Park Authorities to eliminate bracken from large areas (Embetec 1990) which might seriously have distorted the average picture.

To elucidate levels and patterns of infestation, land was classed into two categories: (i) own land plus rented keep (referred to as 'farmland'); (ii) 'common land' on which some farmers have rights to graze their stock.

Answers to questions about grazing on common land were poorly defined on some questionnaires. When the grazing rights were impossible to define from vague statements, such as 'unlimited open fell', they were excluded from the calculations. On the other hand, when the rights were described just in terms of animal numbers, they were converted into pasture equivalents assuming five ewes equals one beef cow and an average stocking of 3 ewes per 0·4 ha of common land (based on average values derived from more complete questionnaires).

Intensities of bracken infestation defined in the questionnaire are crude. Two levels were distinguished (Appendix 1): (i) 'present' (land which could be grazed but at reduced stocking); (ii) 'dense' (unsuitable for grazing). Farmers returning the questionnaires obviously interpreted these terms in variable ways. To minimize errors of interpretation we pooled both categories in the analysis and simply refer to land with and without bracken.

Results are presented as farm averages or estimated totals for each county based on the weighted sample returns, followed by grand totals. Totals may not match precisely due to rounding. Standard errors of complex variables are derived according to formulae in Kish (1967) and Colquhoun (1971), and are presented in parentheses alongside sample means.

RESULTS

Farms that reported bracken

Of the total population of 12 090 farms targeted through the questionnaire, the data suggest that 5894 (49%) have some bracken (present plus dense categories combined) on their land or the land on which they have grazing rights. Table 2 shows the estimated proportion of farms with bracken in each county. Farmers' perceptions suggest that Gwynedd has the highest proportion of infested farms (75%), and Northumberland and Durham the smallest (29%).

TABLE 2. Numbers of farms in the surveyed area and estimated numbers with bracken (S.E.s in parentheses)

	Number of farms		
	Total	Infested	Infested (%)
England			
Durham and Northumberland	1145	327	28·6
		(51)	(4·5)
Cumbria	1519	625	41·1
		(83)	(5·5)
N. Yorkshire	801	429	53·6
		(67)	(8·4)
Devon and Cornwall	848	402	47·4
		(71)	(8·3)
Total England	4313	1783	41·3
		(138)	(3·2)
Wales			
Clwyd	1054	538	51·0
		(81)	(7·7)
Gwynedd	1429	1078	75·4
		(73)	(5·1)
Powys	3112	1468	47·2
		(133)	(4·3)
Dyfed	1448	496	34·3
		(82)	(5·7)
Mid and West Glamorgan and Gwent	734	531	72·4
		(63)	(8·6)
Total Wales	7777	4111	52·9
		(201)	(2·6)
Grand total	12090	5894	48·8
		(244)	(2·0)

Total is the number of farms in each area. Numbers and percentages infested with bracken are estimates based on the sample returns.

Bracken on farmland (own land & rented keep)

Table 3 shows average farm sizes and the average areas of bracken infestation (present plus dense), in each county or groups of counties. Interestingly, although the proportion of farms with bracken is reported to be low in Northumberland and Durham (previous section), infested farms in these counties are reported to carry the largest areas of bracken, although confidence intervals on the estimate are wide. Of the total of 1206 117 ha of own land and keep in the survey area, farmers estimate that 154 054 ha (13%) have some bracken (Table 4), with relatively little variation between regions.

Bracken on common land

Farms with rights of access to commons and the proportion of these that reported bracken on their common are tabulated in Table 5. Compared with farmers' own land and rented keep, questionnaire respondents reported that common lands are much more extensively covered with bracken (compare data in Tables 3 & 5 and 4 & 6). For the surveyed English and Welsh counties as a whole, 427 577 ha of commons are available to the farm types of interest, of which 136 095 ha (32%) are reported to have bracken (Table 6).

Changes in bracken infestation revealed by the questionnaire

The survey suggests that on the grazings of at least 3300 farms including commons (56% of those with bracken), the distribution of the plant has changed over the last

TABLE 3. Average estimated farmland sizes and average area of land with bracken on farms reporting some bracken (present or dense) (S.E.s in parentheses)

	Farmland (ha)	Infested (ha)	Infestation (%)
England			
Durham and Northumberland	175·5	87·9	50·1
	(18·1)	(35·5)	(20·9)
Cumbria	115·8	34·3	29·7
	(12·0)	(10·3)	(9·4)
N. Yorkshire	138·8	19·6	14·1
	(17·1)	(11·0)	(8·1)
Devon and Cornwall	65·9	20·3	30·8
	(12·4)	(13·2)	(20·8)
Wales			
Clwyd	100·2	41·1	41·0
	(6·7)	(15·2)	(15·4)
Gwynedd	118·8	29·8	25·1
	(12·6)	(6·7)	(6·2)
Powys	82·1	12·2	14·9
	(3·7)	(2·9)	(3·6)
Dyfed	60·9	14·3	23·5
	(8·1)	(16·1)	(26·6)
Mid and West Glamorgan and Gwent	58·6	15·1	25·8
	(5·8)	(5·1)	(9·1)

TABLE 4. Estimated total farmland areas occupied by LFA farms in each county or group of counties, together with estimated farmland areas with bracken (S.E.s in parentheses)

	Farmland (ha)	Infested (ha)	Infestation (%)
England			
Durham and Northumberland	200 987	28 741	14·3
	(20719)	(10 703)	(5·1)
Cumbria	175 910	21 461	12·2
	(18 261)	(5787)	(3·0)
N. Yorkshire	111 213	8397	7·6
	(13 673)	(4523)	(3·9)
Devon and Cornwall	55 900	8173	14·6
	(10 484)	(5115)	(8·6)
Total England	544 010	66 772	12·3
	(32 551)	(13 952)	(2·7)
Wales			
Clwyd	105 640	22 089	20·9
	(7024)	(7483)	(6·9)
Gwynedd	169 752	32 151	18·9
	(18 038)	(6897)	(3·5)
Powys	255 455	17 933	7·0
	(11 422)	(3994)	(1·5)
Dyfed	88 209	7110	8·0
	(11 723)	(7896)	(8·8)
Mid and West Glamorgan and Gwent	43 051	7999	18·6
	(4227)	(2522)	(5·5)
Total Wales	662 107	87 282	13·2
	(25 700)	(13 719)	(2·1)
Grand total	1 206 117	154 054	12·8
	(41 474)	(19 567)	(1·7)

10 years. On the remaining holdings, farmers either reported no change or they did not respond to the question. Farmers' perceptions of this change often appear to be at variance with the general notion that bracken is spreading (see Introduction); indeed, the picture is complex (Table 7). If farmers' perceptions of changes in bracken distribution on their own farms are correct, it is clear that the plant is not spreading rapidly in all areas of England and Wales. In several counties, farmers' estimates suggest that bracken on farmland is declining, particularly in Wales. On average, farmers perceive a slow spread in England.

Farmers' support for a national bracken control programme

Not all farmers favour a national programme to control bracken; 68% (S.E. 2%) or 8200 farms (S.E. 248) in the surveyed counties would welcome bracken control, whereas 7% (S.E. 1%) oppose it. This minority of opposition amounts to a total of 820 holdings (S.E. 138). The remaining 25% (S.E. 2%), 3070 farmers (S.E. 283), were undecided. The proportion for and against control, and the proportion undecided differed very little between counties, or between the groups of English and Welsh counties as a whole.

TABLE 5. Estimated numbers of farms with common rights and with bracken on their commons (S.E.s in parentheses)

	LFA farms with rights		LFA farms with rights & bracken on the common	
	Number	% Over all farms	Number	% Of farms with rights
England				
Durham and Northumberland	216	18·9	56	25·9
	(68)	(6·0)	(36)	(18·5)
Cumbria	846	55·7	316	37·4
	(96)	(6·3)	(78)	(10·1)
N. Yorkshire	286	35·7	141	49·3
	(53)	(6·7)	(42)	(17·3)
Devon and Cornwall	363	42·8	230	63·4
	(67)	(7·9)	(64)	(21·2)
Total England	1711	39·7	743	43·4
	(145)	(3·4)	(115)	(7·7)
Wales				
Clwyd	231	21·9	84	36·4
	(70)	(6·6)	(47)	(23·1)
Gwynedd	410	28·7	93	22·7
	(81)	(5·7)	(45)	(11·8)
Powys	1227	39·4	483	39·4
	(134)	(4·3)	(100)	(9·2)
Dyfed	251	17·4	18	7·2
	(68)	(4·7)	(17)	(7·0)
Mid and West Glamorgan and Gwent	391	53·2	228	58·3
	(68)	(9·2)	(63)	(19·0)
Total Wales	2510	32·3	906	36·1
	(197)	(2·5)	(136)	(6·1)
Grand total	4221	34·9	1649	39·1
	(245)	(2·0)	(178)	(4·8)

CONCLUSIONS AND DISCUSSION

In total, the sampled 12 090 LFA farms of EC types 3 and 4 own and rent 1206 117 ha of land, of which 154 054 ha are reported to have some bracken (this figure does not distinguish between the presence of bracken, and dense stands of the plant). The estimated total area of commons on which these farms have grazing rights is 427 577 ha, of which 136 095 have bracken. In total, the farms graze an estimated 1633 674 ha, including commons, of which 290 149 ha are estimated by the farmers to carry bracken (18%). In other words, for every 5·6 ha of upland, 1 ha has bracken on it. The position county by county is summarized in Table 8.

Common land is more heavily infested with bracken than farmers' own land and keep. This presumably reflects the fact that common rights make it much more difficult and uneconomic for individual farmers to control bracken, because they cannot exclude neighbours' stock by fencing.

Interestingly, despite widespread antipathy to bracken among hill farmers, only 68% unequivocally supported a national eradication programme, for example by

TABLE 6. Estimated county total and farm average common grazing rights, and the proportion of common areas with bracken (S.E.s in parentheses)

	Grazing rights		Infestation	
	Farm average (ha)	County total (ha)	Infested total (ha)	% *
England				
Durham and Northumberland	44·6	9652	8156	84·5
	(2·4)	(513)	(453)	(13·5)
Cumbria	194·6	164 538	40 970	24·9
	(47·0)	(40 495)	(24 999)	(13·5)
N. Yorkshire	100·1	28 622	3632	12·7
	(53·1)	(15 196)	(3337)	(8·4)
Devon and Cornwall	182·6	66 266	10 755	16·2
	(95·7)	(34 708)	(11 428)	(13·3)
Total England		269 078	63 513	23·6
		(55 458)	(27 693)	(11·4)
Wales				
Clwyd	51·2	11 802	3179	26·9
	(10·4)	(2391)	(2353)	(18·8)
Gwynedd	93·4	38 339	3336	8·7
	(23·0)	(9431)	(2101)	(4·9)
Powys	58·1	71 284	50 248	70·5
	(12·6)	(15 402)	(33 048)	(42·8)
Dyfed	38·0	9555	337	3·5
	(17·0)	(4270)	(396)	(3·5)
Mid and West Glamorgan and Gwent	70·4	27 519	15 482	56·3
	(24·1)	(9400)	(11 012)	(33·2)
Total Wales		158 499	72 582	45·8
		(20 967)	(34 979)	(22·9)
Grand total		427 577	136 095	31·8
		(59 289)	(44 614)	(11·3)

* The percentage infestation is calculated over all common rights.

biological control (Lawton 1988; Lawton, Rashbrook & Compton 1988); 7% of survey farmers opposed a national control programme.

The survey also reveals discrepancies between widely quoted figures for the average rate of spread of bracken in Britain (Taylor 1986), and farmers' individual perceptions of changes in the distribution of bracken on their own holdings over the past 10 years. We found no evidence for an average rate of spread of 1% $year^{-1}$ (the most widely quoted figure). Farmers' estimates put the maximum rate at just over 4% over 10 years in Cumbria; in Wales as a whole, farmers reported that infestations have declined on LFA farms by just under 2%. These figures cannot be used to assess more subtle changes in the status of the plant, e.g. changes in density from sparse to dense infestations, or the reverse.

We cannot explain why the questionnaire provides such different estimates from those of Taylor (1986). One possibility is that Taylor included but we excluded Scotland from the analysis. Rates of spread of bracken in Scotland would, however, have to be much higher than those in England and Wales to compensate. This does

TABLE 7. Estimated changes in bracken infestation over the last 10 years (S.E.s in parentheses)

	Average change (ha)	Number of farms	Total change (ha)
England			
Durham and Northumberland	2·5	264	661·0
	(0·7)	(66)	(252·0)
Cumbria	9·2	281	2592·0
	(3·2)	(71)	(940·5)
N. Yorkshire	0·1	184	17·7
	(0·3)	(58)	(58·2)
Devon and Cornwall	−0·7	182	−126·0
	(0·3)	(56)	(69·3)
Total England		911	+3144·7
		(126)	(977·9)
Wales			
Clwyd	1·6	256	415·7
	(1·1)	(50)	(297·9)
Gwynedd	0·05	539	25·6
	(0·7)	(83)	(381·8)
Powys	−0·9	827	−781·0
	(1·0)	(122)	(843·1)
Dyfed	−4·0	423	−1707·5
	(1·4)	(79)	(680·3)
Mid and West Glamorgan and Gwent	−2·5	344	−852·9
	(1·6)	(67)	(585·2)
Total Wales		2389	−2900·1
		(107)	(1323·1)
Grand total		3300	+244·6
		(225)	(1645·3)

not appear to be the case (Miller, Morrice & Whitworth 1989). Exclusion of Scotland aside, there are three reasons in particular (which are not mutually exclusive) why our data disagree with those of Taylor (1986): (i) historically high rates of bracken encroachment have slowed greatly over the past decade; (ii) rates of encroachment on farmland and associated commons are lower than in the total landscape; (iii) farmers have poor perceptions of rates of bracken change on their own farms.

We do not have sufficient information to say which (if any) of these possibilities contribute to the discrepancy between Taylor's (1986) data and ours, although farm questionnaires may underestimate non-farmland bracken (Taylor 1990). However, we think it is unlikely that farmers do not know whether bracken has spread, declined or remained constant on their own farm. Indeed, remote sensing data on the distribution of bracken in Scotland compares well with the results of a postal questionnaire survey of 1600 farmers in three upland areas (Miller, Morrice & Whitworth 1989; Miller, Morrice & Whitworth 1990). While there is a clear difference between a static estimate of bracken cover and estimates of its rate of spread or decline, the Scottish data suggest that farmers can assess the status of the plant on their own land with reasonable accuracy. Miller, Morrice & Whitworth (1989) also reported considerable regional differences in rates of change of bracken cover in

TABLE 8. Summary of the total farmland (own land plus rented keep) and common land on LFA farms (EC types 3 & 4) in the surveyed area of England and Wales, together with the status of bracken; infested land includes both land with bracken present and dense stands (S.E.s in parentheses)

	Farmland and common (ha)	Infested (ha)	Infestation (%)	Change (%)
England				
Durham and Northumberland	210 639	36 897	17·5	1·83
	(20 725)	(10 713)	(5·4)	(0·88)
Cumbria	340 448	62 431	18·3	4·34
	(44 422)	(25 660)	(7·9)	(2·43)
N. Yorkshire	139 835	12 029	8·6	0·15
	(20 442)	(5621)	(4·2)	(0·49)
Devon and Cornwall	122 166	18 928	15·5	−0·66
	(36 257)	(12 520)	(11·2)	(0·57)
Total England	813 088	130 285	16·0	2·48
	(64 306)	(31 009)	(4·0)	(0·98)
Wales				
Clwyd	117 442	25 268	21·5	1·67
	(7420)	(7844)	(6·8)	(1·31)
Gwynedd	208 091	35 487	17·1	0·07
	(20 355)	(7210)	(3·9)	(1·08)
Powys	326 739	68 181	20·9	−1·13
	(19 175)	(33 288)	(10·3)	(1·34)
Dyfed	97 764	7447	7·6	−18·68
	(12 476)	(7906)	(8·2)	(17·79)
Mid and West Glamorgan and Gwent	70 570	23 481	33·3	−3·50
	(10 307)	(11 297)	(16·7)	(2·90)
Total Wales	820 606	159 864	19·5	−1·78
	(33 150)	(37 573)	(4·7)	(0·91)
Grant total	1 633 694	290 149	17·8	0·08
	(72 348)	(48 716)	(3·1)	(0·57)

Scotland, varying from an increase of 3% year^{-1} to decreases of 0·5% year^{-1}. These regional differences mirror those reported by farmers in our survey. We attribute apparent declines in Wales to sustained attempts at control by individual farmers, again revealed by the questionnaire.

Farmers' perceptions of the status of bracken in England and Wales now require detailed checking against independent land-based and satellite surveys, as in Scotland (Miller, Morrice & Whitworth 1989, 1990). Land-based and satellite survey techniques, however, have their own special problems and biases (Smith & Wooding 1989; Miller, Morrice & Whitworth 1990; Taylor 1990), making farmers' perceptions an additional valuable contribution to assessments of the scale of the bracken problem.

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APPENDIX 1

The 'Bracken Questionnaire'

Farm No: _____

Please tick the appropriate answers or enter details as requested:

General farm information

(1) What type of farm do you have?
(e.g. hill-sheep, mainly beef, etc.) _____

(2) What is the total area of:
(i) your farm land _____ acres;
(ii) your common land share _____ acres;
(iii) any rented keep _____ acres.

(3) What are the numbers of your livestock kept on the common land?
(i) _____ heads of ewes;
(ii) _____ heads of cattle.

(4) What is the:
(i) lowest altitude point of the whole farm (feet above sea level)? _____ ft;
(ii) highest altitude point of the whole farm (feet above sea level)? _____ ft.

(5) What are the types and sizes of your three main non-livestock enterprises, i.e. arable, cash roots, fodder crops, grasses?

	Crops		
	1	2	3
Type of crop			
Area (acres)			
Annual output (metric tons)			

(6) What are your three main livestock enterprises? Show details below:
In your description of grazing area include your farm-land plus share of common land and any rented keep.
Regard as your common land share the fraction of it that you use (i.e. the share of total common area, or the share that your total stock uses on the common).

	Livestock enterprises		
	1	2	3
Stock type & breed			
Number of head			
Grazing area (acres)			

General farm information (cont.)

	Livestock enterprises		
	1	2	3
Quality of grazing (good/medium/rough)			
Extra feed supplied (type and tons year^{-1})			

(7) Do you consume milk produced on your farm?

Yes _____
No _____

(8) Do you drink water from:

(i) mains supply Yes _____ No _____
(ii) non-mains (wells, streams, etc.) Yes _____ No _____

(9) Indicate the area:

(i) on the non-arable farm-land including *rented keep*, and
(ii) on the non-arable *share* of commons (i.e. the share of total common area, or the share that your total stock uses on the common land), i.e.

	Acres	
	Own + keep	Commons share
Grazing land for livestock not infested with bracken		
Grazing land infested by bracken suitable only for reduced grazing densities		
Land densely infested with bracken, unsuitable for grazing		
Other non-arable, not grazing land (e.g. (e.g. fenced woodland, buildings, etc.)		

(10) Has bracken spread, declined or remained unchanged on your farm (including keep and the share of commons) in the last 10 years?

No change _____
It has spread by _____ acres
It has declined by _____ acres

Farm losses

(1) Estimate the production losses in £ for all livestock enterprises due to bracken infestation during last financial year:

£ _____ for 1987

(2) Specify the following for the last financial year for your main enterprises:

	Livestock enterprises		
	1	2	3
Type of enterprise	_____	_____	_____
Number of cases of:			
Acute bracken poisoning (death)	_____	_____	_____
Tickborne diseases and deaths	_____	_____	_____
Bright blindness	_____	_____	_____
Tumours	_____	_____	_____
Other, e.g. staggers (specify)	_____	_____	_____
Vet costs associated with bracken	£ _____	£ _____	£ _____

(3) Suppose the bracken on your farm was cleared, how would you utilize the released land?

Rough grazing _____

Improved/reseeded grazing _____

Other use (please specify) _____

Weed control costs

(1) What is the average annual area of bracken on your land (including your share of commons and any rented keep) treated with herbicide during the last 5 years?

_____ acres.

Over the last 5 years, how many times, approximately, did you repeat mechanical control of bracken on the same area?

_____ times.

(2) What type of equipment was used for bracken control?

(i) Own equipment used only for bracken control:

Tractor-mounted cutter _____

Tractor-mounted crusher _____

Tractor-mounted sprayer _____

Hand-sprayer _____

Other (specify) _____

(ii) Common farm equipment used *also* for bracken control:

Tractor _____

Sprayers (specify the type) _____

Other (specify) _____

Weed control costs (cont.)

(3) What were the costs associated with bracken control and the average annual area in acres treated over the last 5 years?

	Mechanical		Spraying	
(i) *Own costs* (not contractors' costs)		acres		acres
Labour man-hours				
Regular/fixed including yourself	_____	____	_____	____
Casual labour, hired for this purpose but excluding contractors	_____	____	_____	____
Herbicide costs (£)			£ _____	____
Total own costs (£)	£ _____	____	£ _____	____
(ii) *Contractor costs*				
Total contractor costs (£)	£ _____	____	£ _____	____

Farm gains

(1) If bracken is harvested as biomass/fuel for any purpose on the farm, give an estimate:
(i) of the harvested biomass in tons per year _____
(ii) of the labour man-hours involved per year _____

(2) If bracken is cut and used for bedding:
(i) state the approximate weight used in tons per year _____
(ii) estimate the man-hours involved in cutting per year _____

Personal views

(1) Would you welcome any effort to control bracken on a national basis?

Yes _____
No _____

(2) If you have any further comments that you would like to make, please use the space below.

_____
_____
_____
_____
_____
_____
_____
_____

Please now return this questionnaire using the stamped addressed envelope provided.