Stool density as a factor in the quality of hazel coppice

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I confirm that this piece of work which I have submitted is all my own work and that all references and quotations from both primary and secondary sources, including the internet, have been fully identified and properly acknowledged in footnotes and bibliography.

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1 Introduction

1.1 Hazel Coppice

Hazel (*Corylus avellana)* has been grown as a coppice crop in an intensive and systematic way for the past 1000 years. The hazel understorey is cut off to the ground on a short cycle of 5 – 12 years and used for a range of coppice crafts and products (Tabor, 1994). The practice very nearly disappeared, with the collapse of the traditional markets for coppice, when plastics took over in the 1960's. There are many hectares (ha) of derelict coppice that has not been cut for many years. These woods suffer a reduction in biodiversity because they lose the multilayered structure of an actively managed coppice.

The past 25 years has seen a revival in coppice management primarily for conservation purposes (Buckley (ed), 1992). Inextricably linked to this has been a revival of interest in the commercial uses of coppice products. There has been a resurrection of traditional products, such as the sheep hurdle, and the development of new products, many of which are desirable commodities within the horticultural industry (Howe, 1991).

Having worked as a coppice worker in the North West of England for 10 years, I have renovated many ha of derelict coppice. The majority being coppice with standards, a forestry system where some trees are allowed to mature, with an understorey of hazel and other species. For the construction of hazel hurdles, for which there is a ready market, hazel should be cut in rotation every 7 to 10 years. However, the quality of the re-growth is often very poor and the yield low (Figure 1).

Figure 1: Hazel growing at Hollins Lane

2 Literature Review

2.1 Coppice management

Coppice is a form of sustainable woodland management that dates back to Neolithic times (Peterken, 1992). It has an integral role in our cultural heritage, not only providing the materials for a wide range of household and agricultural uses but more importantly, as a resource which fuelled the industrial revolution (Harmer and Howe, 2003). Coppicing, as a forestry system, is a way of regenerating woodlands and producing a crop of small roundwood poles on a self sustaining cycle, where a crop is raised from the previously cut stumps or stools of most broadleaved trees (Evans, 1992). Coppice systems can be categorised as simple coppice, where all trees and shrubs within an area are cut at the same time, or coppice with standards, where timber species are retained to mature on a longer cycle (Harmer and Howe, 2003). Mixed species coppices are often managed as coppice with standards on cycles of 15 to 25 years for products such as charcoal and firewood (Harmer and Howe, 2003).

2.2 Hazel coppice

Hazel (*Corylus avellana*) is a common native shrub, which grows widely throughout Britain up to altitudes of 600m – 700m. It tolerates a range of soil types but is seen to prefer well drained, fertile, moderately acid to basic soils (Harmer, 2004).

Hazel is particularly suited to coppice management, producing large numbers of shoots or rods from the cut stools, which can be harvested on a 6 to 10 year rotation (Durham, 1956). There are many different coppice products from the now mainly obsolete sheep cages, crate wood and ship's fenders (Durham, 1956), to those products that have survived such as, hurdle making, thatching spars and hedge stakes (Gardener, 1993) (Figure 2). Tabor (1994) describes hazel as 'the best of all woods to work - it cuts easily, is kind to handle, rives (splits) superbly and by twisting the rod the fibres can be separated allowing it to be wound or knotted' (1994: 23).

Figure 2: Hazel products

3 Methodology

3.1 Selection of sites

In total seven sites were selected for investigation. Six of the sites, came within the North West region of England and the remaining site in the South of England (Figure 5 and Figure 6). The Northern sites being: Yealand Hall Allotments (YHA), Hollins Lane (HL), Eaves Wood (EW), Howe Ridding (HR), Roudsea (R) and Creep-a-Crawl (CaC). The Southern site being: Bittles Copse (BC), which was selected for its superior hazel. All seven sites consisted of areas of hazel coppice with standards that have been cut within the period 1996 to 1999 under the Forestry Commission's Coppice for Butterflies Challenge scheme (Forestry Commission, 1996). The scheme offered 100% grants to woodland owners, with the aim of bringing derelict coppice back into management and to protect the re-growth from browsing by the erection of a deer fence; thereby restoring neglected areas of coppice into commercially viable coppice management. The scheme lasted for three years from 1996 to 1998, except in the Morecambe Bay area, where it was extended into the winter of 1999/2000, due to the slow initial take up of the grant (Warren et al., 2001).

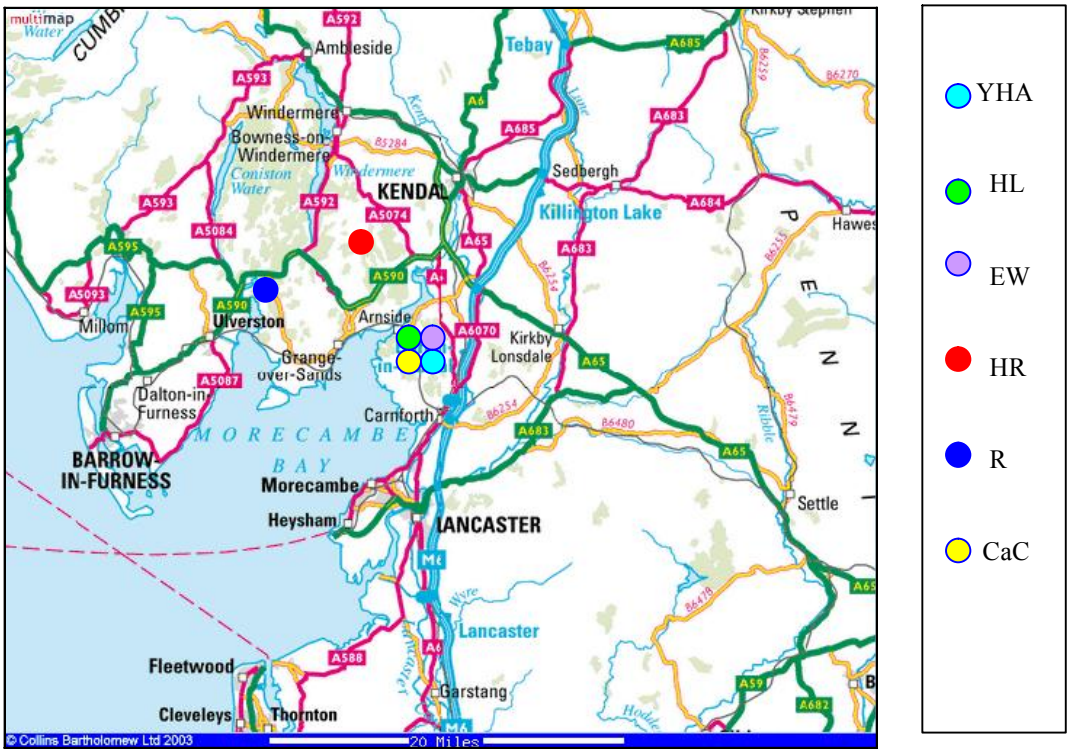

Figure 5: Location map of the North West Survey region (Multimap 2004)

4 Results and Analysis

4.1 Numbers of stools at all sites

4.1.1 Number of stools of all species

The mean number of stools within each 100m^2 plot of all species ranged from between 1 Roudsea to 19.4 at Hollins Lane (Table 3). This compares with the Southern site, Bittles C had a lower mean, 19 stools per 100m^2, than Hollins Lane.

4.1.2 Number of hazel stools

The number of hazel stools at the Northern sites ranged from 6.6 at Hollins Lane to 1 Ridding. This compared with a mean of 18.6 at Bittles Copse, the Southern site (Table 3).

4.1.3 Number of stems of hazel per stool

The number of stems on each hazel stool (excluding dead stems) was recorded and totalled f plot. The results for the Northern sites range from a mean of 74 per 100m^2 at Hollins Lane to Howe Ridding, with 329 at Bittles Copse, the Southern site (Table 3). Calculations can be m average number of stems per hazel stool by taking the number of hazel stems per plot and di the number of hazel stools per plot. Four of the northern sites, Yealand Hall Allotments, Eav Howe Ridding and Roudsea, compare well with the southern site with average counts of bet and 20.4 stems per stool. Only Hollins Lane and Creep-a-Crawl have low results of 11.8 and per hazel stool respectively (Table 3).

4.1.4 Number of quality stems

The study looked at how many stems per stool were of a sufficient quality for making hurdl requires a rod with a straight length of 2.1m or more. Means ranged from 15.2 per 100m^2 at Wood to 160 per 100m^2 at Bittles Copse (Table 3).

Table 3: Results of coppice growth at all sites

5 Discussion

5.1 Introduction

After ten years of managing hazel coppice in the North West of England it was noted that the quality of re-growth was almost always poor. The rods were forked and branched and failed to meet the quality requirements for the hazel crafts that were being produced. One of a number of reasons suspected for this poor growth was damage from browsing animals. However, even at sites where deer were excluded, the quality of hazel regrowth was poor. Stool density was also suspected to have an effect on the quality of hazel re-growth. Recent literature on hazel coppice management has recommended a stocking density of between 1000 and 2000 stools per ha or a hazel stool every 2 –3 m (Glynn 1996; Howe 1996; Harmer 2004). Densities observed at some of the six Northern sites were lower than the recommended level. Other factors were considered; the affects of light levels, soil depth and Ph. A sampling design was drawn up to look at these factors and had three main aims:

- To assess the quality of hazel coppice re-growth at the study sites and assign a grade to each site following a nationally recognised system of grading hazel (Howe 1995).

- To study the relationship between stool density and hazel quality and assess the influence of other environmental factors.

- To formulate a management prescription for improving the quality of future hazel crops.

5.2 Coppice growth factors

5.2.1 Number of stools of all species

The overall number of stools at each site including Bittles Copse were largely similar.

5.2.2 Number of hazel stools

The number of hazel stools at each plot illustrated the main difference between the Northern sites and Bittles Copse. The range was much greater with the least hazel being found at Hollins Lane at a mean of 6.6 in spite of it having the greatest number of stools overall. The greatest number by far was found at Bittles Copse with a mean of 18.6 showing that there was mainly hazel growing within that site. These figures represented a percentage hazel stools to stools of all species of just 34% at Hollins Lane to 98% at Bittles Copse.

5.2.3 Number of stems of hazel per stool

The average number of stems per hazel stool was shown to be compare well between four of the Northern sites and Bittles copse ranging from 17.4 to 20.4, only Hollins Lane and Creep-a-Crawl had quite low counts.

5.2.4 Number of quality stems

The number of quality stems per plot, were very different between the Northern and the Southern site. There was a very poor 15.2 at Eaves Wood and 17.4 at Hollins Lane, a mid range of 25.8 to 32.6 at Creep-a-Crawl and Howe Ridding. Slightly better count at Yealand Hall Allotments of 42.4 and Roudsea at 48.4 but Bittles Copse was by far the best with 160.6.

5.3 Estimation of hazel growth per ha

5.3.1 Number of stools per ha

The overall total of stools of all species ranged from 1160 stools per ha at Roudsea to 1940 at Hollins Lane, with Bittles Copse having 1900. The range for hazel stools was much wider with 660 stools per ha at Hollins Lane and 1860 at Bittles Copse. The best Northern site for hazel stools was Howe Ridding with 1220. The system of grading

coppice devised by Howe (1996) has 1000 stools per ha as its lowest benchmark and 2000 stools per ha for top quality coppice. Only Eaves Wood and Howe Ridding meet the minimum stool density of over 1000 stools per ha, recommended by Howe (Table 4) (Appendix 1).

5.3.2 Number of stems of hazel per ha

The estimation of the total number of hazel stems per ha ranged from 7788 at Hollins Lane to 32,736 at Bittles Copse. These figures can be compared with the system of grading hazel devised by Howe (1995) (Appendix 1) which suggests that Grade 1 hazel should yield 30,000 rods per ha. Bittles Copse exceeds this benchmark. Only Hollins Lane has less than 10,000 rods which is the figure below which hazel is considered Grade 4.

5.3.3 Number and height of quality rods

Howe (1995) refers to the percentage usable rods and ranges from 75% usable rods in Grade 1 hazel to less than 40% in Grade 4 hazel. At the sites studied there was a range from just 8% quality rods at Eaves Wood to 49% at Bittles copse. Height of quality rods also has an impact on quality. At Bittles Copse the height of the hazel at >4.2m was the tallest. Eaves Wood with its very low percentage of quality rods also had the shortest maximum height at 2.9 m. It is this low percentage of quality material that causes all sites to be graded lower than the total count of hazel stems per ha suggest.

5.3.4 The financial value of the hazel at the survey sites

A summary of the relative monetary values of the sites using the grading system devised by Howe (1995) (Table 10), shows that Bittles Copse could produce almost £30,000 worth of hurdles per ha. The best of the Northern sites was Roudsea with a potential £8800. These figures are perhaps misleading as they represent a huge amount of work in cutting the hazel, working it up into bundles then converting them to hurdles. Mercer (1991) suggested that it could take 14 weeks to cut a ha of hazel coppice and an equal amount of time making up the hurdles. This equates to 6 months work which makes the potential £8800 per ha at Roudsea look less attractive. A simpler calculation is the one for the bundles of 25 hurdle rods at £7.50 each. The value of the quality rods at Bittles Copse is £4848 which for 14 weeks work gives a

weekly income of £345. The value of the quality rods at Roudsea, bundled is £1452 per ha or £103 per week, not a financially viable (Mercer 1991).

Table 10: Summary of the value of the hazel at the study sites

			Number of square feet of hurdle and value at £2 per square foot				
Site	**Grade**	No of quality Rods per ha	(Rod number divided by 1.1)	Value	(Rod number divided by 25 x 18)	Value	Value of rods at £7.50 per bundle of 25
YHA	**3**	4240	3854	£7704	2775	£5550	£1272
HL	**4**	1740	1582	£3164	1139	£2278	£522
EW	**4**	1520	1382	£2764	995	£1990	£456
HR	**4**	3260	2964	£5928	2134	£4268	£978
R	**3**	4840	4400	£8800	3168	£6336	£1452
CaC	**4**	2580	2345	£4690	1688	£3376	£774
BC	**2**	16160	14,690	£29,380	10,577	£21,154	£4848

5.4 Key issues

5.4.1 The relationship between hazel stool density and hazel quality

There was shown to be a relationship between the number of hazel stools and the overall number of hazel stems but not between the number of hazel stools and the number of quality stems. There was no causation between stool density and quality. There was a relationship found between the number of hazel stems and the number of quality rods. The more hazel stems there were the more quality rods were found.

The percentage of quality hazel at the Northern sites was undoubtably low. The quality of the hazel at the Southern site was definitely higher but not high enough to make it the Grade 1 hazel coppice that the stem count would suggest. There was, at Bittles Copse, a higher percentage of hazel stools, a higher number of stems per ha, and a much higher number of quality rods. Only the average number of hazel rods per stool was comparible with four of the Northern sites. The only conclusion that can be drawn with certainty is that more stools would produce more stems of which a percentage would be of good quality.

5.4.2 Environmental factors

5.4.2.1 Soil Factors

The literature states that hazel prefers well-drained reasonably fertile, moderately acid to basic soils; it will thrive on both loam and chalk (Harmer 2004). The soil analysis found that the soil texture varied from silt loam to silty clay loam at the Northern sites and clay loam at the Southern site. The soil depth at Bittles Copse was considerably deeper than the Northern sites and produced a better grade of hazel. However, when the Southern site was removed from the analysis, there was no statistical significance between soil factors (pH, soil depth and soil texture) and hazel quality at the Northern sites. This does not necessarily mean that soil factors are not linked to hazel quality, this would therefore merit further investigation with a larger sample size.

5.4.2.2 Canopy Cover

There was no significant relationship between percentage canopy cover and hazel quality although the regression of these two factors suggested a weak relationship where hazel quality improved with higher percentage canopy cover. In contradiction to what the literature suggests; that hazel prefers an open site with maximum light levels (Harmer and Robertson 2002). A larger sample would be required to investigate this.

5.4.2.3 Altitude

The altitudes of the sites were all fairly similar ranging between 10 and 85m above sea level. All well within the range suggested for hazel growth of up to 700m (Harmer 2004) This did not have any significant relationship to hazel quality.

5.4.3 Seedling regeneration

The regeneration of seedlings on the sites was variable with only Roudsea and Bittles Copse showing very little regeneration. The regeneration was young and was assumed to have very little impact on the hazel growth. There may well be some future competition between seedling regeneration and coppice regeneration with the potential for the affect on quality of forcing shoots up to find light.

5.5 Limitations of the study design

5.5.1 Suitable sites

The main limiting factor for the study was the low number of sites within the North West region suitable for investigation. There were ten sites in this region, that had been coppiced, under the Coppice for Butterflies Challenge scheme. Four of these sites were deemed unsuitable either because of; the lack of hazel within them, excessive canopy cover or difficulties with access. The six study sites from the North West region comprised the remainder.

5.5.2 Access within the sites

All sites had been effectively fenced to exclude deer. The light levels within the woods, following felling four, five and six years previously, had encouraged bramble growth and some of the areas were almost impenetrable. Despite conducting the field work in winter there were problems of access within the some of the study sites.

5.5.3 The Southern site

The Southern site was selected from the Sussex area, 'Bittles Copse' and was situated in an area where hazel coppice is still widely practiced. It had been restored from an area of derelict coppice within the restrictions of the Coppice for Butterflies Challenge scheme. This site was intended as an illustration of the coppice grading system used in the study. On examination, Bittles Copse was considered to be grade 2 coppice according to the system developed by Howe (1995) (Table 4). Because the Southern site was so statistically different from the Northern sites it was considered an outlier and therefore was removed from the analysis into the relationship between coppice growth factors, environmental factors and hazel quality.

5.5.4 Comparisons between the Northern and the Southern site

Direct comparison between the Northern sites and the Southern site were invalid as there were other variables such as latitude, and soil depth to be taken into account. When the data from Bittles Copse was taken out of the analysis the main premis that there would be a relationship between stool density and hazel quality was not upheld.

There was little substantive difference between the Northern sites. A larger sample would have been needed to discover any trends that may have become apparent.

5.6 Recommendations for further study

The findings of this study were partially inconclusive. A definite relationship between stool density and hazel quality was not found. Further study on this subject would be useful. Recommendations for future studies include:

- Replicate the study with a higher sample of sites, in both the North and South of England featuring a range of grades of hazel to establish what factors encourage a higher percentage of quality rods.
- Investigate further the relationship between soil depth and the number of quality rods.
- Set up a longitudinal study to measure dynamic parameters such as growth. A long term study would allow better control of environmental factors such as canopy cover, browsing and climate.
- Consider recutting the sites to see if the second cycle of regrowth would be stronger than the first (Harmer 2004).

6 Conclusion

6.1 Hazel grading

The grading system devised by Howe (1995) proved very useful as a basis for quantifying hazel quality. There were some modifications that had to be made to it to take into consideration the low percentage of quality material available. Also the financial element was adapted to local market conditions in the North West of England. The findings revealed that the best hazel coppice in the study was at Roudsea, which would be considered grade 3 coppice, with a monetary value of £1452 per ha. The next best site was Yealand Hall Allotments, which was also grade 3 and had a value of £1272 per ha. All the other Northern sites were grade 4 hazel and of very low value. The conclusion drawn is that it is unlikely to prove to be financially viable to coppice any of these sites again in future without further financial support. The Southern site; Bittles Copse was a grade 2 hazel coppice and had a financial value of £4828 per ha, which could offer a coppice worker a potential income of £345 per week (Mercer 1991).

6.2 Hazel quality

The study found that there is a positive relationship between hazel stool density and the number of hazel stems and a positive relationship between the number of hazel stems and the number of quality rods. However, no relationship was found between the number of stools and the number of quality rods. The conclusion could be drawn, therefore, that the more stools there are, the more stems there are, therefore the more quality rods will be found.

Environmental factors do appear to have an impact on hazel growth, however, no specific factors were identified that influence the quantity of quality rods in a hazel coppice. A larger, more in-depth, study would be required to identify these factors.

6.3 Management Recommendations

1 Increase the stocking rates of hazel coppice by planting seedlings or layering hazel shoots (Harmer and Howe 2003). The study shows that an increase in stocking rates would accomplish three things:

- More stools would produce more stems of which a percentage would be quality rods.
- More stools would produce earlier canopy closure reducing the conflict between commercial and conservation aims of coppicing (Mitchell 1992).
- More quality rods would increase the financial viability of hazel coppice, allowing a return for woodland owners and reducing the dependence on the public purse.

2 Hazel when it has been stored (allowed to become derelict) for some time may well regrow more vigorously following a second cut (Harmer 2004). Cutting the hazel on a shorter rotation in order to benefit from the superior growth following a second cut should be considered.

3 When selecting sites for hazel coppice management, assess the percentage of hazel to other species. Although the stool density was similar over all the sites studied, only the Southern site had a high percentage of hazel stools. It may be more appropriate to manage mixed coppice on longer cycles for different products such as charcoal or firewood (Harmer and Howe 2003).

4 Favour sites with deeper, well drained, acid to base soils. Although there was no statistically significant link found between soil depth and hazel quality at the Northern sites it was a major factor that differentiated Northern sites from the Southern site.

6.4 Conclusion

The commercial hazel coppices of the North West of England, that supplied the material for the packing crates used in the Potteries up until the 1960's, have disappeared. The lack of management and the conversion of coppice woods to other uses has resulted in the loss of a resource which used to support many coppice workers, up until the latter half of the last century. The coppice woods that remain are mixed species and suitable for products other than those made of quality hazel. Even within those sites where a high percentage of hazel is found, lack of management has allowed stool death to reduce stocking density until the coppices are not able to produce a viable quantity of quality material. The coppices that remain are often on marginal sites with poor, shallow soils, which may never produce quality hazel. To improve this situation, urgent action is required:

- Coppices which have a high percentage of hazel to other species but a low number of hazel stools should be planted up with hazel seedlings or layered to increase the stocking density (Tabor 1994; Harmer and Howe 2003).
- Commercial coppice managers should avoid sites where growth is weak and stem length short.
- Coppices where the stool density is good but hazel quality is poor may benefit from being cut again as the second cycle of re-growth is often stronger than the first.
- Consideration should be given to planting new hazel coppice.

When the demand for hazel hurdles was at its peak in the Middle Ages, the best most fertile farmland was given over to growing this valuable crop (Edlin 1974). With the steady rise in demand for hazel products at the present time, this may well be a viable solution to the problem once more.

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Appendix 1

Table A: System for grading hazel as devised by Howe (1995)

Grade 1	30,000 plus rods/ha (12,000/acre) with a yield of over 75% usable over waste should produce 1350m (1,800ft) of hurdle
Grade 2	20,000 plus rods/ha (8,000/acre) with a yield of over 60% usable over waste should produce 900m (1,200ft) of hurdle
Grade 3	10,000 plus rods/ha (4,000/acre) with a yield of over 40% usable over waste should produce 450m (600ft) of hurdle
Grade 4	Less than 10,000 plus rods/ha (4,000/acre) with a yield of less than 40% usable over waste

Table B: Number of usable rods per stool on average at each grade of hazel (Harmer 2003, from Howe 1995)

Stool density (ha)	Grade 1	Grade 2	Grade 3
1000	30	20	10
1375	22	15	8
1875	16	11	5

Table C: Calculating stool density (Howe 1995)

960 stools per ha	Stools 3.5 yards apart
1200 stools per ha	Stools 3 yards apart
1800 stools per ha	Stools 2.5 yards apart

Table D: Number of rods per stool, per ha (Howe 1995)

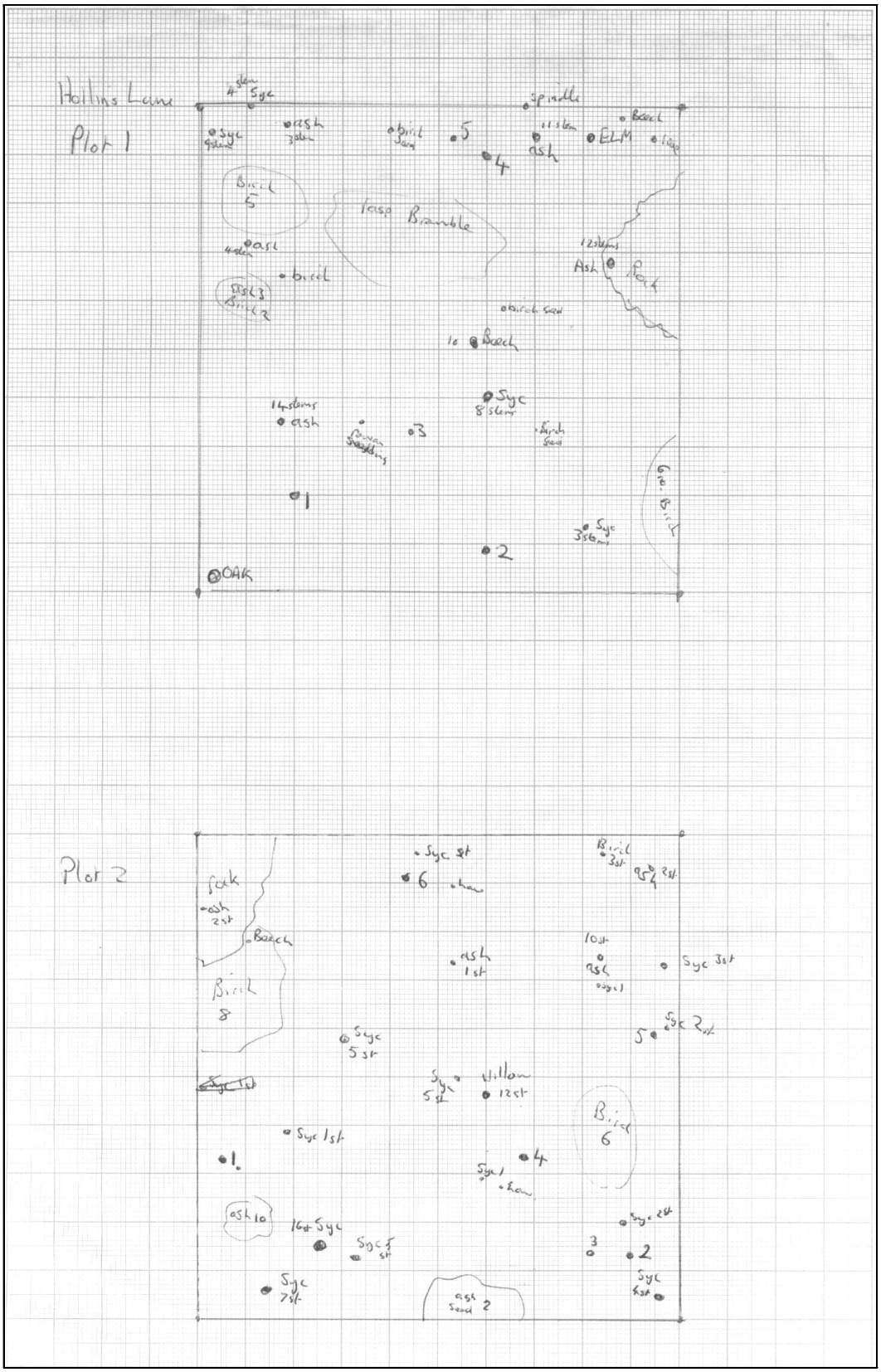
No. of stools per ha.	Usable rods per stool to produce		
	30,000 rods/ha	20,000 rods/ha	10,000 rods/ha
1000	30	20	10
1500	22	15	8
2000	16	11	5

Appendix 2

Figure 1: Map of Yealand Hall Allotments

Appendix 3

Figure 1: Sample of 10m x 10m plot



Appendix 4

Table A: Field work data: Yealand Hall Allotments

Grid Reference **SD492759**
Approximate area of survey site **0.7436 ha**
Overall canopy cover 30%
Aspect South
Altitude 20 –30m
Description Wood accessible from metalled road. Gentle slope with exposed limestone pavement and deeper soils. Standards of Oak, Birch, Ash, Yew and Hawthorn. Coppiced in 1998/99

Sample plot no.	1		2		3		4		5	
Visual estimation of canopy cover	10%		0%		0%		30%		10%	
Total Number of stools	13		10		22		17		22	
Hazel	13		10		13		5		8	
Number of stems per hazel stool	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	13 3 11 13 28 6 28 26 9 30 22 51 23	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	23 29 16 4 30 22 29 7 21 36	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	26 18 26 18 7 25 14 23 14 7 32 5 13	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	23 18 25 27 31	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	20 5 38 6 22 3 17 34
Number of stems with a minimum straight length of 2.1m	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	- - - 2 6 - 7 7 1 4 2 1 1	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	- 3 - - 2 8 8 2 9 4	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	8 6 5 8 3 10 8 9 3 4 17 3 1	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	3 5 3 4 6	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	3 1 9 2 5 10 9
Maximum height of straight lengths	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	- - - 2.3 - 4.5 4.2 3.8 2.9 4.1 4.3 3.8 3	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	- 3 - - 2.8 3.4 3.8 3.7 4.3 3.9	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	3.8 - - 4.2 - 3.5 3.7 3.6 3.8 3.5 3.9 3.6	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	3 3 3.4 3.6 3.6	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	3.2 2.8 3.4 2.2 4 - 3.1 3.3
Ash regen	110		65							
Birch regen	3						11			
Other			1							
Bramble cover	50%		30%		25%		70%		50%	
Bracken cove4	0		0		0		0		0	
Soil sample (20cm)										
Soil depth (cm)	65		31		44		20		45	

Appendix 5

Table A: Minitab data file

	C1	C2	C3	C4	C5	C6
	Site	Plot	stools, all species	stools, hazel	stems per hazel stool	2.1m straight
1	1	1	13	13	263	31
2	1	2	10	10	217	36
3	1	3	22	13	228	85
4	1	4	17	5	124	21
5	1	5	22	8	145	39
6	2	1	17	5	104	31
7	2	2	26	6	61	3
8	2	3	14	8	71	1
9	2	4	15	7	76	30
10	2	5	25	7	58	22
11	3	1	11	8	218	28
12	3	2	22	10	164	11
13	3	3	31	8	98	7
14	3	4	17	14	253	0
15	3	5	14	11	228	30
16	4	1	26	18	274	68
17	4	2	16	11	177	16
18	4	3	14	10	240	31
19	4	4	14	11	156	17
20	4	5	15	11	194	31
21	5	1	16	12	135	53
22	5	2	11	8	171	59
23	5	3	12	10	203	50
24	5	4	8	6	168	33
25	5	5	11	8	143	47
26	6	1	22	12	95	17
27	6	2	14	9	106	21
28	6	3	12	11	171	58
29	6	4	7	7	170	30
30	6	5	14	8	20	3
31	7	1	19	18	349	174
32	7	2	17	17	232	69
33	7	3	21	21	358	198
34	7	4	18	17	331	174
35	7	5	20	20	377	188