FOREST RESEARCH

Does Bramble Facilitate the Natural Regeneration of Broadleaved Trees?

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With: **Dave West**, Research Forester
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Summary

A survey in Northamptonshire of 10 sites with heavy clay soils was made in July 2004 to investigate whether bramble is beneficial to the establishment of tree seedlings. The number of tree seedlings occurring, and the amounts and heights of grass and bramble present were assessed within a total of 516 quadrats. Seedlings of 13 species were recorded with willow, birch and ash being most common. The amount of bramble tended to be greatest beside drains and windrows, whereas grass was more abundant in the areas between these. Analyses showed that there was no simple relationship between bramble cover and tree seedling numbers. Although there were some significant relationships for some species at some sites they were inconsistent and there is little evidence to support the hypothesis that bramble facilitates the establishment of tree seedlings.

Introduction

1. Bramble is an important species in many British woodlands playing an important role in their ecology. It produces flowers that are a source of nectar and pollen for insects; the fruits are consumed by a variety of animals; the thickets of bramble canes can provide a valuable habitat for some small birds and mammals.

2. The presence of bramble is not always beneficial, for example it can provide shelter for rabbits and voles that can damage tree seedlings, and it may have an adverse effect on the quality of the ground flora present.

3. Its role in the natural regeneration of trees is unclear. Although some studies suggest that it can protect trees from browsing animals, most recent experimental results indicate that bramble can hinder the establishment of naturally regenerating trees.

4. In contrast recent local observations in Northants Forest District suggest that bramble is beneficial for the establishment tree seedlings.

5. The survey described below was carried out on 10 sites in Northamptonshire to investigate whether the number of seedlings present was related to the cover and height of brambles.

Methods

Sites

6. Seven sites were selected from a list of felled areas provided by the local forester, the sub-compartments selected were chosen on the basis of:
   - The presence of tree regeneration in the early stages of establishment that was scattered across the site – not too large, old or too dense;
   - Bramble cover – which varied across the site;
   - The absence of a well established, planted crop of conifers.

7. Three additional sites that the local forester identified as being representative of those where bramble was thought to be aiding establishment of trees were also surveyed.

8. The sub-compartments selected were located in 5 woodlands and were 2–11 ha in area (Table 1). The soils were surface-water gleys that supported rank vegetation dominated by grasses (*Calamagrostis epigejos*, *Deschampsia cespitosa . . .*) with some bramble that was dense in parts. There were usually some poor quality broad-leaved trees remaining after the removal of the previous crop which was most commonly Norway spruce (Table 1). All sites were in the regeneration phase, but the time since felling was unclear. The most recently felled were probably cut in 1998, and records of the current crops indicate that the oldest may have been felled in 1988. The natural regeneration observed may have been developing for between 6 and 16 years.

Sampling

9. The sites were surveyed using temporary 2 x 2 m quadrats placed on transects laid out across the sites. The structure of the sites indicated that the sampling needed to be stratified; there were 2 obvious strata on most sites and transects were placed alongside drains or windrows and the areas between these.

10. The survey aimed to assess a minimum of 50 quadrats on each site with half in each stratum. In order to try and ensure that they were independent the quadrats were widely spaced along the transects within each stratum, but they were paired between the strata (i.e. beside each other) – see Appendix I.

11. The precise layout varied and was decided by a quick walking inspection of each site. In order to capture the variation across the site the transects were located systematically across the site. The distance between quadrats along the transects depended on the size of the site and varied between 16 and 35 metres. Quadrats and transects were located by pacing the distances required.

Assessments

12. For each quadrat the following assessments were made in July 2004:
    - Transect number – number of the transect across site;
    - Quadrat number – number of quadrat along transect;
    - Distance of the quadrat along the transect – in metres approximate, by pacing;
    - Distance to the nearest potential parent tree of willow, birch, ash, oak – estimated in metres, in the following categories ≤ 25, ≤ 50, > 50, and no trees;
    - Distance to nearest old tree of any species – an estimate of how close (in metres) was the nearest established tree, or patch of scrub/shrubs either remaining from the previous crop or growing in surrounding area (e.g. road sides, next compartment). This was to get an idea of whether the quadrat was close to a tree or shrubs that could affect it by shading or use of water;
    - Bramble cover – visual estimates of cover in the following 6 classes were made: 1 = 0%; 2 = < 5%; 3 = 5 < 15%; 4 = 15 < 30%; 5 = 30 < 50%; 6 = 50 – 100%;
    - Bramble height – the height, measured in 10 cm class intervals, below which 80% of the bramble cover on the plot occurred;
    - Grass cover – for green leaves only using the same classes as for bramble;
    - Grass ht – for green leaves on vegetative shoots using the same procedure as for bramble;
    - Relative topography – was the quadrat on a higher (H) or lower (L) piece of ground relative to the area in its immediate surroundings. This was to give an indication of whether drainage on the quadrat was likely to be better or worse than its immediate surroundings;
    - Number of tree seedlings of the following species: willow; birch; ash; oak; hawthorn; field maple; other, which includes all unspecified species. Planted trees and re-growth from cut stumps were ignored. Tree seedlings were defined as plants that had obviously grown after felling; they varied widely in size from a few centimetres to several metres (i.e. those that would normally be regarded as saplings).

13. The assessments were made in summer, when all tree seedlings would have flushed and any seeds germinated.

Analyses

14. Relationship between tree seedlings, site and vegetation characteristics were investigated using Generalised Linear Models with a Poisson distribution. The basic model – *Site/(Transect + Stratum)* – allowed for differences between transects and strata within sites to be taken into account allowing the effects of vegetation to be analysed.

Table 1: Numbers and species of tree seedlings present in quadrats on the 10 sub-compartments surveyed.

Woodland/ sub-cpt.	Area	Crop	Trans	Quad	Willow	Birch	Ash	Hawthorn	Oak	Maple	Other	Total	Stocking
Top Lodge													
1019d	4.4	S	6	54 (35)	14 (648)	2 (93)	6 (278)	1 (46)	1 (46)	1 (46)	1 (46)	**26 (1204)**	**880**
1015f	3.0	S	4	54 (14)	196 (9074)	40 (1852)	2 (93)	0 (-)	5 (232)	0 (-)	0 (-)	**243 (11250)**	**1852**
1015c	5.6	S	5	54 (28)	33 (1528)	8 (370)	1 (46)	6 (278)	4 (185)	0 (-)	4 (217)	**56 (2593)**	**1204**
1016a	7.4	S/OK	5	46 (30)	14 (761)	4 (217)	9 (489)	7 (380)	0 (-)	0 (-)	4 (217)	**38 (2065)**	**1033**
1022b	11.0	S/RC	11	52 (19)	1 (48)	75 (3606)	0 (-)	1 (48)	4 (192)	0 (-)	11 (528)	**92 (4423)**	**1587**
Castor Hanglands													
1037b	6.4	S/OK	2	52 (25)	17 (817)	17 (817)	1 (48)	5 (240)	2 (96)	0 (-)	6 (289)	**48 (2038)**	**1298**
Greenside													
1072a	11.6	S	3	52 (24)	103 (4952)	0 (-)	4(192)	3(144)	8 (385)	0 (-)	9 (433)	**127 (6106)**	**1298**
Southwick													
1047c	4.6	OK	5	52 (30)	3 (144)	3 (144)	4 (192)	11 (529)	2 (96)	0 (-)	16 (769)	**39 (1875)**	**1058**
1044d	5.6	S	3	50 (20)	8 (400)	0 (-)	0 (-)	42 (2100)	0 (-)	0 (-)	3 (150)	**53(2650)**	**1450**
Brampton													
1050b	2.0	S	4	50 (8)	64 (3200)	7 (350)	59(2950)	7 (350)	17(850)	4(200)	24 (1200)	**182 (9100)**	**2100**
Total					453	156	86	83	43	5	78		

Area = area of sub-compartment (ha); Crop = previous crop; Trans = number of transects surveyed; Quad = number of quadrats assessed, the figures in brackets are the number of quadrats without seedlings. Maple = Field maple; For individual and total species the figures in brackets are estimated numbers of seedlings ha^{-1}. Stocking = No. trees ha^{-1} (estimated number of stocked quadrats ha^{-1}, see paragraph 24 for further details). S = Norway spruce; OK = oak; RC = western red cedar. The rows highlighted in grey are those identified by the local forester where bramble appears to have had a beneficial effect.

Results

15. The number of transects assessed varied between 2 and 11 (Table 1). The target of fifty quadrats was achieved on nine of the ten sites: a total of 516 were assessed.

Vegetation

16. The cover of grass present on the quadrats varied from <5% to >50%; the most common cover score was 50–100%. There were only two quadrats without grass. Overall the mean height of leaves on vegetative shoots was 50–60 cm with minimum and maximum values of 30 and 90 cm respectively.

17. Overall the cover of bramble was less than that for grass. Although range of cover scores for bramble on the quadrats varied from <5 to >50% the most common value was only 5<15%. There were forty-three quadrats which had no bramble cover. Mean height of bramble overall was about 60 cm with minimum and maximum values of 20 and 150 cm respectively.

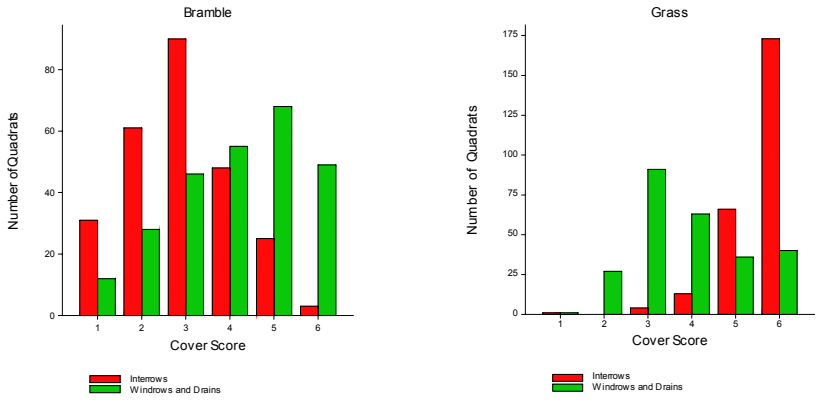


Figure 1 Cover scores for grass and bramble by strata, red is the interrow, green is the windrow/drain.

18. There were differences in the distribution of bramble and grass cover between the interrow and windrow/drain strata (Table 2, Figure 1): for grass the higher cover scores occurred in quadrats in the interrow, whereas for bramble they occurred in those beside the drains. At all sites except Brampton the mean cover score of bramble was greater in the quadrats located beside windrows or drains than in the interrows; in contrast the mean cover of grass was always greater in the interrow area between the windrows and drains.

19. The cover scores for bramble have a different distribution in the two strata with few high scores in the interrows and few low scores in the windrows/drains (see Figure 1).

Table 2: Mean cover scores of bramble and grass, and total number of seedlings, in the two strata at each site.

Woodland/sub-cpt.	Bramble		Grass		Total No. Seedlings	
	I	WD	I	WD	I	WD
Top Lodge						
1019d	3.2	5.0	5.6	4.2	14	12
1015f	2.6	3.9	5.7	3.2	49	194
1015c	2.5	4.5	5.8	2.7	50	6
1016a	2.9	5.3	5.9	3.0	26	12
1022b	2.5	3.2	5.7	5.5	35	57
Castor Hanglands						
1037b	2.9	4.5	5.2	4.4	15	33
Greenside						
1072a	3.0	3.3	5.9	3.5	113	14
Southwick						
1047c	3.5	4.7	5.5	4.3	17	22
1044d	3.2	4.4	5.7	4.8	17	36
Brampton						
1050b	3.2	2.4	4.8	3.2	98	84

I = stratum 1, the interrow areas of the sites between windrows or drains; WD = stratum 2, beside windrows or drains.
Cover scores were: 1 = 0%; 2 = < 5%; 3 = 5 < 15%; 4 = 15 < 30%; 5 = 30 < 50%; 6 = 50 – 100%.

20. For all sites the mean cover of grass in the interrow area always exceeded that for bramble (Table 2). Grass was also abundant beside the windrows and drains, and on four sites its cover exceeded that of bramble.

Tree seedlings

21. A total of 904 seedlings were recorded, half of which were willow (Table 1). The most common of the species in the other category were hazel and elder, but blackthorn, alder, Scots pine, Norway spruce and Grand fir were also recorded. Species richness was greatest at Brampton where eight species were recorded (including hazel and blackthorn), and least at Southwick, cpt. 1044d, which had only three species (including elder).

22. The distribution of seedlings between the interrow and windrow/drain areas varied between sites. On five there were more in the interrow and on the other five more beside the windrows/drains (Table 2).

23. The distribution of species varied between sites (Table 1): willow occurred everywhere, but the remaining species were absent from one or more sites.

24. Estimated stocking densities (seedlings ha^{-1}) for individual species and overall are shown in Table 1, but no account was taken of the seedlings' sizes and they may not all be truly established. In addition, differences in the areas covered by the 2 strata at each site have not been accounted for. Many sites appeared to be more or less adequately stocked but only that at Brampton had a combined total of more than 2500 stems ha^{-1} of ash and oak which are usually regarded as good timber trees. However, many quadrats had no seedlings which indicates that large areas of the sites were probably understocked. Assuming that a quadrat is stocked if it has a minimum of one seedling present (which is equivalent to 2500 stems ha^{-1}), then the proportion of stocked quadrats will give a better measure of stocking across the site than a simple estimate of seedling numbers: the data collected suggest that stocking is between 880 and 2100 stems ha^{-1}.

Relationships between site factors and seedlings

25. If bramble had a marked effect on the establishment of seedlings, then the numbers present should be greater in areas with most bramble. As there was generally more bramble beside the windrows/drains, these areas should have more seedlings than in the interrows (Table 2). However, there was no simple relationship between position and numbers of seedlings.

26. Analyses showed that the total numbers of tree seedlings were significantly related to site, transect, stratum, topography and the topography x site interaction. Bramble cover was significant but there was no trend, with classes 2 and 3 having the highest numbers. As trees differ widely in their biological characteristics, detailed analyses have been carried out on individual species.

27. The main effect of stratum (i.e. position within the interrow or windrow/drain areas) was not significant across all sites for any species. However, there was a significant site x stratum interaction for willow, birch, ash and hawthorn. This means that within a site the number of seedlings depended on position, but the effect varied with site; on some sites there were more seedlings in the interrows and on others there were more beside the windrows/drains.

28. While there was a significant relationship between grass and bramble (χ^2 = 164.4, 20 d.f., $P < 0.001$) both could still be included in the models (i.e. the presence of bramble is not equivalent to the absence of grass).

29. Distance to the nearest parent tree was significant for willow, birch and ash: the closer the tree the more likely that seedlings of these species were to be found.

Willow

30. This species provided the best set of data for analysis; it had the most seedlings and occurred at all sites.

31. In general, quadrats that were relatively lower than the surrounding land had most willow seedlings which is consistent with their need for bare wet soil during summer when seeds are germinating.

32. The effects of bramble on the number of willow seedlings was not simple: there was a significant ($P<0.001$) interaction with site (i.e. the effect varied with site). There were only four sites where the effect of bramble cover was significant (Table 3), but there was no clear trend in the effect. Data for site 1015f show that seedling numbers were greatest for cover scores of 3 and 5: mean values for the other sites were very variable and could not be separated reliably.

33. The effects of grass cover was also complicated; there was a significant interaction ($P<0.05$) with site, but no clear trend in the relationship between seedling numbers and cover were obvious.

34. The number of willow seedlings increased as bramble height increased. In contrast, seedling numbers decreased as grass height increased.

Table 3: Mean number of willow seedlings within each cover score class on the 4 sites where bramble had a significant effect.

Bramble Score	Top Lodge		Greenside	Brampton
	1015f	1015c	1072a	1050b
1	0.4c	2.1	1.5	0.7
2	1.2c	1.1	2.0	1.2
3	7.6a	0.5	3.0	1.7
4	2.4b	0.1	0.8	0.5
5	7.3a	0.0	1.7	3.3
6		0.1	0.0	

Within each column figures with different subscripts are significantly different.
Cover scores were: 1 = 0%; 2 = < 5%; 3 = 5 < 15%; 4 = 15 < 30%; 5 = 30 < 50%; 6 = 50 – 100%.

Ash

35. Analysing data over all sites showed that bramble and grass cover, and bramble height were all significantly related to the number of ash seedlings. However, this was entirely due to the data for sub-cpt. 1050b at Brampton, which was the only site to have substantial numbers of ash seedlings (Table 1). Excluding these data from the analysis showed that none of these three vegetation characteristics were significant on the remaining sites.

36. An individual analysis of the data for Brampton found that both bramble and grass cover were significantly related to the number of ash seedlings present (both $P<0.001$, Table 4). For bramble the effect was due to higher numbers of seedlings in quadrats with the second cover score (i.e. <5% bramble); for grass, cover score 4 (i.e. 15<30%) is significantly greater than cover score 3 (i.e. 5<15%).

37. At Brampton bramble height was not significant, but grass height was.

Table 4: Numbers of ash seedlings within, and quadrats with, each cover score for bramble and grass at Brampton.

Bramble Score	Seedlings	No. Quads	Mean
1	3	6	0.5
2	43	14	3.1
3	4	17	0.2
4	8	10	0.8
5	1	3	0.3
6	*	0	*
Grass Score			
1	*	0	*
2	0	1	0
3	28	19	1.5
4	26	12	2.2
5	3	15	0.2
6	2	3	0.7

Mean = mean number of seedlings in each quadrat.
Cover scores were: 1 = 0%; 2 = < 5%; 3 = 5 < 15%; 4 = 15 < 30%; 5 = 30 < 50%; 6 = 50 – 100%.

Birch

38. The relationship between birch seedling numbers and vegetation characteristics are, as for willow and ash, rather complex and there is no simple relationship with bramble. Bramble and grass heights were never found to be significant.

39. When the data for all sites were analysed bramble cover was found to be significant; this was largely due to higher numbers of seedlings in quadrats with cover scores 2 and 3 (Table 5). However, only two sites (sub-cpts. 1015f and 1022b at Top Lodge, Table 1) have substantial numbers of seedlings and omitting data for these makes the effect of bramble for the other eight sites non-significant.

Table 5: Numbers of birch seedlings within, and quadrats with, each cover score for bramble.

Bramble Score	Seedlings	No Quads	Mean
1	7	43	0.2
2	37	89	0.4
3	65	136	0.5
4	19	103	0.2
5	25	93	0.3
6	3	52	0.1

Data are for all sites. Mean = mean number of seedlings in each quadrat.
Cover scores were: 1 = 0%; 2 = < 5%; 3 = 5 < 15%; 4 = 15 < 30%; 5 = 30 < 50%; 6 = 50 – 100%.

40. Analysing the data for sub-cpts 1015f and 1022b showed that the effect of bramble cover was significant ($P<0.001$) and was due to higher numbers of seedlings in quadrats with cover scores of 5 in addition to the high numbers for quadrats with cover scores 2 and 3 (Table 6).

41. Although grass cover was significant ($P<0.05$) for the two-site analysis there was no clear trend in the data with seedling numbers peaking at cover scores of 3 and 5 (Table 6).

Table 6: Numbers of birch seedlings within, and quadrats with, each cover score for bramble and grass in sub-compartments 1015f and 1022b at Top Lodge.

Bramble Score	Seedlings	No. Quads	Mean
1	4	13	0.3
2	33	23	1.4
3	52	30	1.7
4	9	26	0.3
5	17	14	1.2
6	*	0	*
Grass Score			
1		0	
2	3	4	0.8
3	20	16	1.3
4	6	11	0.5
5	33	19	1.7
6	51	55	0.9

Mean = mean number of seedlings in each quadrat.
Cover scores were: 1 = 0%; 2 = < 5%; 3 = 5 < 15%; 4 = 15 < 30%; 5 = 30 < 50%; 6 = 50 – 100%.

Hawthorn

42. Bramble had no significant effect on the number of hawthorn seedlings present.

43. Investigation of data for all sites showed that grass cover was significant ($P<0.01$) with most seedlings being found at cover scores of 4 (Table 7).

Table 7: Numbers of hawthorn seedlings within, and quadrats with, each cover score for grass

Grass Score	Seedlings	No. Quads	Mean
1	0	2	0
2	3	27	0.1
3	11	95	0.1
4	27	76	0.4
5	19	102	0.2
6	23	213	0.1

Data are for all sites.
Mean = mean number of seedlings in each quadrat.
Cover scores were: 1 = 0%; 2 = < 5%; 3 = 5 < 15%; 4 = 15 < 30%; 5 = 30 < 50%; 6 = 50 – 100%.

Oak

44. There was no relationship whatsoever between the number of oak seedlings and any of the vegetation characteristics.

Other species

45. These were analysed as a group and no vegetation characteristics were found to have any significant effect.

Conclusions

46. There was no simple relationship between bramble cover and tree seedling numbers that was applicable to all species at the sites surveyed. There is little evidence to support the hypothesis that bramble facilitates the establishment of tree seedlings: there are no relationships between bramble cover and seedling numbers for most species at most sites, and those that occur are inconsistent.

47. Willow showed significant relationships with bramble cover at four sites but on only one could a clear difference between mean seedling numbers under different bramble covers be identified (Table 3).

48. There were significant relationships between birch seedlings and bramble cover on only two sites (Table 6).

49. For ash the bramble cover/seedling number relationship was significant at only one site (Table 4).

50. The three sites identified by the local forester as demonstrating the positive relationship between bramble and seedlings were Southwick sub-cpts 1044d and 1047c, and Brampton 1050b.

51. At Southwick sub-cpt. 1044d only hawthorn had sufficient seedlings present (Table 1) to carry out an analysis, which showed no significant relationships with any vegetative characters.

52. There were too few seedlings of any species present at Southwick sub-cpt. 1047c to carry out any meaningful analyses.

53. Brampton sub-cpt. 1050b had enough seedlings of both willow and ash (Table 1) to carry out analyses which showed that numbers were significantly related to bramble cover. However, the highest numbers of ash seedlings were found under bramble covers of <5%, whereas the highest number of willow appeared to occur at 30>50% covers.

Comments

54. The data were collected at a single point in time from a number of sites at different stages of development.

55. The flora on any site is dynamic and the current vegetation structure may not represent those that occurred when the tree seedlings first began to develop.

56. Small seedlings may not have been seen amongst tall, dense vegetation.

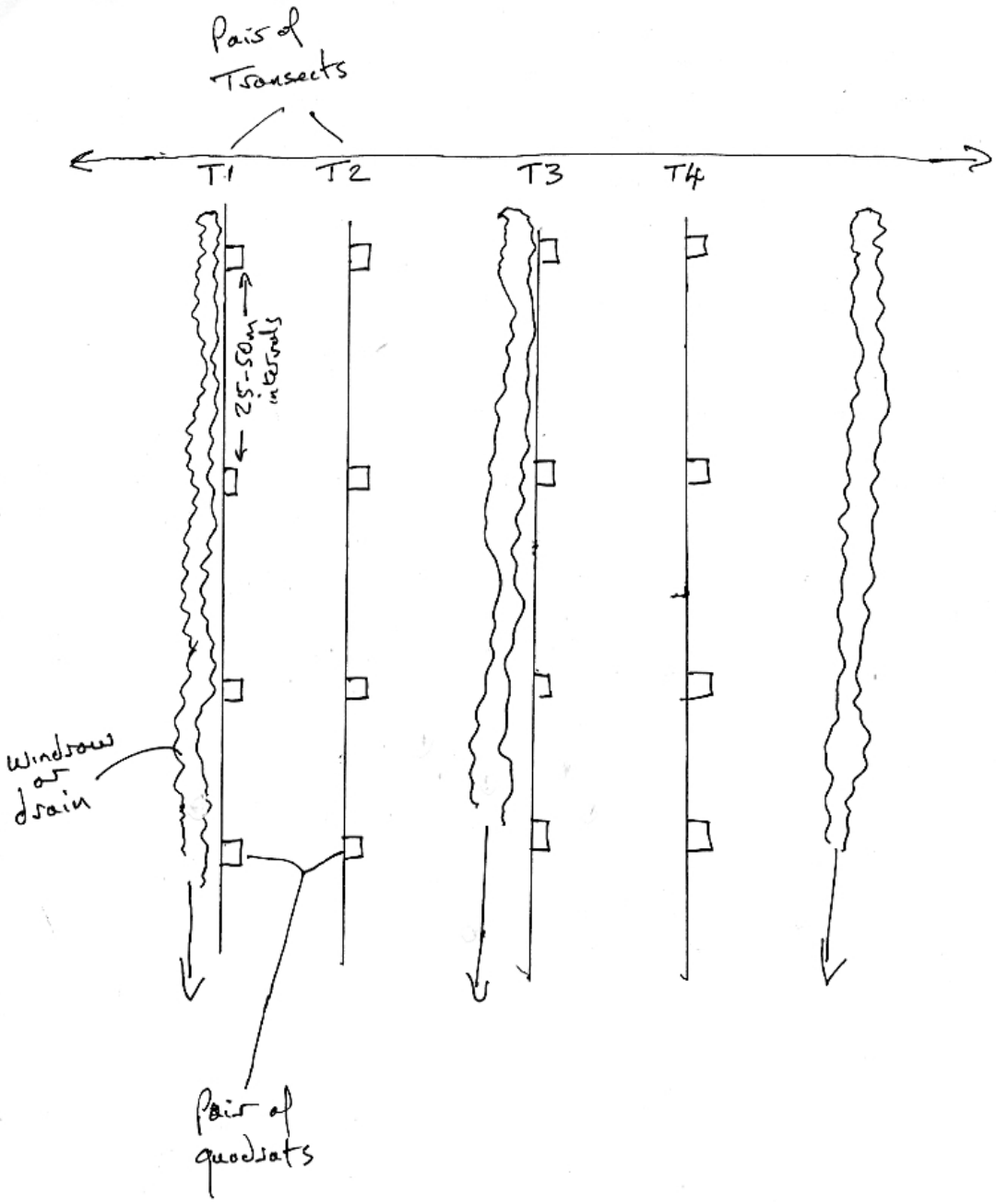
57. Willow and birch seedlings require moist soil in summer to establish. Initially they are very small and they are unlikely to survive amongst a competitive ground flora of either dense grasses or bramble. Seedlings of these species must be established before significant amounts of other ground flora develop.

58. The relationship between bramble and trees seedlings is likely to differ with size and age of the seedling: it may have adverse affects if abundant when the seedlings are small, yet have a positive effect against browsing animals when the seedlings are larger, and have grown as tall or taller than the bramble.

59. If there are relationships between bramble and tree seedlings, then it may be due to them both preferring the same type of microsites rather than one creating conditions that promote the development of the other.

60. The true relationships between bramble and the establishment of tree seedlings will only be revealed by longer-term studies with repeated assessments that begin during the early phases of vegetation development.

Appendix 1


Pair of Transects
T1
T2
T3
T4
25-50m intervals
Windrow or drain
Pair of quadrats