A baseline vegetation composition and structure survey of the Ken Hill estate rewilding area

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Fig. 1. Leica Z- Rover in a Spring Barley plot to the south

0 – Summary

The Ken Hill Estate plan to rewild a large area of some 422.7 ha of their Estate during 2019 and 2020. The summer of 2019 was the last crop for much of this area and as such, the 2019 survey season was an exciting opportunity to collect baseline data before any changes were made to the site. The author was commissioned to carry out a wide range of surveys in 2019, including this baseline vegetation composition and structure survey.

The rewilding area was gridded into a 200 x 200 m grid and circular plots placed at the nodes of the grid. A high-accuracy GPS was used to accurately mark the centre of each 300 m^2 circle (a radius of 9.77m). In each plot, species-richness, nectar abundance and diversity, structural types, seedlings, saplings, canopy trees and dead wood were all counted, identified and measured. A total of 98 plots were recorded in all, 39 of these were woodland plots and 55 more open plots, with four plots not assessed as either.

A total of 232 species were recorded to species, an additional 22 species were record to genus only or family. The most species-rich plot was 85, along the edge of the railway track to the south. It is completely surrounded by very species-poor plots dominated by Sugar Beat and is a good indicator of the direction the southern fields will head in. The mean species-richness across plots was 15.5 ± 1.3 with plot 85 having 56 species.

Bramble was by far the most frequent plant in the plots and the only species to be seen in more than half of the plots. Bramble was also by far the most frequent species to be assessed as 'Dominant', at just under a fifth of the plots.

Eight species with conservation status were recorded in the plots being: Common Cudweed, Corn Marigold, Corn Spurrey, Dwarf Spurge, Field Woundwort, Hoary Mullein, Prickly Poppy and Stinking Chamomile. All but Hoary Mullein are considered arable weeds. Plot 55 on the western edge of the site had the most species with status in, with three species present. No species with status were found in the woodland plots.

A total of 26 species were classed as non-native with the most frequent being Sycamore, at 28 plots, followed by Winter Wheat at 19 plots and Rhododendron at 18 plots. Clearly, the woodland held more non-native species than the open areas with a mean of 2.31 ± 0.19 per plot in the wooded plots compared to 1.14 ± 0.09 per plot in the open plots. This is despite the crops being classed as non-native species. The most non-native species per plot was 5 in plot 33 in the northern woodland.

Woody seedlings were recorded in 61 out of the 98 plots and were considerably more numerous in the woodland plots (133.2 ± 82.5) compared to the more open plots (8.9 ± 3.2). A total of 7086 seedlings were counted during the survey. The most abundant seedling was Honeysuckle with 4623 counted/assessed, followed by Blackthorn with 1183. After this, there was a big jump with 199 Sycamore seedlings. The most frequent seedlings were Honeysuckle present in 23/98 plots, Holly in 20/98 plots and Rhododendron in 17/98 plots.

Saplings were more than ten times more numerous in the wooded plots (20.2 ±3.2) compared to the open plots (1.43 ± 0.71). One surprising omission that was well represented in both the seedling layer and the canopy layer was pine, suggesting that the seedlings do not survive well.

A total of 594 qualifying stems had their GBH measured, occurring in 47 out of the 98 plots (48.0%). Birch was the most abundant with 148 trees measured, followed by Sycamore at 132 then Pedunculate Oak at 62. Sycamore was however the most frequent canopy tree.

A total of 41.7m^2 of basal area were measured. The greatest amount in any one plot was plot 71 with 2.49 m^2, followed by 88 with 2.29 m^2 and then 92 with 1.89 m^2. There were 13 trees with a GBH greater than 2.5 m. All bar one of the top six being oak. The largest tree was a Pedunculate Oak with a GBH of 3.87 m

Plots with only two structural layers present were the most abundant type and were almost always crops, where the only layers present were the crop layer and almost always some bare ground. The mean number of structural layers was slightly higher in the wooded plots than the open plots but this was not thought to be a particularly significant difference due to some variability between plots in each section.

The mean nectar index was slightly higher in the open areas than in the woodland but this was not tested for significance. Despite being higher, there is much room for improvement, the most frequent nectar index score across the whole site was 0, with 68 plots (69.4%) having no nectar sources at all.

No measurable deadwood was found in the open plots. Seemingly there was a greater quantity of deadwood in the southern half of the wood.

This survey should be repeated in between three and five years but if there are rapid changes that need capturing, this could be brought forward.

1 – Introduction

The Ken Hill Estate plan to rewild a large area of 422.7 ha of their Estate from 2019 and 2020. The summer of 2019 was the last crop for much of this area and as such the 2019 survey season was an exciting opportunity to collect baseline data before any changes were made to the site.

The author was commissioned to carry out a wide range of surveys in 2019, including this compositional and structural vegetation survey.

The aim of the survey was to create a robust baseline for assessing change over the coming years, using an 'atlas' like approach. That is to generate grid maps of the 98 points to allow for the spatial analyses of a wide variety of biometrics, as well as numerical analyses. The true power of this approach will be realised when more data points are collected in the future. It should be noted that more data has been collected here than could be analysed in this report and the Estate are encouraged to come up with analyses based on the data that has been collected that they think will be of benefit.

2 – Methodologies

2.1 – Logistics

2.1.1 – The grid

A 200 m grid was selected to give approximately 100 sample points across the site, this being a compromise between a large number of samples and cost-effectiveness. The nodes of this grid were posted at multiples of 100 m (rather than 200 m) due to logistical reasons of where the 200 m posts fell. Plots were labelled 1 to 104.

Seven points were not sampled due to being impossible to access safely without damaging the nature of the plot so much as to render surveying meaningless (60 plots) or had semi-naked miscreants present in them (1 plot). One plot was added that appeared on paper to be too close to the edge (any plots that were partially intersected by the proposed boundary fence were discounted).

The original ordering of the numbers was kept to avoid any confusion.

As each plot is 300m^2, 98 plots cover an area of 2.94 ha. This means that only 0.7% of the 422.7 ha rewilding was sampled.

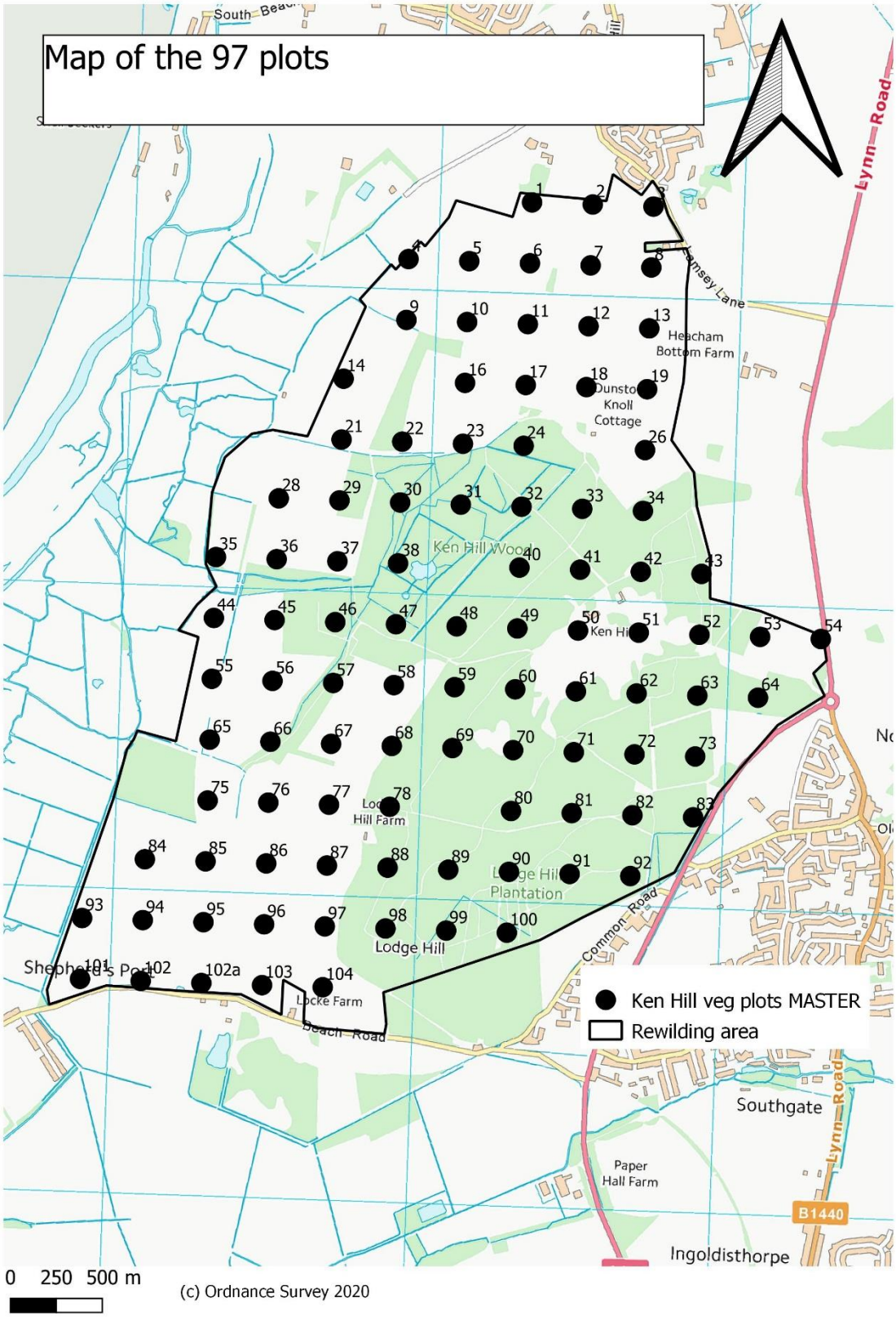

Fig. 2. Map of the survey plots

2.1.2 – Locating the points

A high-powered GPS (Leica Z-Rover – see figure 1 above) was hired by the author to carry out the survey on the three weeks in June, July and August. This allowed the author to get within 2-3 cm of the exact grid reference. This is crucial for measuring the regeneration of woody plants and other variables. Placing markers was thought to be too problematic with the changes in management that are planned, large numbers of livestock would likely destroy any markers as would any mechanical intervention. The hire of the device cost around £180 per week, therefore c£540 for the total hire. This would have been slightly lower if the work could have been done in one block but this was not possible for the author to achieve.

2.2 – Survey plots

The basic methodology of the plots follows that of Swift. It is summarised here as follows.

Once the exact location had been found, a stake was placed in the ground at the exact spot and the high-powered GPS placed on stand by and laid carefully on the ground. A Tape measure was connected to the top of the stake and run out to exactly 9.77 m. This would delineate a circle of exactly 300 m^2.

2.2.1 – Species-richness of all plants

All species of plant (including those only found in the other layers below) were recorded using the DAFOR scale.

- Dominant
- Abundant
- Frequent
- Occasional
- Rare

Plants were recorded to species where possible but in some occasions were only recorded to genus or family. Tree species particularly were often recorded to just genus. Difficulty assessing conifers resulted in spruce/larch/fir being recorded as one. Pine was recorded as pine sp. however.

2.2.2 – Seedling layer

All seedlings were counted, measured and identified within each plot. Where large quantities were present, estimates were made. A seedling was considered as any tree or shrub under 1.3 m in height. It was decided to remove Bramble from the seedling count as it wasn't possible to accurately count it. Raspberry was also removed.

2.2.3 – Sapling layer

The sapling layer was considered as all plants over 1.3 m in height but with a GBH of under 20 cm. Multi-stemmed plants, such as hazel, were counted as stems rather than individual plants (e.g., a 400m tall Hazel with 20 stems would count as 20). Bramble was not included in the calculations as it was not possible to count individual plants, instead an overall percentage score was made for bramble.

2.2.4 – Canopy layer

All trees with a Girth at Breast Height (GBH) of over 20 cm were classed in this category. They were measured using the same tape attached to the central point. This allowed for a total basal area per ha to be calculated.

2.2.5 – Structure survey

Each of the following structural layers was assessed at the end of the plot using the same DAFOR scale above. It helps to do the easier and more obvious layers first, those that are Rare or Dominant, that way the less obvious layers that site between these extremes, can be calibrated between them. There are a maximum of nine structural layers, these being:

1. Bare
2. Short grass
3. Medium grass (beat was placed here for want of a closer fit)
4. Rank grass (including cereal crops)
5. Tall herb (Oilseed Rape was also placed here)
6. Low scrub
7. Medium scrub
8. Established scrub
9. Established trees/woodland

2.2.6 – Nectar sources

Nectar sources were assessed in two ways; abundance and diversity. Each was assessed on a scale of 0 to 3. Clearly if abundance was scored as 0, diversity was also 0. The product of the two numbers was then calculated (called here 'nectar index'), allowing for scores of between 0 and 9 (or 0, 1, 2, 3, 4, 6 & 9).

2.2.7 – Mean vegetation height

This was only carried out in open areas away from the woodland. There was only enough time to take a single value at each sampling point.

2.2.8 – Deadwood

All deadwood was measured as both a diameter and a length in order to be able to calculate the volume. In practice, this was often estimated. The total number of pieces was also counted while measuring the wood. Each piece was also assessed as either hanging, standing or fallen.

3 – Results

With such a large amount of data collected, there are for more ways of analysing this data than are presented here. Repeats of this methodology in the future would also naturally generate more creative analyses. The Estate are therefore encouraged to consider other ways that this data can be analysed and interpreted.

For example, it is easily possible to generate distribution maps using the DAFOR scale for abundance for all of the species recorded during the survey. This has not been done in this report, where summaries of data have been favoured.

All means are followed by standard errors but at this stage no statistical tests have been applied to the data.

3.1 – Species-richness of all plants

A total of 232 species were recorded to species, an additional 22 species were record to only genus or family. Additionally, 15 lower plants were recorded (14 mosses and *Cladonia* lichen) but these were not counted in the analyses. The most species-rich plot was 85 with 56 species, along the edge of the railway track and was coincidentally the first plot recorded. It is completely surrounded by very species-poor plots dominated by Sugar Beat and is a good indicator of the direction the southern fields will head in. The mean species-richness across all plots was 15.5 ± 1.3.

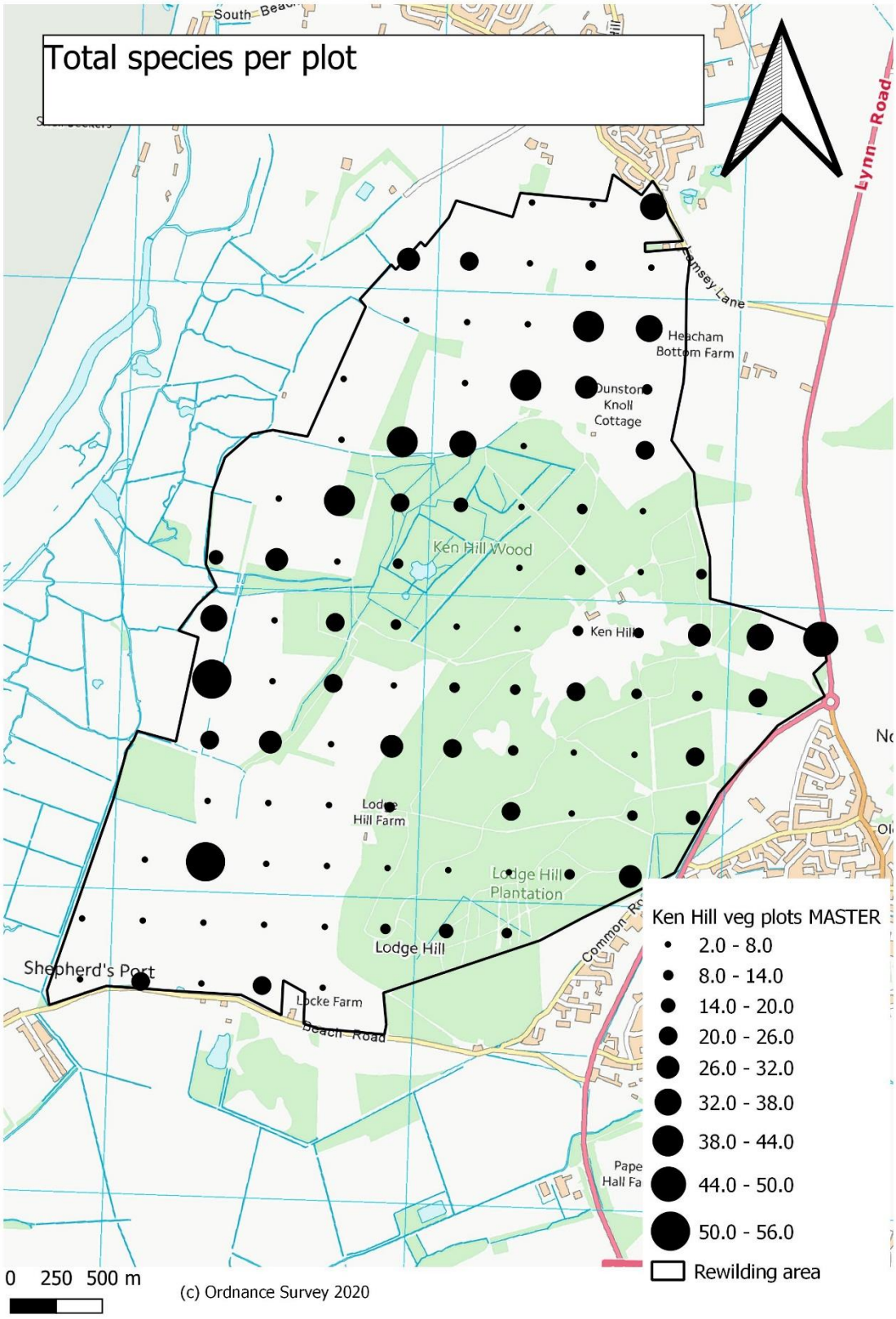

Fig. 3. Species-richness of vascular plants per plot.

Tab. 1. The most frequent species across the 98 plots

Rank	Species	Number of plots	%age of plots
1	Bramble agg.	57	58.2
2	Yorkshire-fog	37	37.8
3	Pedunculate Oak	29	29.6
4	Sycamore	28	28.6
5	Honeysuckle	26	26.5
6	Broad Buckler-fern	26	26.5
7	Black-grass	26	26.5
8	Holly	24	24.5
9	False Oat-grass	23	23.4
10	Rough Meadow-grass	22	22.4

Bramble was by far the most frequent plant in the plots and the only species to be seen in more than half of the plots.

Tab.2. The most frequent species scoring as 'Dominant'

Rank	Species	Number of plots where 'Dominant'	%age of plots
1	Bramble agg.	18	18.4
2	Winter Wheat	15	15.3
3	Spring Barley	10	10.2
4	Sugar Beat	9	9.2
5	False Oat-grass	8	8.2
6	Sycamore	7	7.1
7	Bracken	7	7.1
8	Pine sp.	6	6.1
9	Oil-seed Rape	4	4.1
10	Yorkshire-fog	4	4.1

Again, Bramble was by far the most frequent species to score 'Dominant' at just under a fifth of the plots, the next three species being crops. Five of these ten species could be considered crops (including pine).

3.1.2 – Species with conservation status

Maps of rare species will be provided in the NVC survey of the rewilding area.

Eight species with conservation were recorded in the plots. All but one of these (Hoary Mullein) could be considered an arable weed. These were:

Common Cudweed – Red List, Near Threatened

Although on the Red List, this species was so frequent around the site that it wasn't realistic to be mapped. It did however only occur in three of the plots. All three plots were arable and occurred in the north, west and south of the site.

Corn Marigold – Red List, Vulnerable

This key species was just about mappable but at times was so locally-frequent that this became difficult, the key areas being fields to the south and a single field at the very north of the site. However, the only plot that it was picked up in was at the vey east of the site adjacent to the road in field 54. Oddly this was a grassland plot, very close to an arable field where Corn Marigold just crept into the plot.

Fig.4. Corn Marigold to the south of the site.

Corn Spurrey – Red List, Vulnerable

Recorded in four plots around the site. The species is perhaps the most widespread of all the scarcer arable plants, as such it was not possible to map the species across the site in detail beyond this exercise. It even often occurred at low levels under the Spring Barley crop.

Dwarf Spurge – Red List, Near Threatened

Recorded at fairly low levels and such this species was mappable. In this survey it was only recorded in one plot, this being plot 55.

Fig. 5. Dwarf Spurge.

Field Woundwort – Red List, Near Threatened

Another species that was recorded at very high levels across the site, too frequent to be mapped. Recorded only in plot 55 along with the above species, the plot with the most species with conservation status in.

Fig. 6. Field Woundwort.

Hoary Mullein – Nationally Scarce

This species is somewhat of an East Anglian speciality and is only occasionally encountered on the site. Recorded in the plots in the fields to the east of the site. This species was recorded at a low enough frequency for all individuals to be mapped by GPS.

Fig. 7. The distinctive ‘candelabra’ of Hoary Mullein.

Prickly Poppy – Red List, Vulnerable

Recorded only from one plot, plot 103 at the extreme south end of the site near the breeding Woodlark. The species was only ever found in this general area and then at low levels.

Fig. 8. Prickly Poppy.

Stinking Chamomile – Red List, Vulnerable

This species was locally frequent but was just about mappable. In the plots, it was only recorded in one plot, plot 29. This was to the north west of the site on a plot that was about half arable and half scrub.

Fig. 9. Stinking Chamomile.

Many more species with conservation status occurred in the rewilding area but not in the plots, these will be covered in detail in the NVC survey. Distribution maps comprised of 10 square grid references made for some of these rare species will be provided in the NVC mapping exercise.

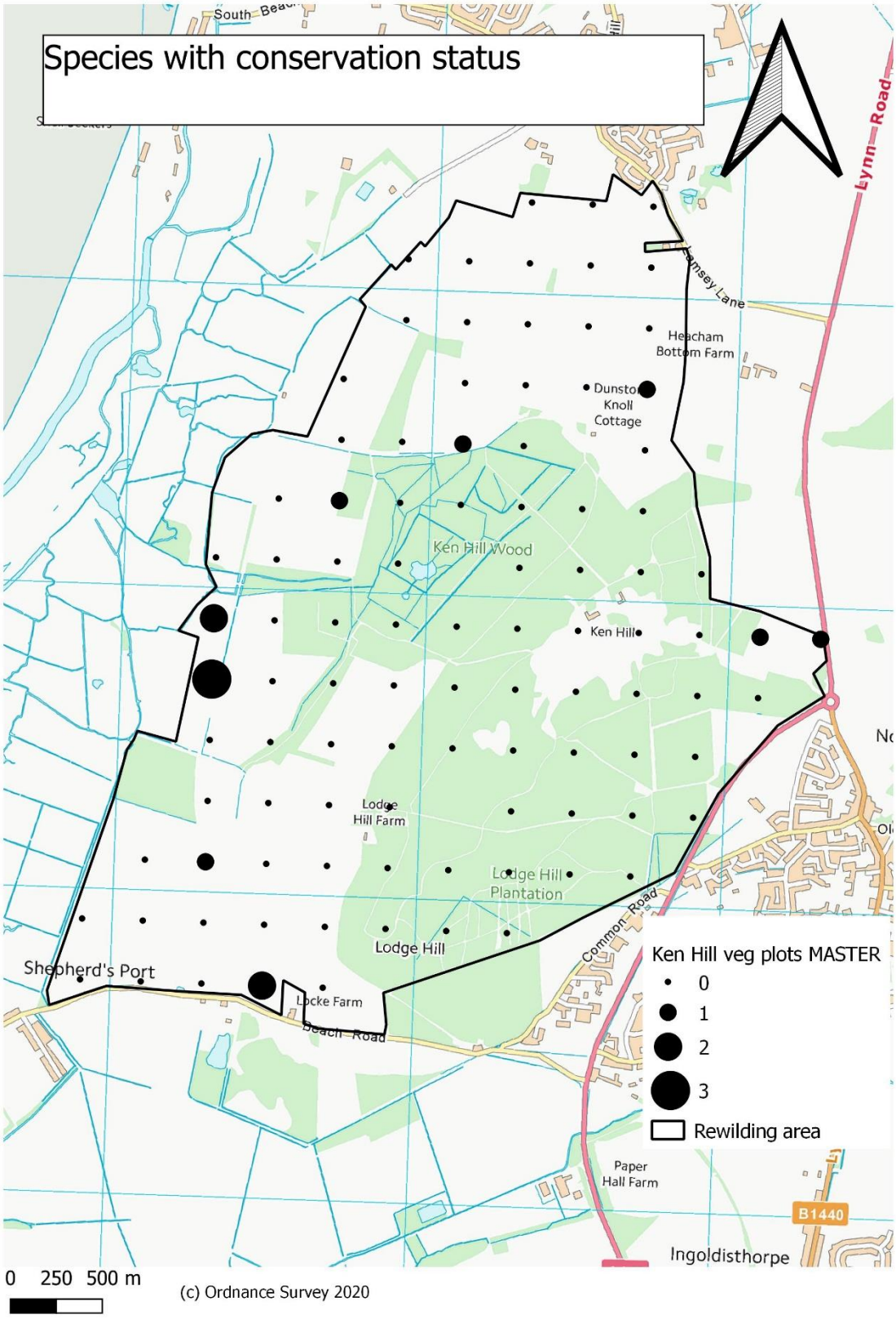

Fig. 10. Species with conservation status per plot.

Clearly the western field plots held the most rare species, followed by the southern fields, and a scattering elsewhere. This shows that although some of the rare plants mentioned

above are widespread on the site, they are still very localised. Such as only four of the available 26 plots in the southern fields had these rare species. Hopefully it will be possible to demonstrate a positive change in these plant's distributions as they spread into and around the fields.

3.1.3 – Arable plants

A total of 21 species of arable weed were recorded, these unsurprisingly being restricted to the open habitats on the site. The most species in any one plot were the six species recorded in plot 103 to the south of the site. Hopefully an improvement in this will be demonstrated but holding onto the site's rich assemblage of arable plants may not be straightforward.

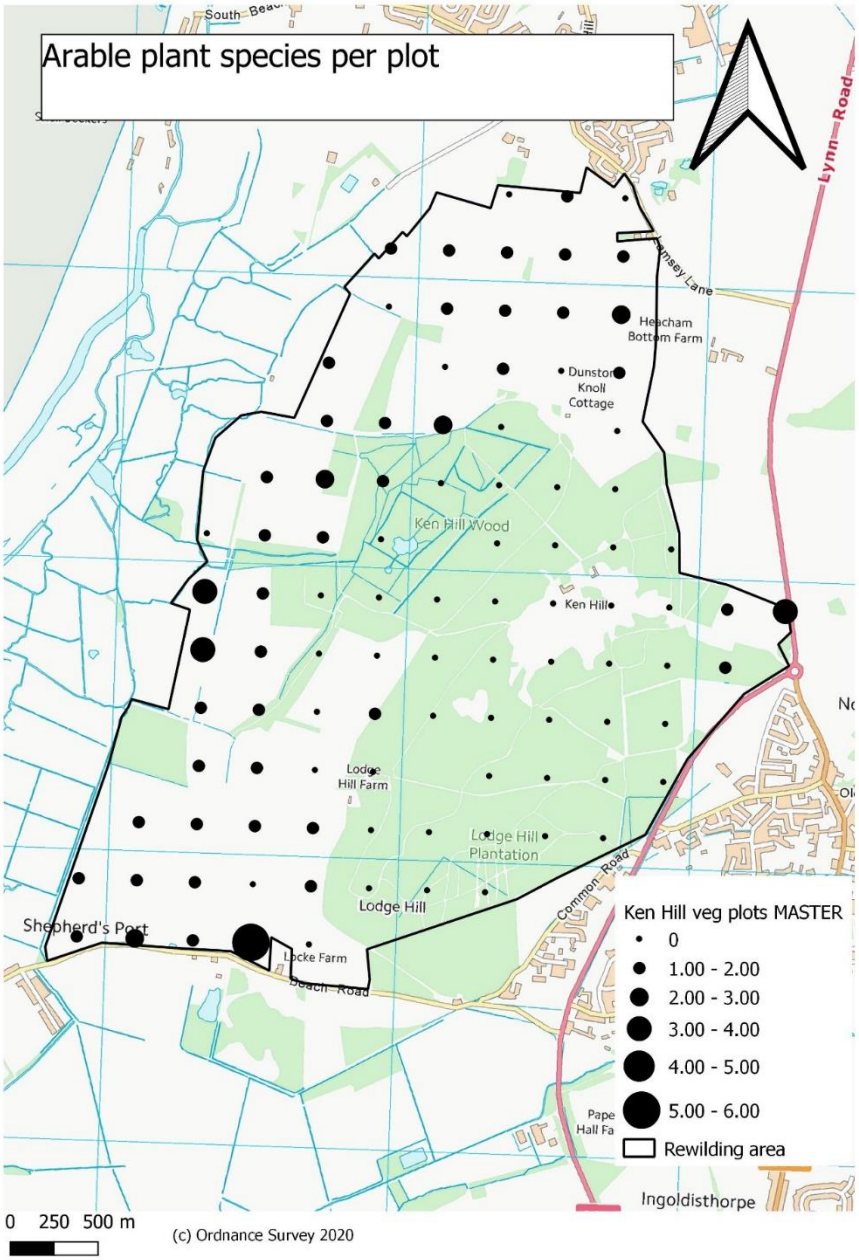

Fig. 11. Number of arable plants per plot.

3.1.4 – Non-native species

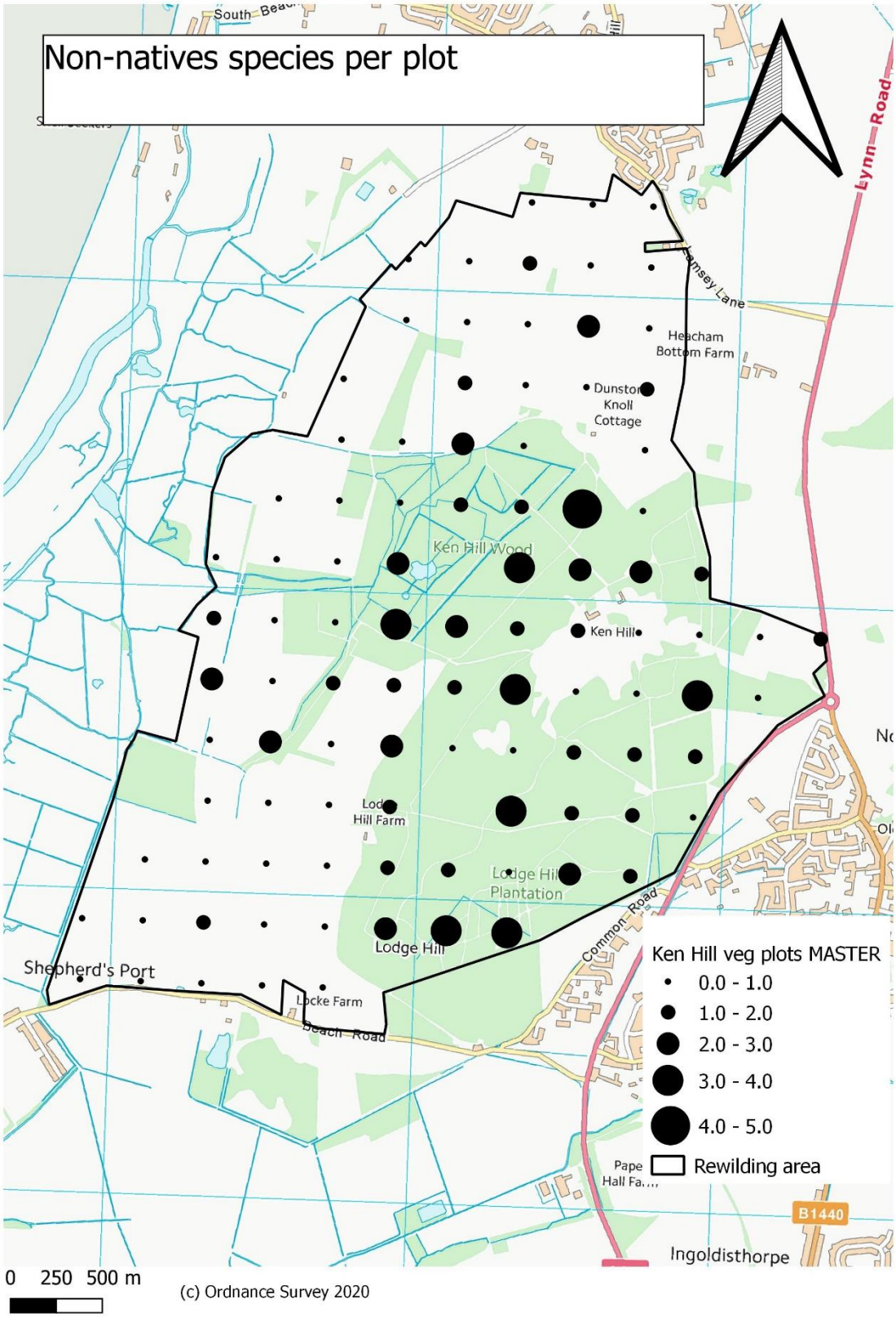

Fig. 12. Non-native species per plot.

A total of 26 species were classed as non-native with the most frequent being Sycamore, at 28 plots, followed by Winter Wheat at 19 plots and Rhododendron at 18 plots. Clearly, the woodland held more non-native species than the open areas with a mean of 2.31 ± 0.19 per plot in the wooded plots compared to 1.14 ± 0.09 per plot in the open plots. This is despite the crops being classed as non-native species. The most non-native species per plot was 5 in plot 33 in the northern woodland.

3.2 – Seedling layer

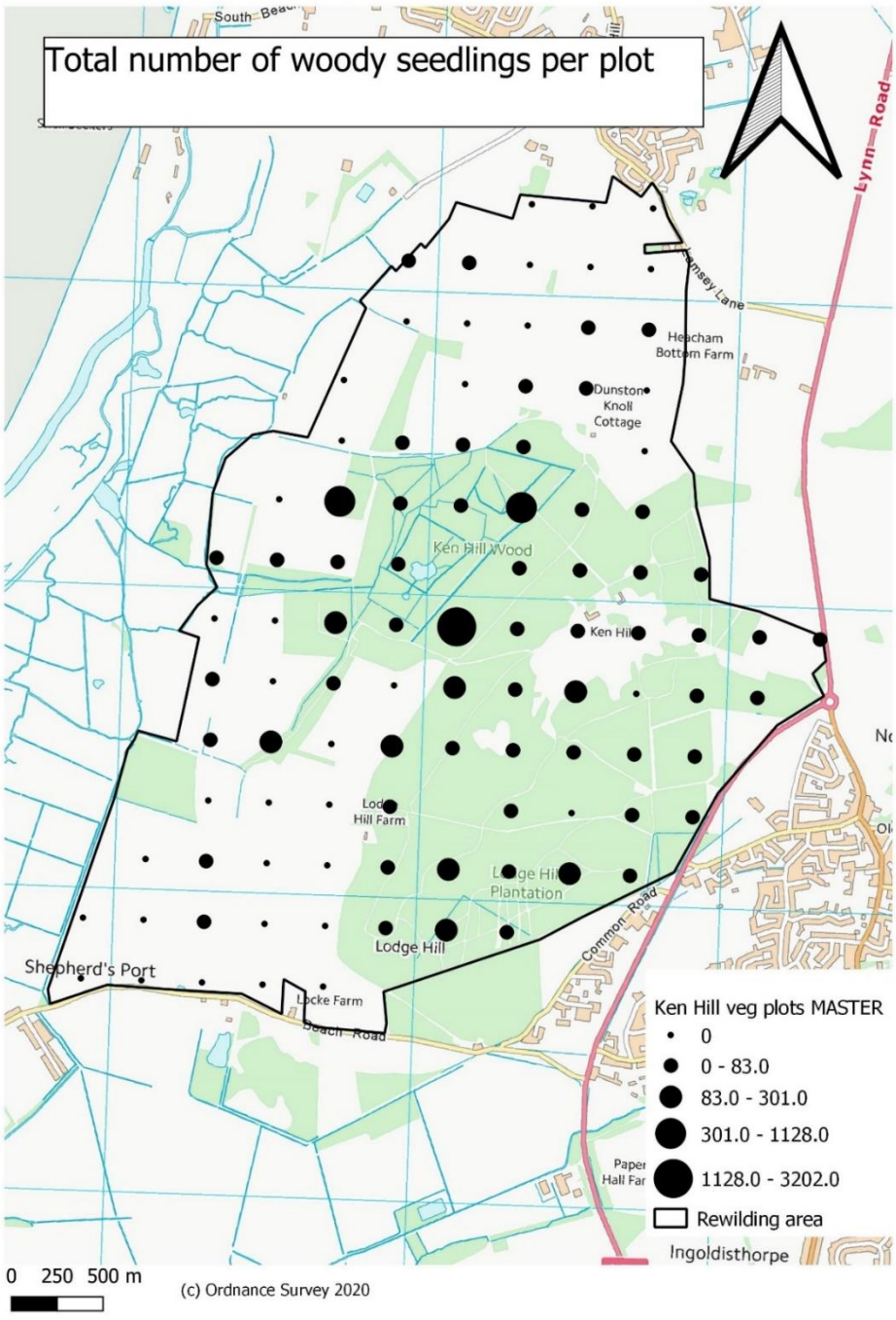

Fig. 13. Total number of woody seedlings per plot

Woody seedlings were recorded in 61 out of the 98 plots and were considerably more numerous in the woodland plots (133.2 ± 82.5) compared to the more open plots (8.9 ± 3.2). A total of 7086 seedlings were counted during the survey. The most numerous seedling was Honeysuckle with 4623 counted/assessed, followed by Blackthorn with 1183. After this there was a big jump with 199 Sycamore seedlings.

The most frequent seedlings were Honeysuckle present in 23/98 plots, Holly in 20/98 plots and Rhododendron in 17/98 plots.

3.3 – Sapling layer

Bramble was removed from this exercise and is displayed in its own map below (see figure 15). Saplings were more than ten times more numerous in the wooded plots (20.2 ±3.2) compared to the open plots (1.43 ± 0.71). One surprising omission that was well represented in both the seedling layer and the canopy layer was pine, suggesting that the seedlings do not survive to become saplings. No saplings of Turkey Oak or Yew were recorded either.

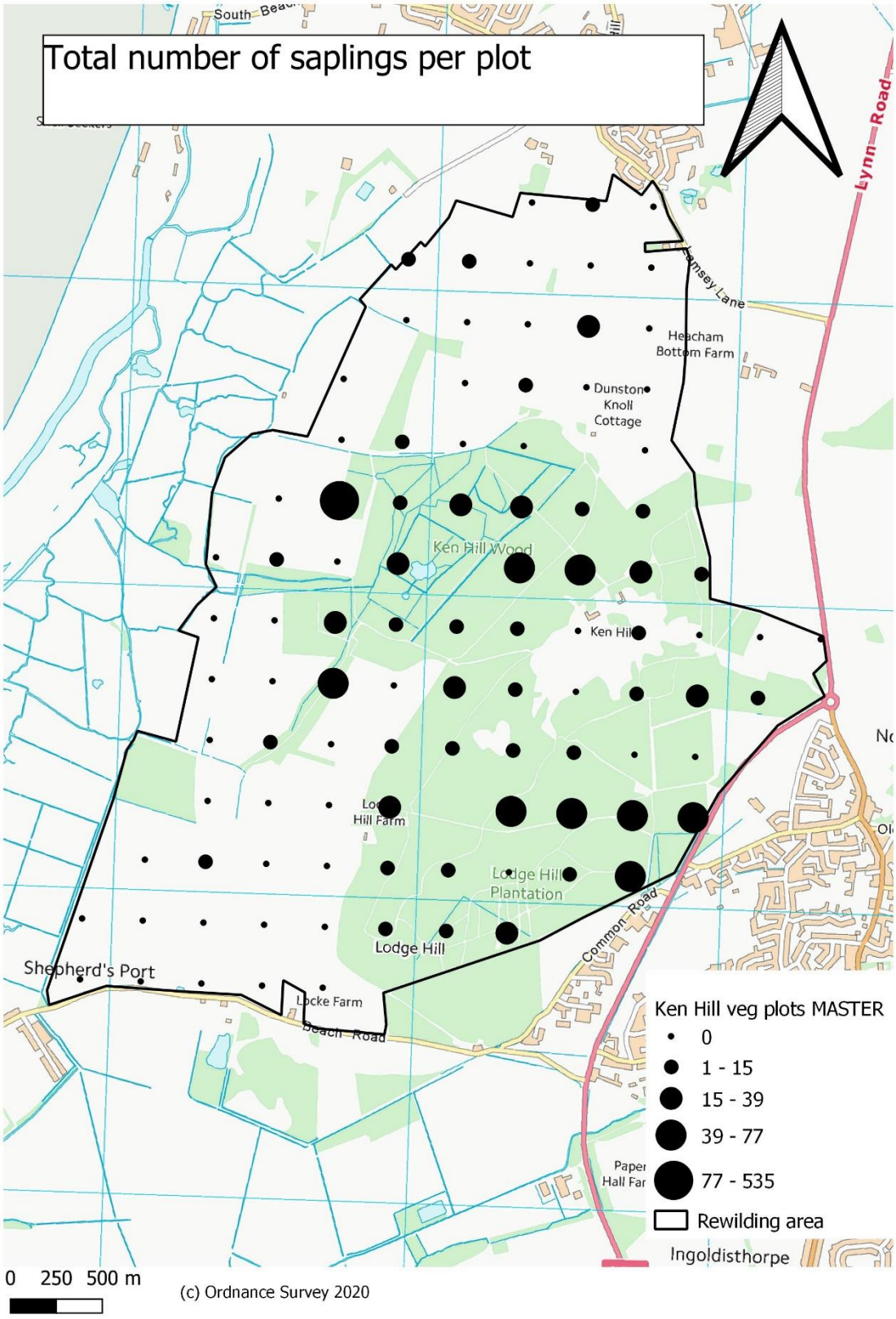

Fig. 14. Total number of saplings per plot.

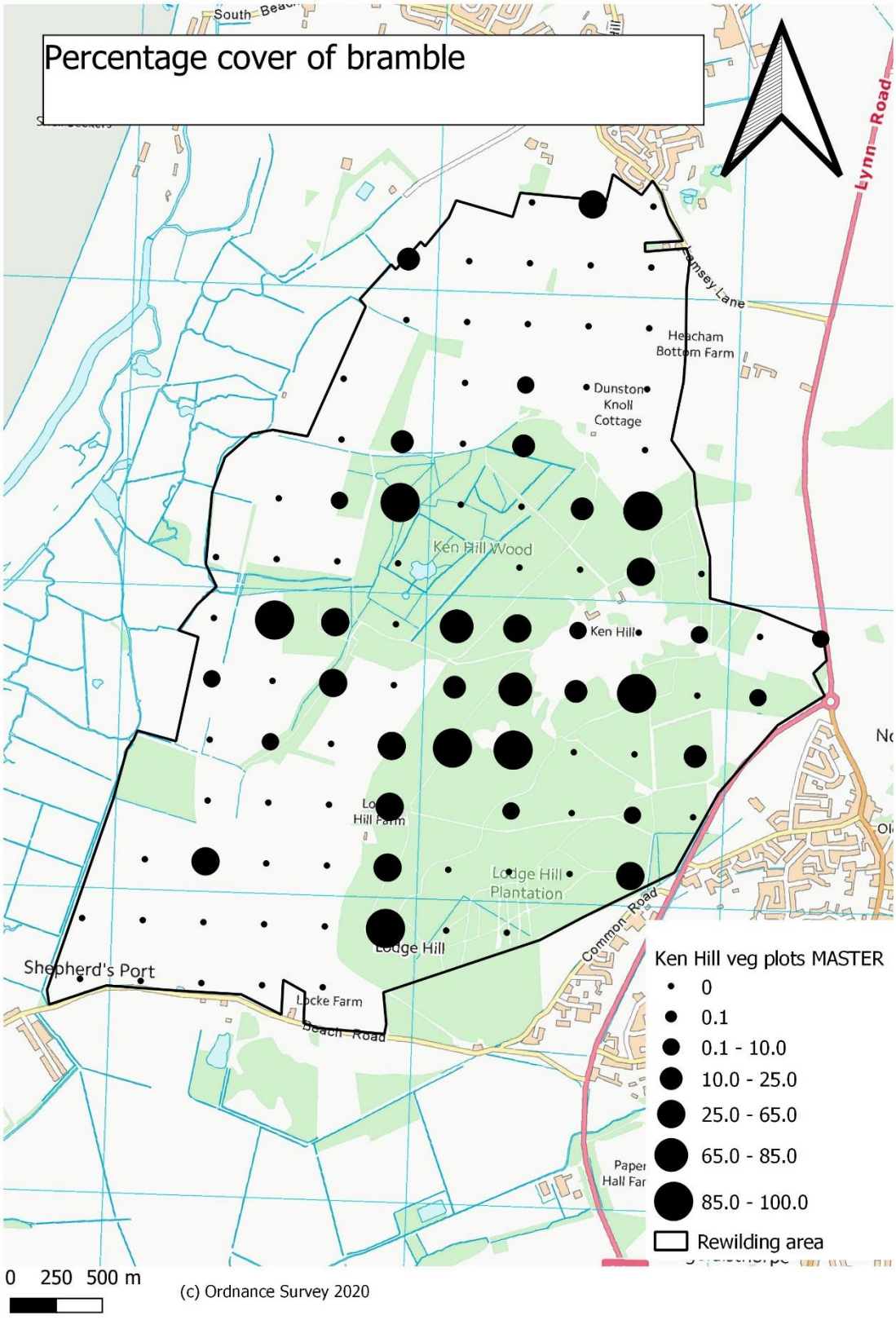

Fig. 15. Percentage cover of Bramble agg..

3.4 – Canopy layer

A total of 594 qualifying stems had their GBH measured, occurring in 47 out of the 98 plots (48.0%). Birch was the most abundant with 148 trees measured, followed by Sycamore at 132 then Pedunculate Oak at 62. Sycamore was however the most frequent canopy tree.

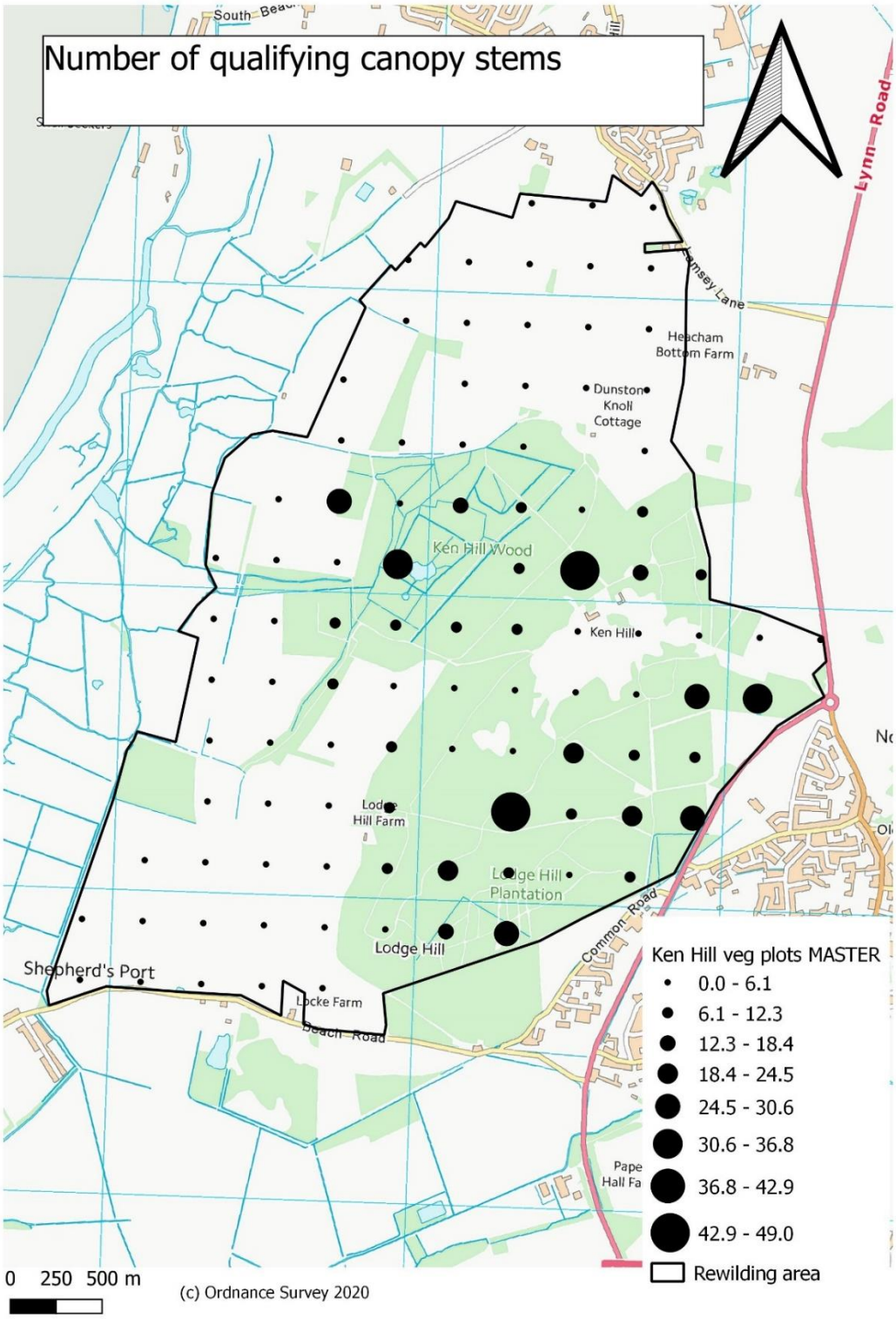

Fig. 16. Number of qualifying canopy stems per plot

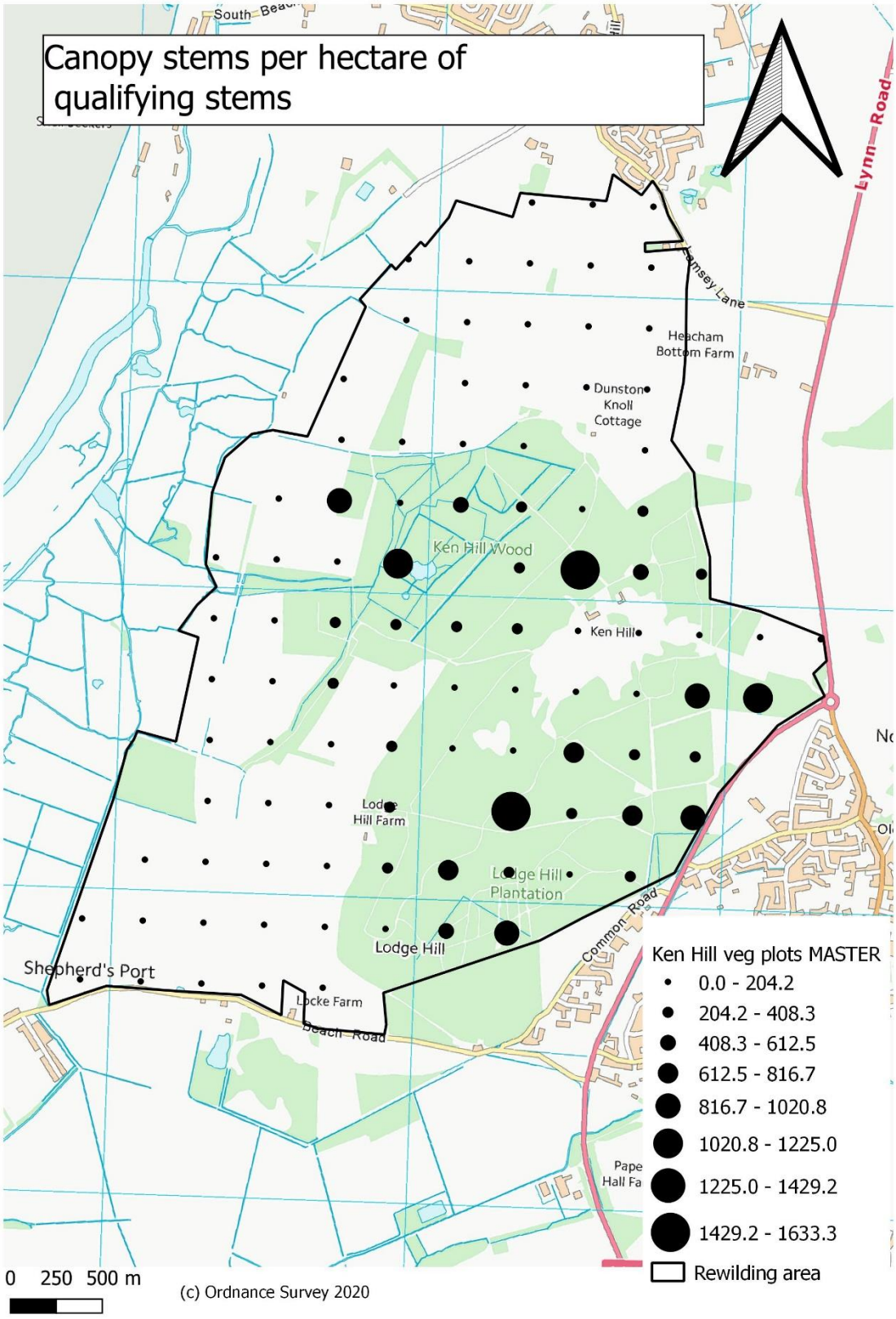

Fig. 17. Number of qualifying canopy stems per hectare.

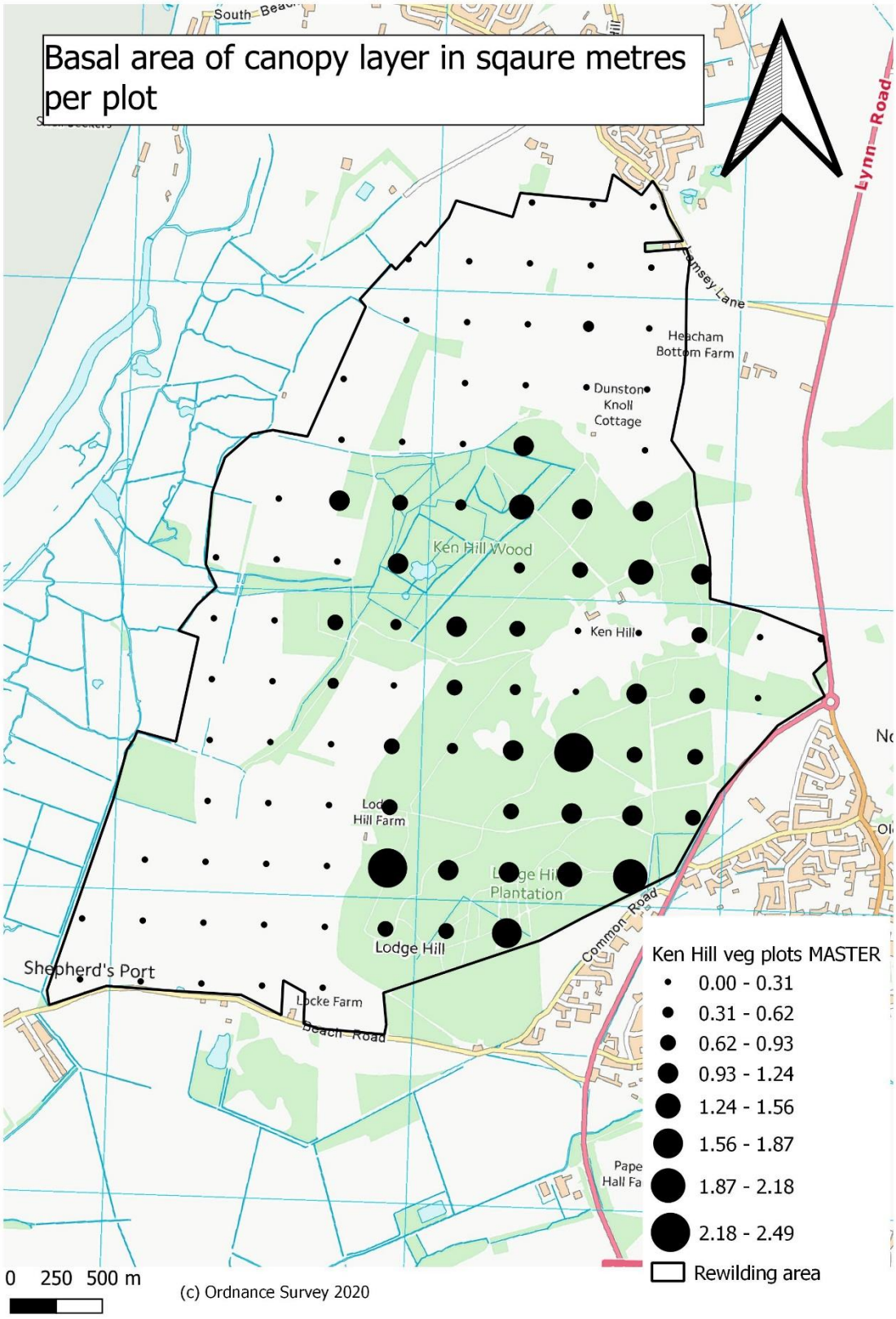

Fig. 18. Total basal area of qualifying canopy stems per plot.

A total of 41.7m^2 of basal areas were measured. The greatest amount in any one plot was plot 71 with 2.49 m^2, followed by 88 with 2.29 m^2 and then 92 with 1.89 m^2. In table 3 below it can be seen there were 13 trees with a GBH greater than 2.5 m. All bar one of the top six being oak. The largest tree was a Pedunculate Oak with a GBH of 3.87 m

Tab. 3. All trees with GBH over 2.5 metres.

Species	GBH (cm)	Plot
Oak	387	92
Oak	372	71
Beech	349	88
Oak	340	42
Oak	333	24
Oak	319	71
Red Oak	294	62
Sycamore	292	98
Oak	283	91
Oak	270	82
Oak	258	62
Pine	256	60
Sweet Chestnut	255	88

3.5 – Structure survey

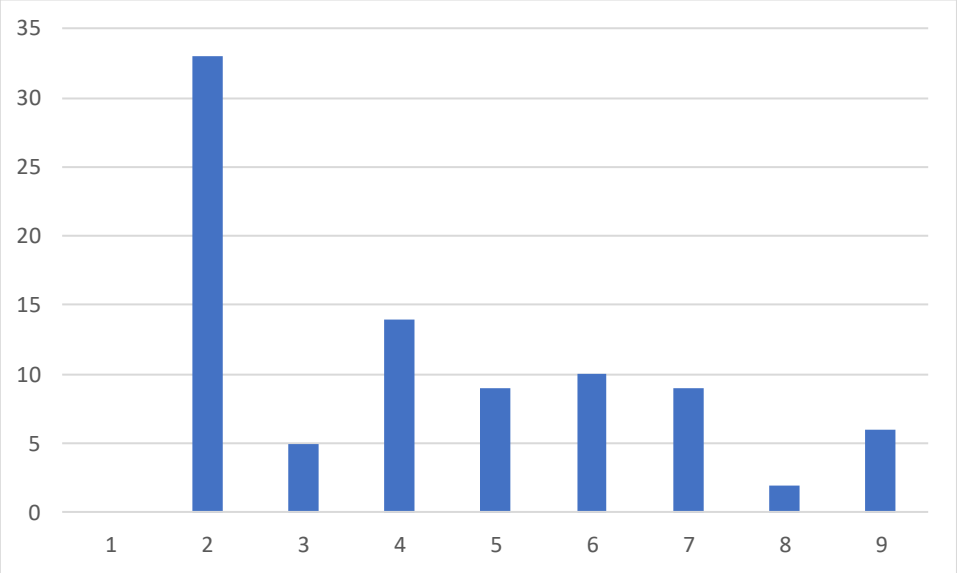

Fig. 19. Frequency distribution of the number of structural layers present in each plot.

As can be seen from figure 18 above, the frequency distribution is skewed strongly to the left. Plots with only two structural were the most abundant type and almost always crops,

where the only layers present were the crop layer and almost always some bare ground. The mean number of structural layers was slightly higher in the wooded plots than the open plots but this was not thought to be a particularly significant difference due to significant variability between plots in each section. It should be very easy to increase the number of structural layers in the previously cropped plots.

The nine structural layers are displayed sequentially. It should be noted that bare ground under closed canopy trees has very little value compared to open and sunny bare ground. Short grass and medium scrub were the least represented structural layers present which should change with grazing and the rewilding approach.

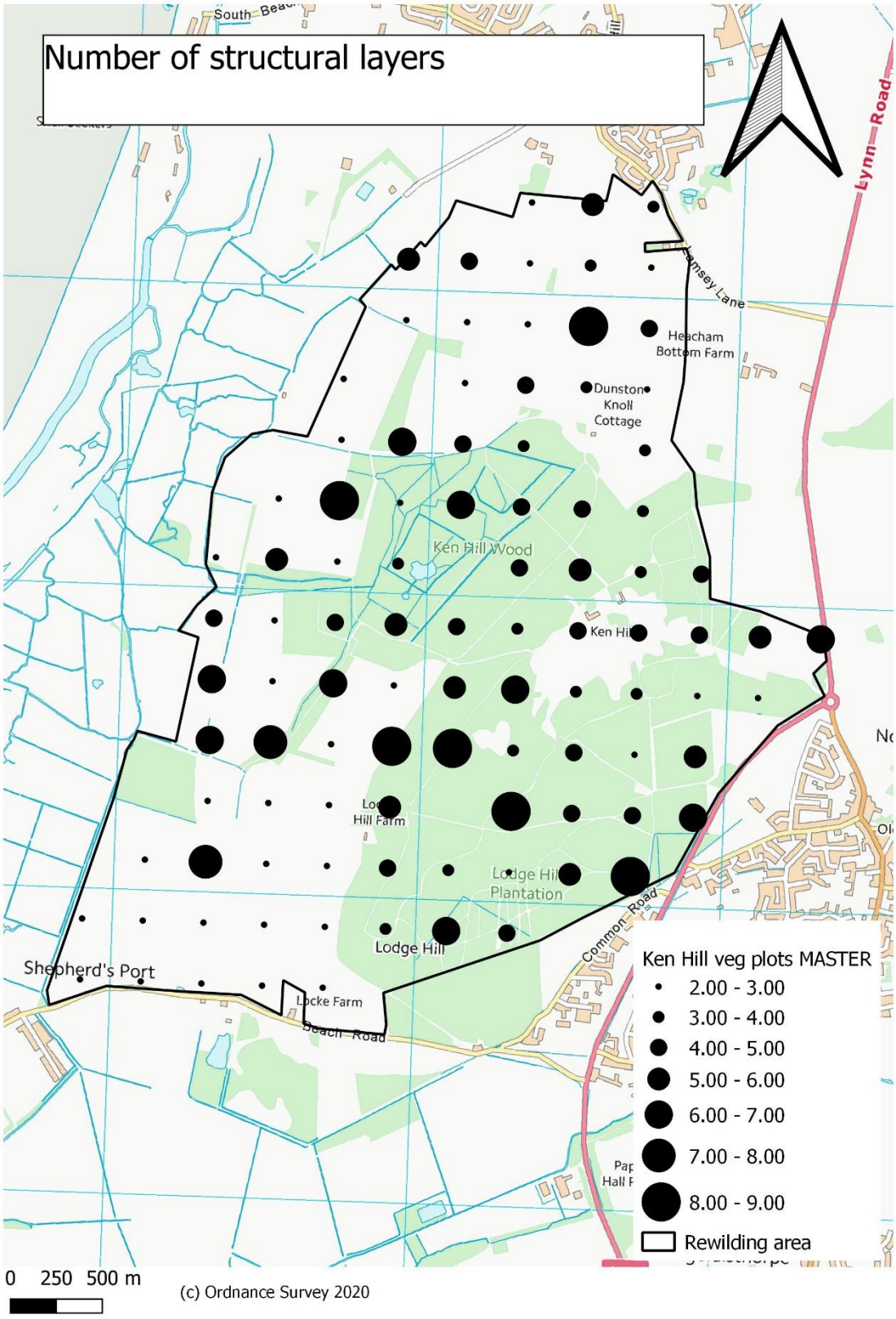

Fig. 20. Number of structural layers per plot.

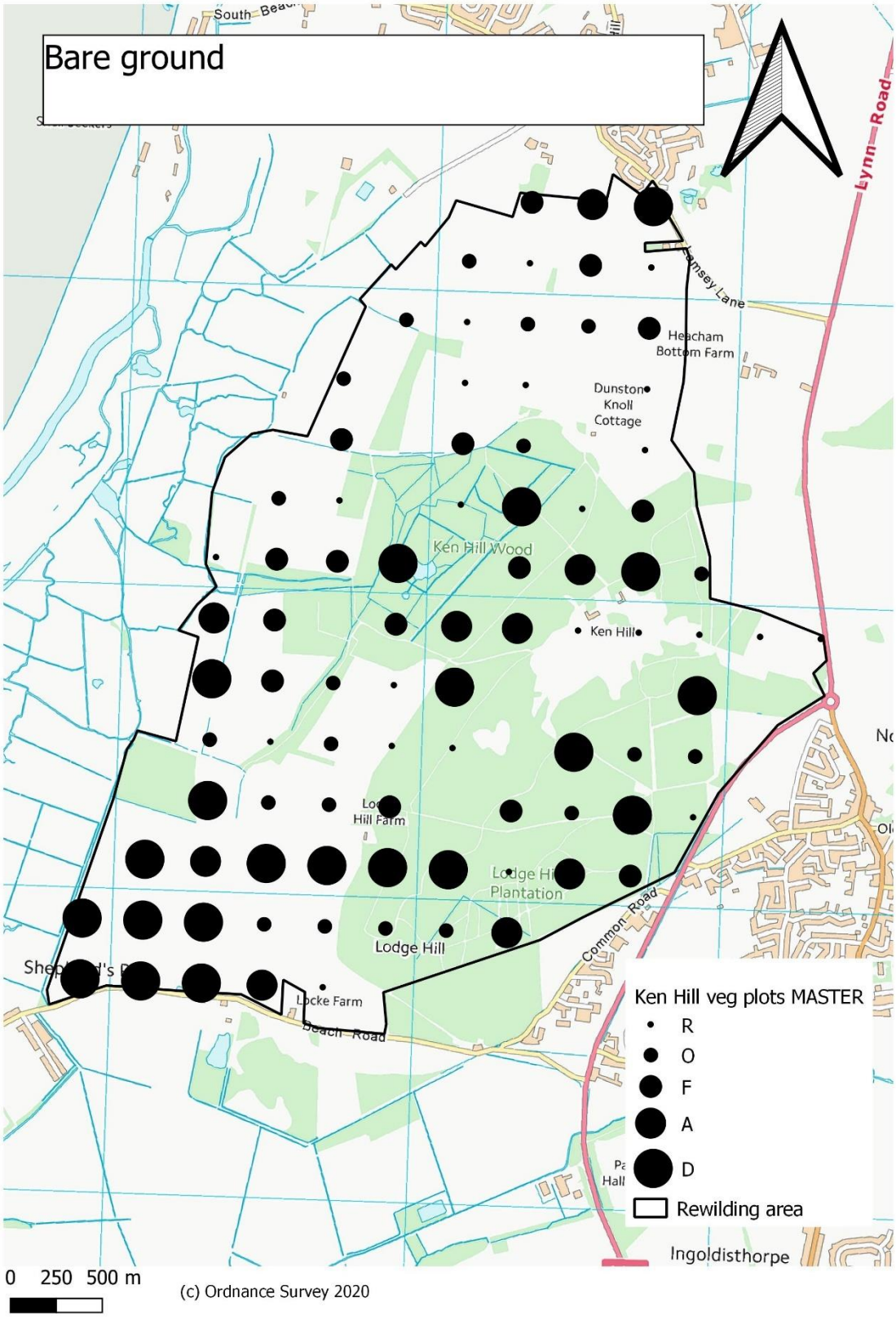

Fig. 21. Bare ground.

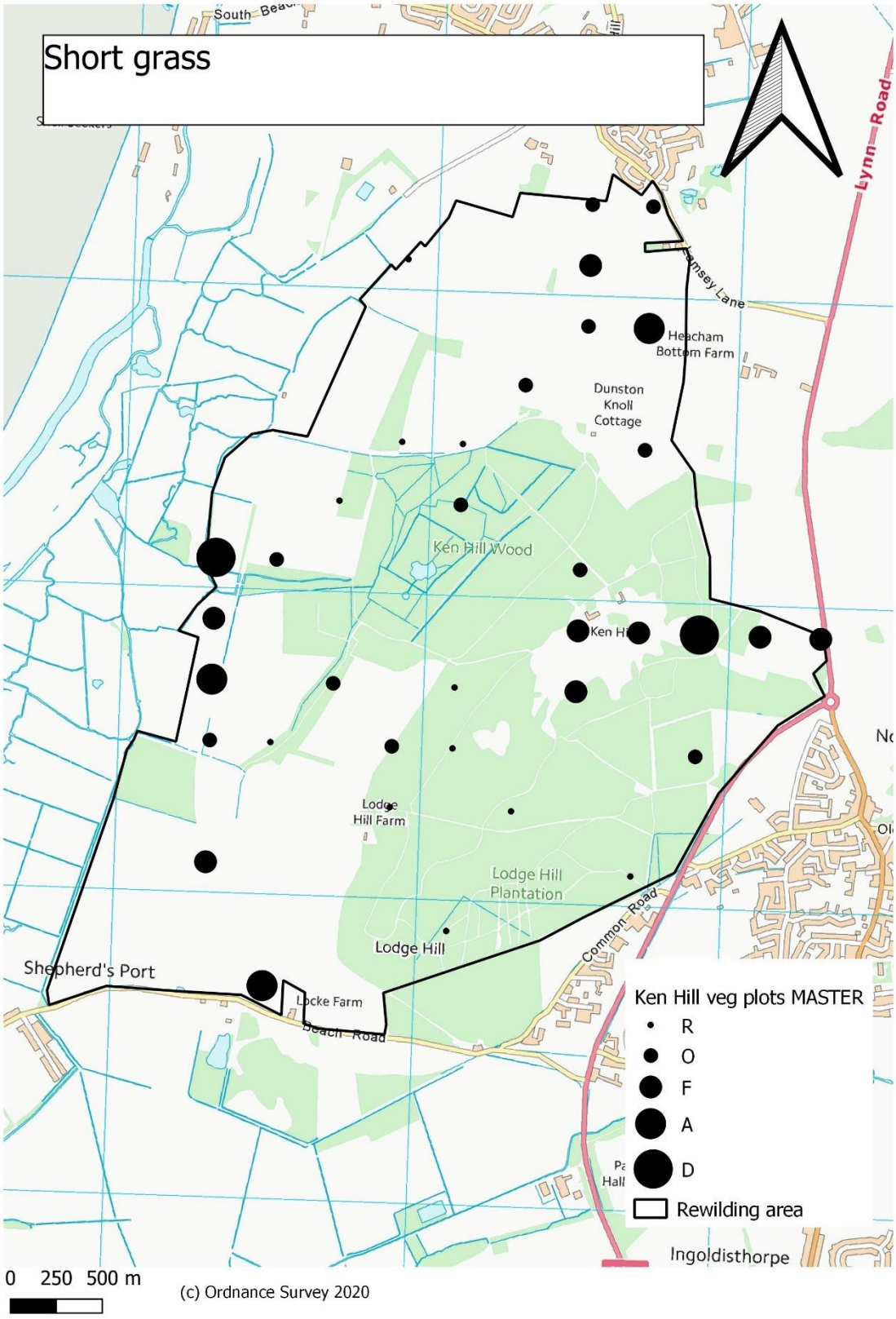

Fig. 22. Short grass.

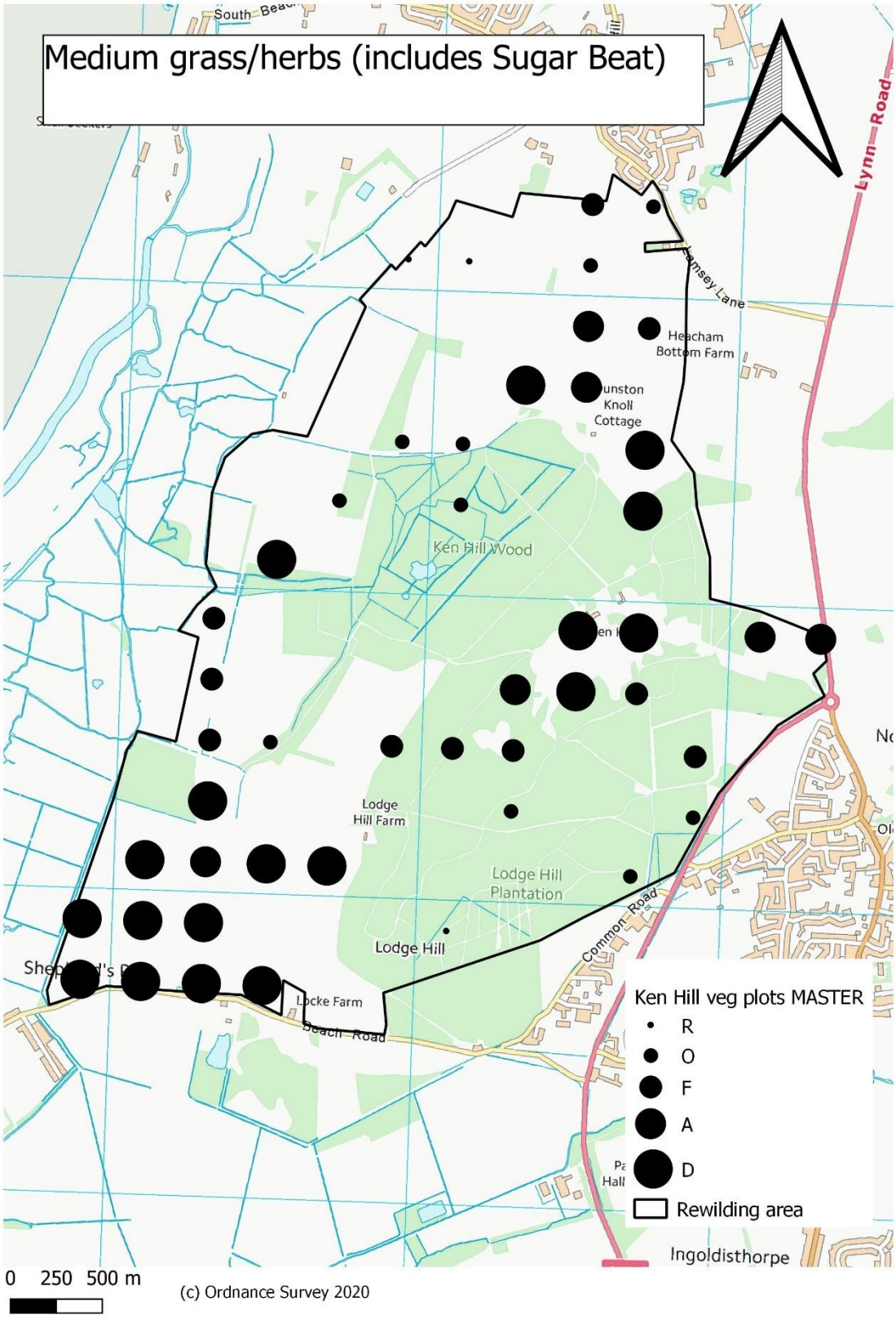

Fig. 23. Medium grass.

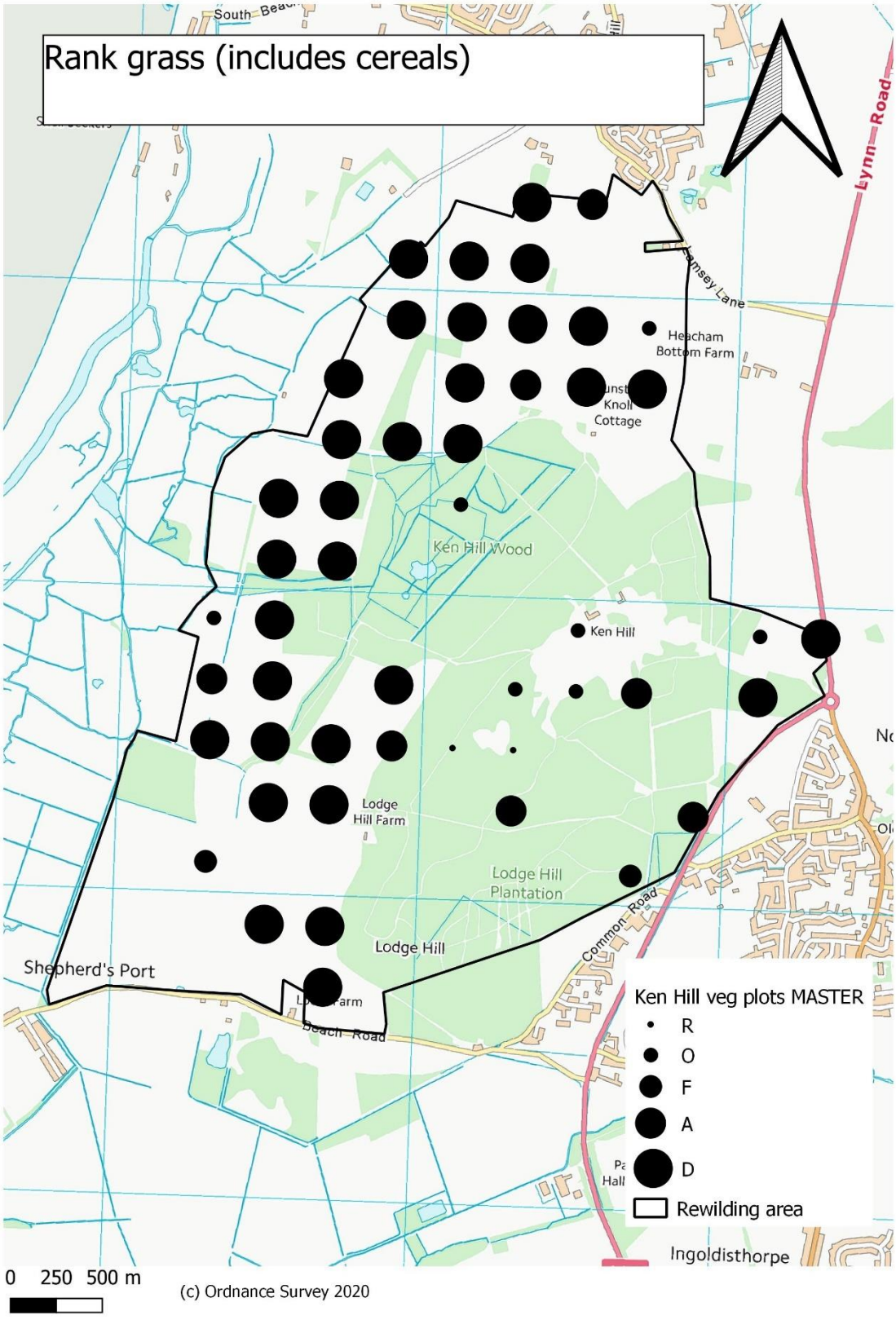

Fig. 24. Rank grass.

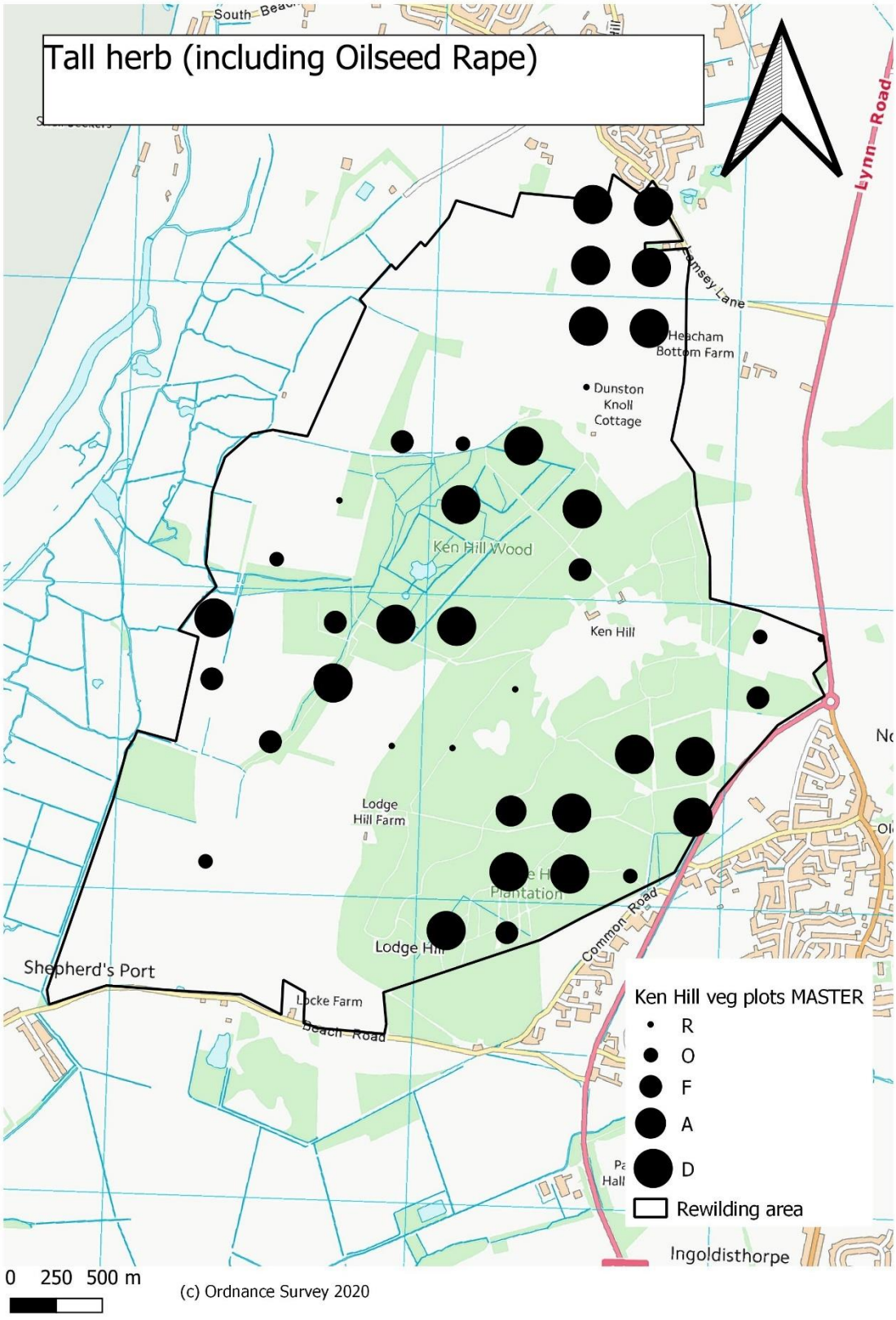

Fig. 25. Tall herb.

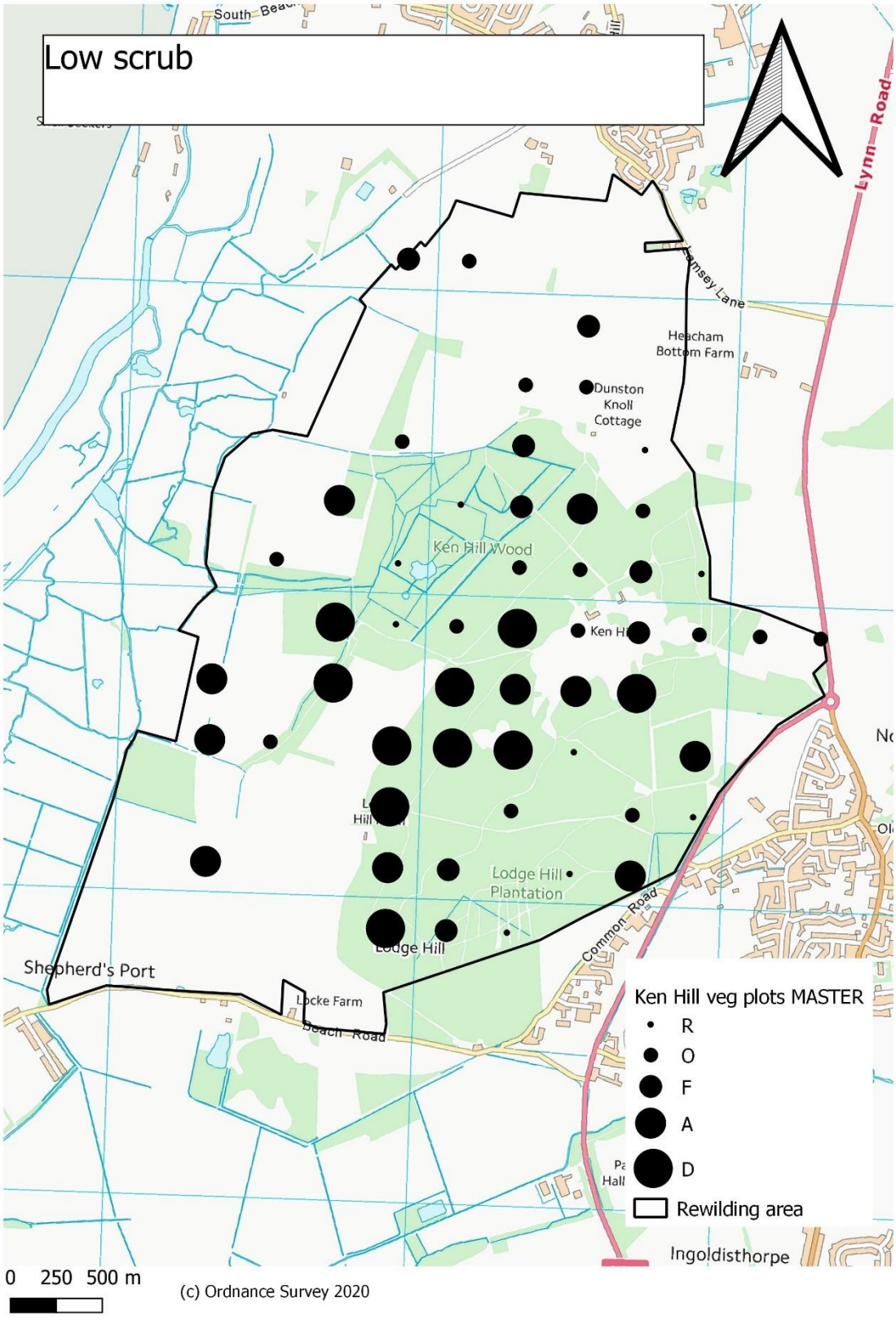

Fig. 26. Low scrub.

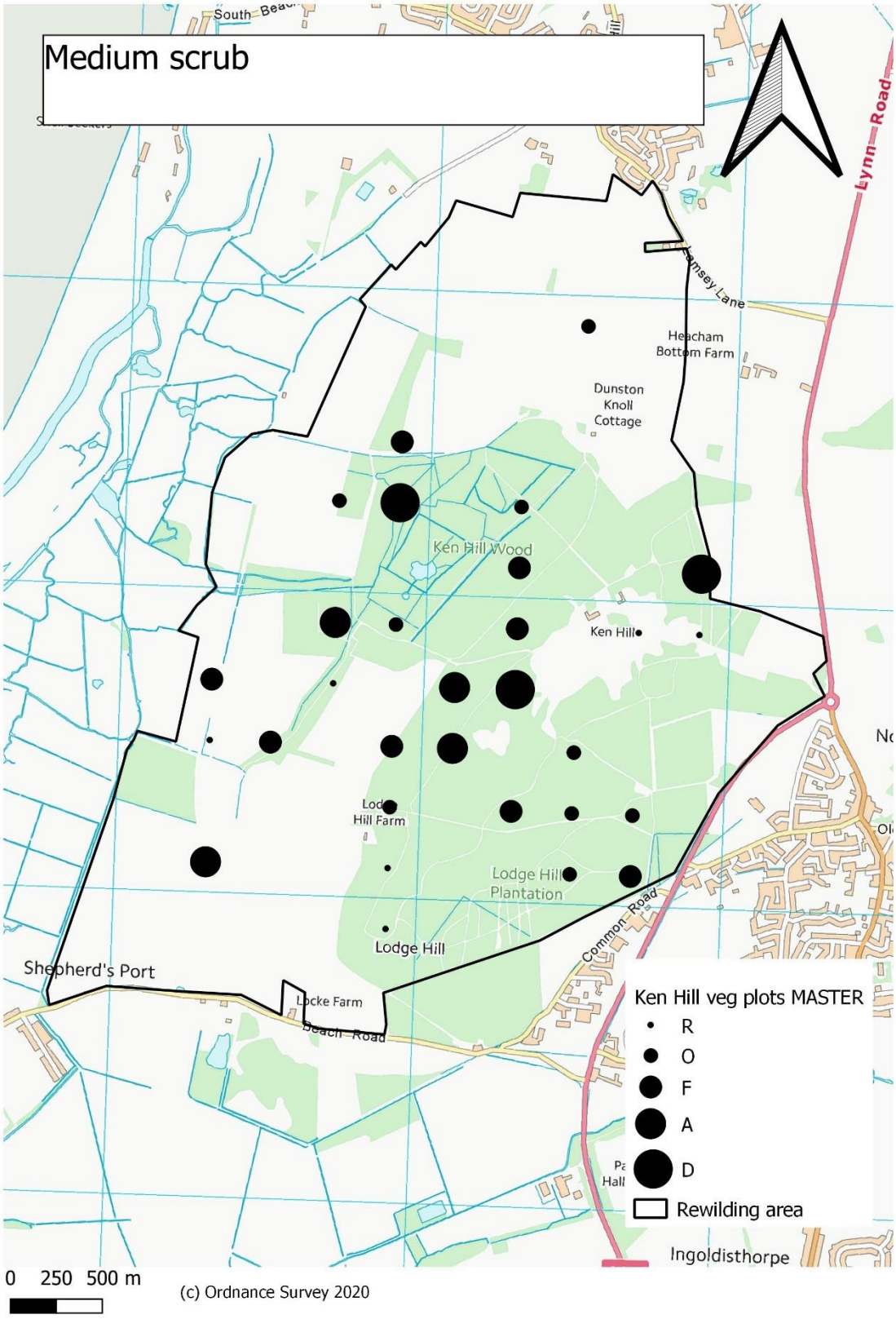

Fig. 27. Medium scrub.

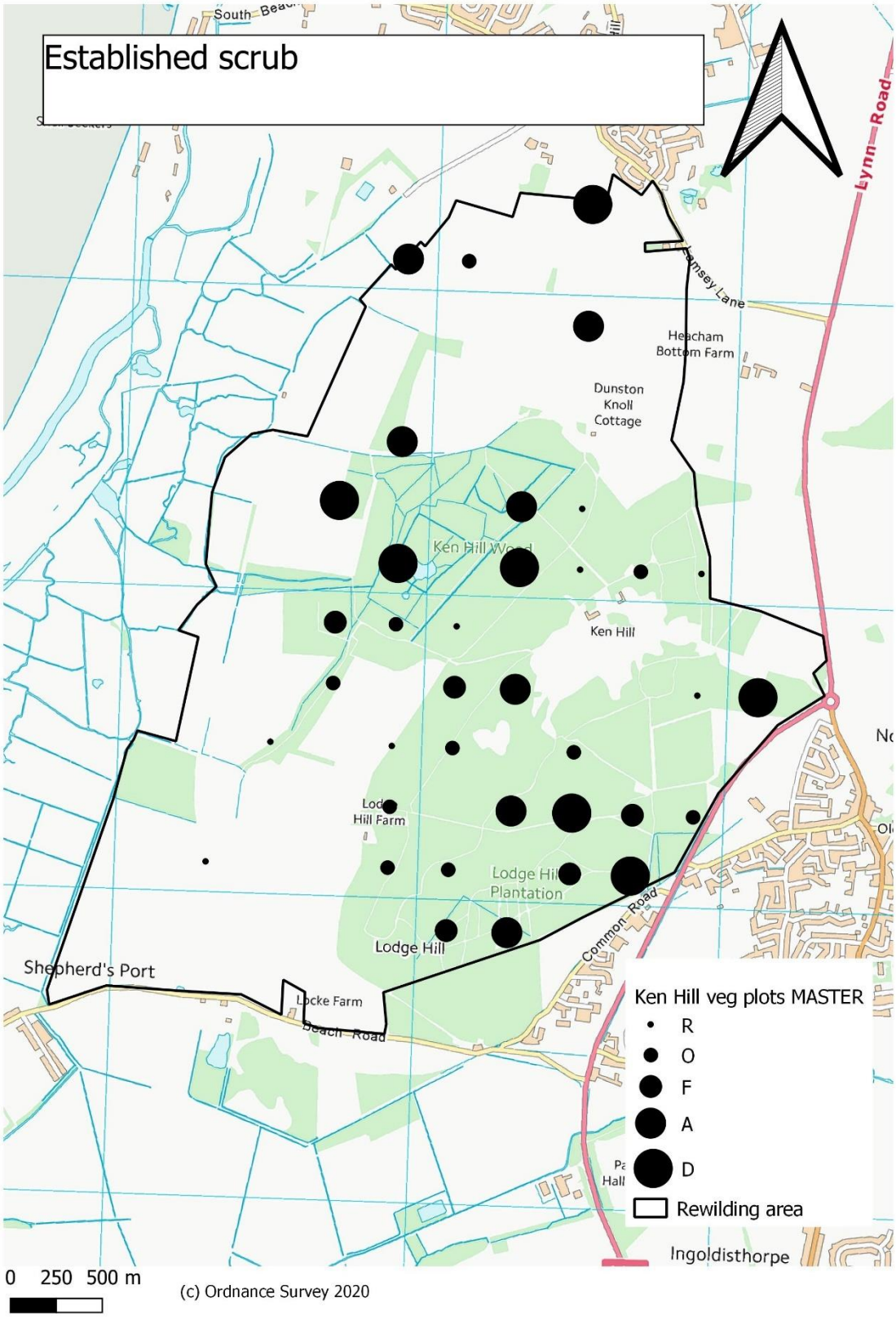

Fig. 28. Established scrub.

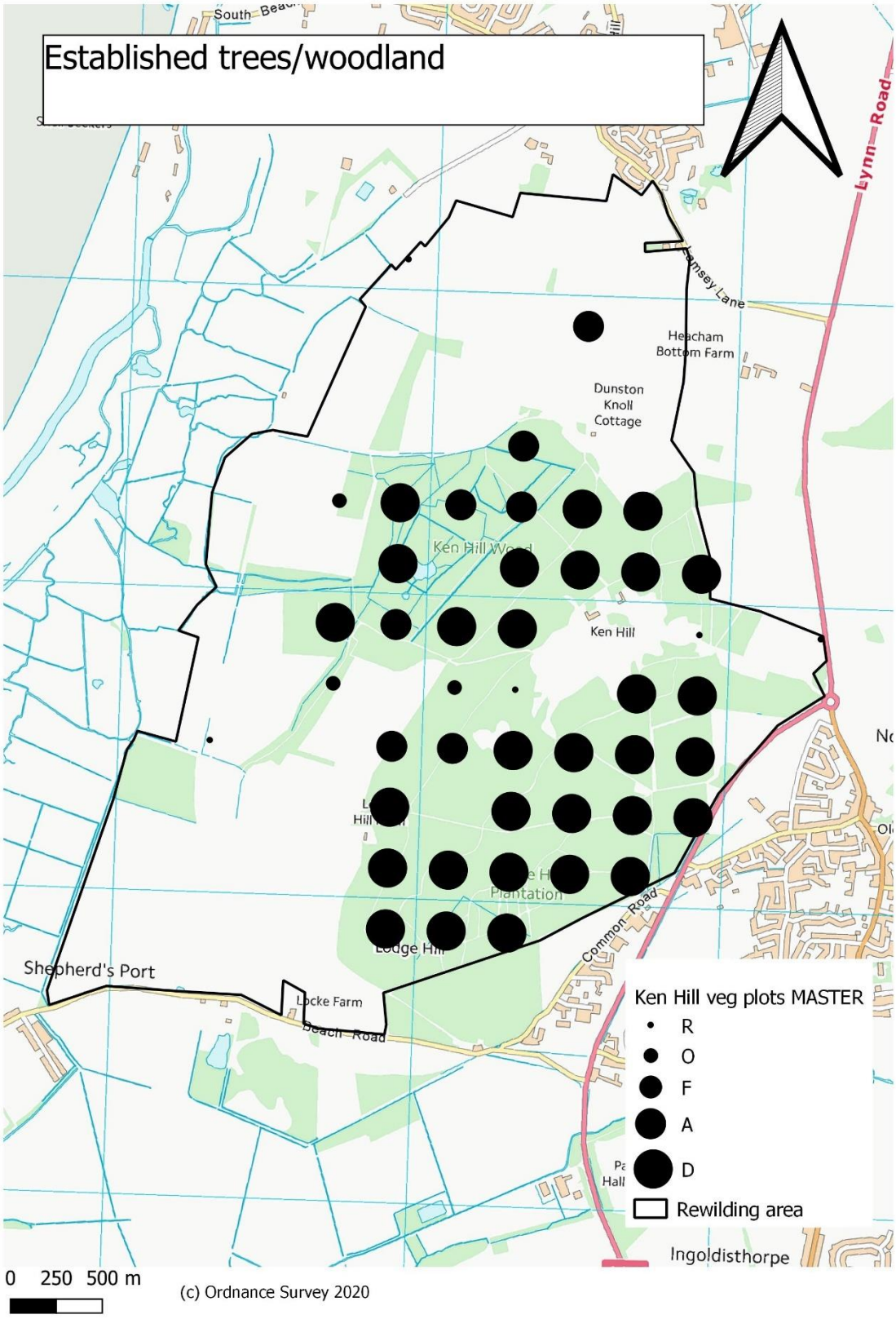

Fig. 29. Medium scrub

3.6 – Nectar sources

The mean nectar index was slightly higher in the open areas than in the woodland but this was not tested for significance. Despite being higher, there is much room for improvement, the most frequent nectar index score was 0, with 68 plots (69.4%) having no nectar sources at all. After this, the next highest score was 1, with 15 plots (15.3%). In all, 73 plots (74.5%), that is, three quarters of plots have either no nectar source or nominal ones. This is not surprising given that so much of the site is currently either in arable or under dense continuous canopy.

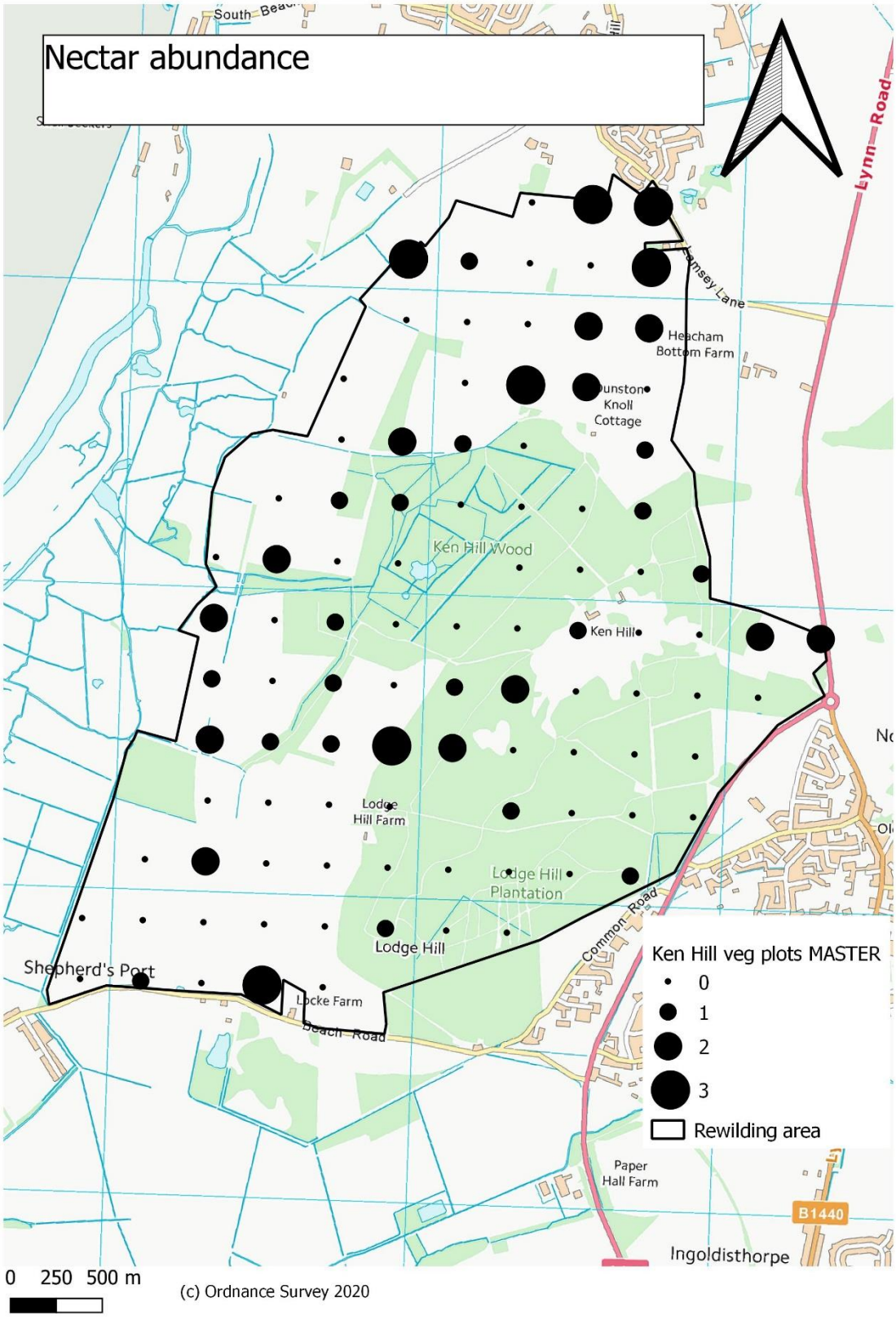

Fig. 30. Nectar abundance.

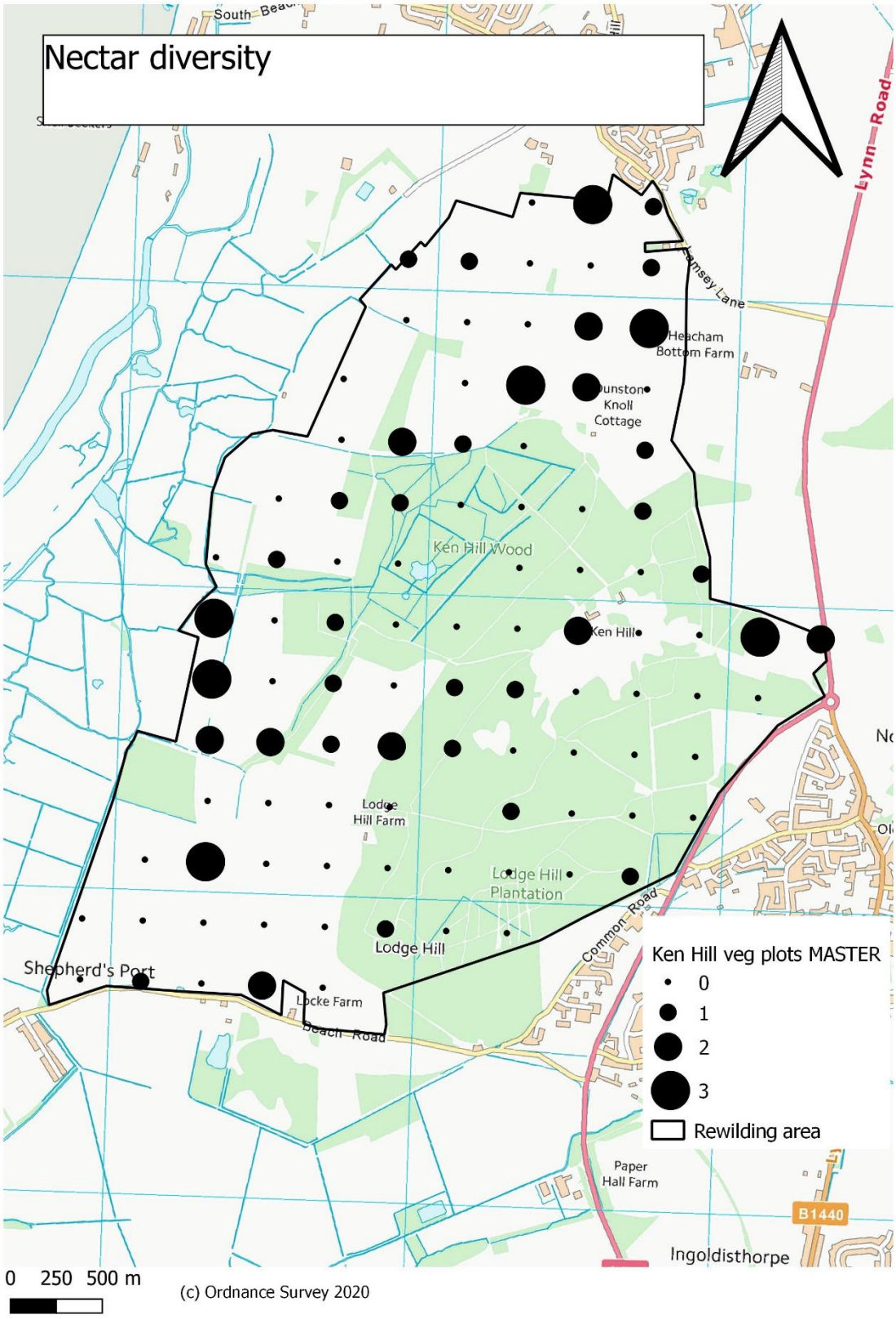

Fig. 31. Nectar diversity.

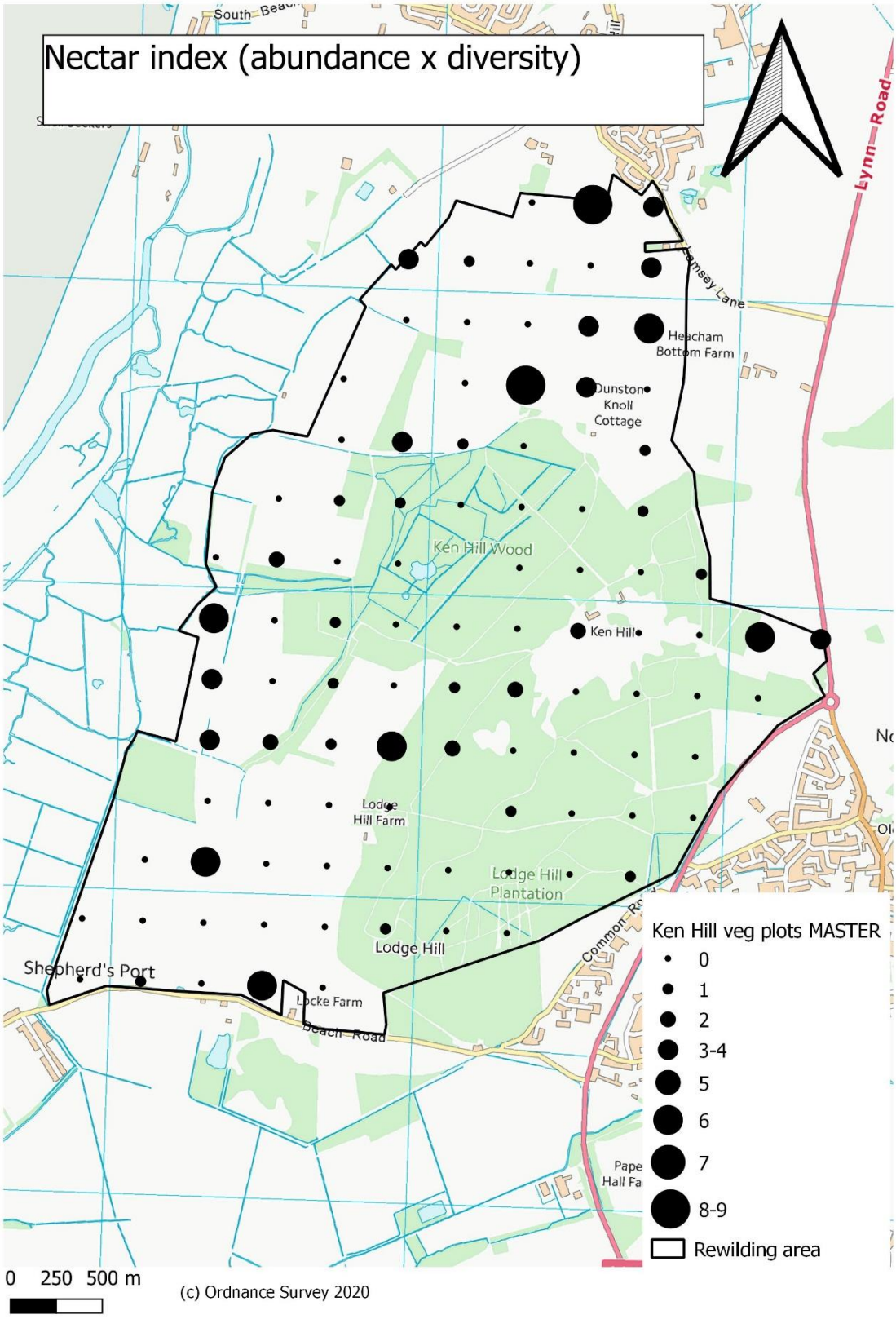

Fig. 32. Nectar index.

3.7 – Mean vegetation height

Mean vegetation height was thought to be too crude to give meaningful information and what data was collected was not presented here.

3.8 – Deadwood

No measurable deadwood was found in the open plots. Seemingly there was a greater quantity of deadwood in the southern half of the wood compared to the north.

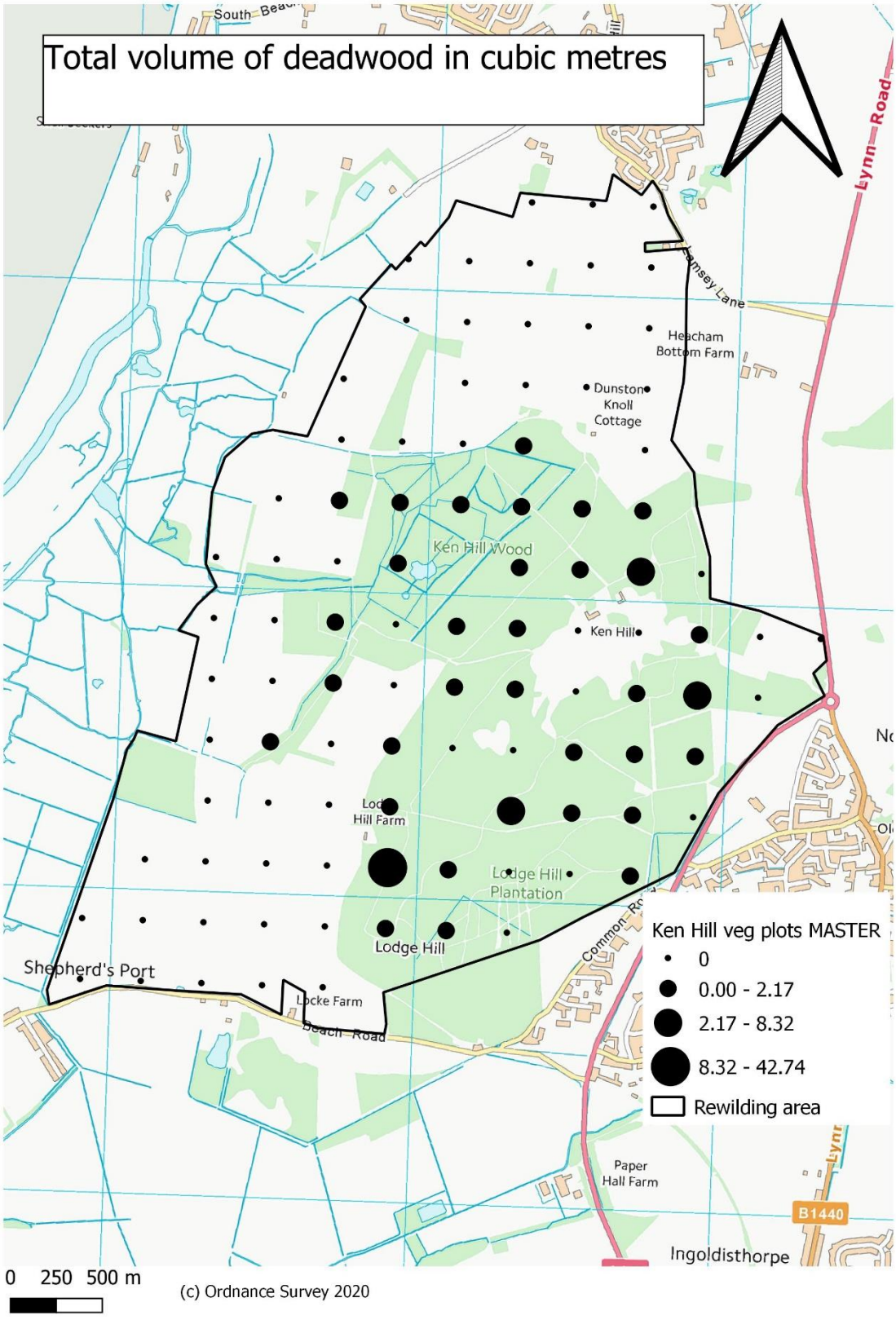

Fig. 33. Total volume of deadwood per plot.

3.9 – Wooded versus open plots

Each plot was assigned to one of the two categories and the data split in two for analysis. Four plots were borderline and excluded from this exercise, this left 94 plots, 39 in open habitats and 55 in closed or woodland habitats.

Tab. 4. Summary of mean values in wooded plots and open plots. The higher value is highlighted in green.

Factor	Overall	Wooded	Open
Number of plots	97	39	55
Mean species-richness	15.5 ± 1.3	12.6 ± 1.2	16.3 ± 2.1
Mean species with status per plot	0.13 ± 0.05	0	0.22 ± 0.08
Mean non-natives per plot	1.64 ± 0.10	2.31 ± 0.19	1.14 ± 0.09
Mean arable weeds per plot	0.77 ± 0.11	0.05 ± 0.04	1.22 ± 0.17
Mean seedling per plot	72.3 ± 35.1	133.2 ± 82.5	8.9 ± 3.2
Mean saplings per plot	14.4 ± 5.66	20.2 ± 3.2	1.43 ± 0.71
Mean canopy stems per plot	6.06 ± 1.02	13.9 ± 1.8	0.18 ± 0.11
Mean basal area per plot (m^2)	0.43 ± 0.06	0.99 ±0.08	0.01 ± 0.007
Mean structural types per plot	4.3 ± 0.2	5.2 ± 0.3	3.5 ± 0.3
Mean nectar index per plot	1.1 ± 0.2	0.3 ± 0.1	1.6 ± 0.3
Mean deadwood per plot (m^3)	0.8 ± 0.4	2.0 ± 1.1	0

4 – Conclusions

Ken Hill is an extremely rich botanical site with varied structural types and habitats. There is however a great deal of room for improvement with much of the best habitat existing in thin strips or in a very rank and overgrown state. It is surprising that nearly 70% of the site has no nectar sources, showing the high value of the strips of existing habitat that can support such a wealth of wildlife. This survey should act as a strong baseline for assessing this change over time.

This survey should be repeated in between three and five years but if there are rapid changes that need capturing, this could be brought forward.

5 – Management recommendations

This survey is more focused on providing a rigorous, quantifiable baseline to assess change over time, management recommendations for the scarcer arable plant communities broadly follow those provided in the invertebrate survey carried out by the author and the reader is encouraged to read that document for more detail. Additionally, single species maps of rare plants and a more thorough botanical list and advice will be provided in the NVC, which will cover succession, management and more.

Acknowledgements

A huge thanks to everyone at the Estate, particularly Nick and Michelle Padwick for their hospitality. Thanks also to the Buscall's for commissioning me to do the survey. Thanks to Mark Mukiri-Smith of SCCS for being extremely helpful in delivering the GPS and in giving me vital tuition and phone support.

Reference and bibliography

Swift, A. L. (2006*) Long-term Structural Changes, and Their Causes, in the Canopy Tree Layer of a Non-intervention Mixed Deciduous Woodland in West Sussex*. Unpublished master's thesis.

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Appendices

The data is too big to attach directly to this report, instead it is attached as an associated Excel file.